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	<p><b>PURE FONTE LT E</b>  <b>PIG IRON PRODUCTION PLANT FEASIBILITY STUDY</b>  <b>CUSTOMER N 1 21</b></p>
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	<p>TENOVA          TECHINT ENGINEERING &amp; CONSTRUCTION</p>
	<p><b>FEASIBILITY STUDY</b>  <b>SECTION 10</b>  <b>PLANT EQUIPMENT</b></p>

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**PURE FONTE LTÉE**  
**PIG IRON PRODUCTION PLANT FEASIBILITY STUDY**  
**CUSTOMER N 121**



TENOVA  
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SECTION 10 – PLANT EQUIPMENT  
**CHAPTER 10 1**  
**EQUIPMENT DESIGN CRITERIA & SPEC**

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## 10.1 Equipment Design Criteria & Specifications

This chapter provides the Design Criteria utilized to produce the technical specifications of for the electrical, mechanical and material handling equipment that are described in detail in chapter 10.2. This chapter presents data about:

1. Electrical Installations design criteria
2. Electrical Package design criteria
3. Mechanical equipment design criteria
4. Material Handling equipment design criteria

### 10.1.1 Electrical Design Criteria (3786-TARG-E-DC-000-001)

The purpose of this document is to describe the general concepts for the Electrical Design Criteria for the new, Greenfield Pig Iron Production Plant project, owned by North Atlantic Iron Corporation, located in Port Saguenay, Quebec, Canada.

The criteria contained in this document must be understood as guide in design process, subject to be changed some of them for a specific application, according to the project general conception and to standards and codes stated in the Standards and Codes chapter. Any change must be highlighted in italic or bold fonts.

In this document, minimum demands are described which must fulfill designs, electrical equipment and materials.

In addition to the design criteria, there are indicated parameters and special conditions which must be considered for the execution of electrical installations design.

Electrical installations must be designed under complete resources exploitation concept, focusing in safety for people, equipment and efficient use of energy and process continuity.

Terminology	Description
Preferred and Acceptable Practices	In case that this Design Criteria indicates more than one acceptable equipment or method, selection will be based in installation total cost. If a particular equipment or method is stated as preferred, it will be chosen considering that it must cost less than or equal to installed total cost that other acceptable equipment or method. Cost advantages must be considered to reduce maintenance and cost of operations, instead of an additional investment.
As Built	Updated drawing or document, as built.
Cable trays	Cable trays are rectangular ducts, closed with removable covers, which are part of a complete wiring system along with other accessories that allow installation of conductors for one or several circuits and feed different services. Trays without covers are not acceptable, as per design criteria.
Duct	Closed or open channel of metallic or non-metallic materials, designed to contain electrical conductors.
Breaking Capacity	Current value of a protection which corresponds to maximum current value of short circuit cleared by an equipment in pre-established

Terminology	Description
	conditions without changing its constructive or operating characteristics.
Defined Load	Load value obtained from characteristics, efficiency and cycles of work from installed equipment.
Non-lineal Load	Load which current wave shape in stationary state does not follow the wave shape of impressed voltage.
Grounding Conductor	Conductor used to ground any equipment.
Grounded Conductor	Any system conductor or circuit grounded on purpose.
Frequency Control	Performed actions to keep operating frequency in a predefined band to the referenced frequency, adjusting any instant unstable equilibrium between generated power and demanded power in the electrical system.
Short Circuit	Failure which impedance value is very little.
Adjusted Maximum Demand as per Defined Load	Equals to 1.0 times maximum demand.
Adjusted Maximum Demand as per Non-Defined Load	Equals to 1.05 times maximum demand.
15 Minutes Maximum Demand	Highest medium load measured in 15 minutes period.
8 Hours Maximum Demand	Highest effective value that the load can demand in 8 hours. Equals to load thermal aging.
Grounding Electrode	Metallic body in direct contact with ground, assigned to establish connection with it, must be made of a corrosion-resistant material and good conductor, like copper or copper alloy.
Explosion proof Apparatus	Enclosed equipment capable of bearing a gas or specific vapour explosion inside of it and preventing gas or specific vapour ignition around its casing, caused by sparkles, voltaic arc or gas or specific vapour explosion inside of it. It is suitable to be used under such external temperatures that surrounding explosive atmosphere cannot be burnt.
Technical Equivalent	The clause “Technical Equivalent” means that the document, material, equipment or element as an alternative of the indicated one, must fulfill specifications of required product or service, and at least comply with same values and characteristics stated in the original specification,

Terminology	Description
	applied to design, manufacturing, building, constructions, installation, inspection, tests, operation or maintenance.
Cable Rack	Support system of electrical conductors made with longitudinal profiles and cross rails with accessories, which result a rigid and complete installation unit.
Structure (applied to overhead lines).	Support main unit (metallic, concrete or wooden), generally a column or tower.
Load Factor	Rate between medium load in a determined time period and peak load occurred during that period.
Demanding Factor	Rate between installation maximum load demand, or part of installation, and total power connected to the installation or part of the installation, respectively.
Diversity Factor	Rate between the addition of individual maximum load demands of each installation subdivision or system and maximum load demand of the installation or complete system.
Data Sheet	It is a document where equipment information such as service, operation conditions, type of materials, characteristics and equipment components can be found.
Allowable Intensity (Ampacity)	Intensity in amperes which a conductor can continuously transport in conditions of use and without exceeding its service temperature. Also called permanent intensity.
Under voltage release	Characteristic of a switch applied to a motor control, which causes an instant trip of motor controller due to a feeding voltage permanent drop or voltage loss and instant re-connection when voltage is restored to normal conditions, no matter the duration time of the feeding voltage permanent drop or voltage loss.
Overhead power line	It is constituted by bare, covered or isolated electrical conductors, wired outside or in open spaces and supported by columns or other type of structures with necessary accessories to fix, separate and isolate them from those conductors.
Underground line	It is constituted by one or many isolated conductors which are part of installed electrical circuits placed underground level, buried in ducts or in any other type of installation.
Meeting Room	It is a closed place prepared for more than twenty five people to stay for more than fifteen minutes in it.

Terminology	Description
Lightning Arrester	Device for protection against atmospheric discharges, connected directly to ground.
Under voltage protection	Device connected to a motor control, which causes an instantaneous trip of motor controller or after a permanent feeding voltage permanent drop or voltage loss. After normal voltage is restored, the controller does not connect, or only connects if the feeding voltage remains during a predetermined time.
Corrosive Environment Rooms	Rooms where acids or alkali are stored, eventually with moisture in environment.
Hot Rooms	Rooms where environmental temperature exceeds 35°C for periods longer than fifteen minutes.
Dry Rooms	Rooms without moisture or even exposed temporally.
Humid Rooms	Rooms where air moisture produces condensation in ceiling and walls but they are not enough to form drops nor even can become impregnated.
Wet Rooms	Rooms where air moisture is enough to impregnate ceilings and walls and condensation produces water drops, or form water steam permanently or during periods longer than fifteen minutes.
Exposed Rooms	Rooms where equipment and installations are exposed to the weather, exposed to rain, sun rays, cold or any other atmospheric agent.
Ground Grid	It is a protection grid used to establish a uniform power in and around any structure. It is also firmly linked to ground electrodes.
Resistance to grounding	It is the system resistance of grounding, compared with a remote ground.
Resistivity of soil	It is the resistance by length unit, specific of the terrain, determined where it is located or is going to be located itself or is going to be located the ground system.
Overload	Operation of an equipment over its normal parameters at full load or a conductor over its admissible nominal ampacity which, if persists for a certain period, could cause damages or dangerous high temperature. A short circuit or failure to ground are not overload (See “Over current”).
Over current	Intensity over an equipment nominal current or a conductor allowable ampacity. It could be caused by an overload (See “Overload”), short circuit or failure to ground.
Earth (soil)	Element of dissipation or attenuation of electrical currents.



Terminology	Description
Lighting Transformer	Transformer which mainly feeds lighting loads, but also delivers energy to lighting outlets and other non-critical loads in low voltage.

Table 10.1-1.: Electrical definitions

### 10.1.1.1 Standards and reference documents

The design and manufacture of all piping and related equipment will comply with all relevant State and Federal Government Acts, By-laws and Regulations.

Piping systems, including pressure accessories and safety accessories, will conform, but not be limited, to the latest revisions of the following:

All equipment, material and installations will be designed and selected for continuous duty.

The system electrical design will be such that can be installed and operated according to the following codes:

CSA	Canadian Standard Association
CEC	Canadian Electrical Code
ANSI	American National Standard Institute
NEMA	National Electrical Manufactures Association
IEEE	Institute of Electrical and Electronic Engineers
UL	Underwriters Laboratories Inc.
ICEA	Insulated Cable Engineers Association
NFPA	National Fire Protection Association
ASTM	American Society for Testing and Materials
OSHA	Occupational Health and Safety Administration
ISA	Instrumentation Society of America

Table 10.1-2.: General standards for electrical work

In In case of discrepancies between codes, rules and standards the most demanding one will prevail. For equipment using the latest edition of following standards:

NFPA 70	National Electrical Code
NFPA 780	Lightning Protection Code
ANSI C2	Electrical Safety Code
ANSI C37.010	Application Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis (IEEE STD 320)
ANSI C37.13	Low-Voltage AC Power Circuit Breakers Used in Enclosures
ANSI C37.20	Metal-enclosed Low-voltage Power Circuit-breaker switchgear
ANSI C37.20.7	ARC Resistance Switchgear
ANSI C57.12.00	General Requirements for Distribution, Power and Regulating Transformers
ANSI C80.1	Specification for Rigid Steel Conduit, Zinc Coated
IEEE 080	Safety in AC Substation Grounding
IEEE 485	Practice for Sizing Lead-Acid Batteries for Stationary Applications
IEEE 515	Testing, Design, Installation and Maintenance of Electrical Resistance Heat Tracing for Industrial Applications
IEEE 519	Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems
IEEE 1115	Sizing Nickel-Cadmium Batteries for Stationary Applications
IEEE 835	IEEE Standard Power Ampacity Tables
IEEE 141	Recommended Practice for Electric Power Distribution for Industrial Plants
UL 489	Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures
UL 1778	Uninterruptible Power Systems
AEIC CS8	Specification for Extruded Dielectric, Shielded Power Cables Rated 5 through 46 kV
NEMA MG 1	Motors and Generators

Table 10.1-3.: specific standards for electrical works

### 10.1.1.2 General conditions of service

Site Conditions:

For site conditions refer to document 3786-TARG-R-ME-000-001

#### Seismic & Snow Considerations:

Also must be taken in consideration that design would consider that according to the Canada National Building Code the Peak Ground Acceleration (PGA) in case of seism is 0.31. Seismic loads will be according to NBCC –Volume 2 –Division B – 4.1.8  
For Outdoor installations a maximum of 1m of snow accumulation must be considered. Snow loads will be according to NBCC –Volume 2 –Division B - 4.1.6.

#### Protection Indexes for Electrical Equipment:

Ingress protection will be defined as per criteria stated in items 5.3.1 and 5.3.2 according to NEMA 205 rule.

In any case the project defines protection levels as per IEC 60529 standard, it will be stated the equivalent as per recommendations in publication NEMA “A Brief Comparison of NEMA 250 and IEC 60529”.

For external electrical equipment and lighting installation the index protection will be NEMA 4. When necessary due to environmental conditions, it will be demanded fulfillment of NEMA 4X, due to corrosive environments like gases, sea environment, others, indicating in equipment data sheets the type of environment. In case the equipment is exposed to external ice formation, excepting the lightings, it will have index protection NEMA 3R.

For offices, exchange bureaus, canteens and similar will be used level protection NEMA 1. In dressing rooms, kitchens or others including showers and/or vapors, they will be considered NEMA 12.

#### Area Classification:

Requirements for installations and electrical and electronic equipment installed with any voltage with risk of fire or explosion due to gases or inflammable vapors, liquids or dusts or combustible fibers or particles, will be ruled by indications in Art. 500 from NEC. Dangerous places will be classified by vapor properties, inflammable liquids or gases and combustible fibers or dusts existing in them and possibility of creation of inflammable or combustible concentrations. For this classification, each room, section or area will be considered separately.

#### Voltage Levels & Short Circuit Standards for design:

##### Electrical Voltages:

- The frequency of alternating current electrical power systems will be 60Hz.

Nominal voltage (V)	Phase	Wire	Type Grounding	Use
120 / 240	SINGLE	THREE WIRE	SOLID	Lighting / Sockets / Control / Motor Space Heaters
208Y / 120	THREE	FOUR WIRE	SOLID	Lighting / Sockets
600	THREE	THREE WIRE	SOLID	L.V. Motors
480Y / 277	THREE	FOUR WIRE	SOLID	Lighting/ Welding Sockets
4160	THREE	THREE WIRE	LOW RESIST.	M.V. Motors / Distribution
34500	THREE	THREE WIRE	LOW RESIST.	Distribution

Table 10.1-4.: Voltages levels

- Control Voltages:
  - Nominal Voltage of CA Control:120 VAC, 1 Phase, 60 Hz (UPS)
  - Nominal Voltage of CC Control:125 VDC

### 10.1.1.3 Considerations for design

General Design Criteria:

- Equipment and components to be considered in designs will be of standard manufacturing for a specific service and will be selected with capacity for continuous operation.
- Calculation and specification of equipment and electrical installations will consider energy efficient design to reduce losses for equipment and materials heating. This criteria will be considered in installation designs and while selecting equipment and materials for the project.
- Reduction of energy consumption, CO2 emission and fresh water consumption will be considered as priority and preferable. The designer will consider the reduction of variables like using of high efficiency equipment, using of recycled energy, designing an adequate layout which avoids loss of energy or equipment overheating's, reducing loss of energy through an adequate sizing of conductor cross section (reducing voltage drop through a higher investment)

- All operation equipment will have safety padlocks to insure people while equipment maintenance is being made. Also, ergonomic basic concepts will be taken into consideration to easy maintenance and operation of electrical equipment.
- The design will include an easy access to installations to make easier investigations and repairs of eventual failures as well as the execution of modifications and enlargements during the project development or in the future.

#### Installations & Equipment sizing:

- While sizing installations and equipment, it will be considered an excess of 20% for future loads not foreseen when executing the project.
- Transformers and distribution switchgears will have a capacity 20% larger than 8 hours of maximum demand. General feeders for this equipment will be calculated to cover the transformers maximum power under forced air ventilated conditions (FA), forced oil (FO) or operation with combination of both situations, always selecting the superior limit power operation. The nominal capacity with natural air ventilation (OA) of transformers will be sized considering that the voltage drop during the motor startup will be a maximum of 15% in MCC bar from the worst system point under analysis.
- It is recommended to include a spare switch and a spare voltage divider for each size of equipment used, for each switchgear, distribution panel and MCC, except otherwise indicated in other chapters of this document.
- For selection of transformers, operating and disconnecting equipment and protection systems for equipment and installations of project, this guide will be followed.

#### Distribution Transformers & Unit Substations:

- Generally, the layout of electrical substations for energy distribution will consist of transformers in substation yard and associated medium and low voltage cells, located inside the electrical equipment rooms. These transformers will be sealed type and will not have expansion tank.
- Transformers for outside installation will be mineral oil immersed type. Transformers for inside installation will be Dry type. Other internal use power transformers to feed general services like commercial departments or offices will be selected with the following criteria:
  - For clean environments: Ventilated dry type.
  - For contaminated environments: Hermetically sealed dry type.
  - When dry type are not available: Non-inflammable liquid type.

- Transformer impedance will be the manufacturing standard:
  - Voltage drop limit
  - Failure or equipment breaking reduction.
  - Current failure current limited to standard value of installation.
- Power transformer selection will consider the following values:
  - Single-phase transformers: 1; 3; 5; 10; 15; 25 kVA
  - Three-phase transformers: 10; 15; 30; 45; 75; 100; 150; 200; 300; 500; 750; 1.000; 1.500; 2.000; 2.500; 3.750 y 5.000 kVA.
- General feeding of transformers will be through vacuum switches located in medium voltage switchgears, manufactured under Metal-Clad standard, as per ANSI C37.20.7, Switchgears Assemblies Including Metal-Enclosed Bus and ARC Resistance Equipment.

#### UPS:

- Uninterruptible Power Supplies (UPS) will be used specifically in case that the electrical service requires 100% of secure service and without any supply interruption. It must be installed particularly in centralized control system feeding instruments and control installations for critical processes. However, the application of this equipment will be limited and will be determined for each Project, according to special characteristics.

#### Installation Power Factor:

- To design considerations necessary for the efficient and rational use of energy with power factor of 0.95

#### Control Design:

- Local control stations (LCS) comprised of Stop (mushroom type) and Start pushbuttons located near the equipment being controlled, to enable line-of-sight operation. All motors will have a dedicated LCS.
- The start button will be operational when the respective drive is selected to "Local" from the HMI or LOS. The start function will be used for maintenance and testing.
- The Local Stop button will be wired to a remote I/O and from that to a PLC. The Emergency Stop will be hardwired directly to MCC. The Stop button will stop the equipment regardless of the mode of control of the equipment. The button will be mushroom head and maintained contact type.

- Local control boxes will be placed on field, as close as possible to the drives involved. Conditions of space and ergonomics for easy access for Maintenance People must be considered.

#### 10.1.1.4 Electrical rooms

Electrical Rooms Design:

- According to the Project requirements the electrical rooms will be prefabricated.
- The design will consider equipment to be installed inside rooms, such as substations, medium voltage switchgear, motor control center (MCC), frequency drives, PLC, instruments panel, communication, control and command panel, electrical distribution panels, etc., apart from auxiliary equipment and components like lighting, air conditioning, pressure system, intrusion control and fire protection.
- The dry-type Transformers will be installed indoor together with their distribution panels.
- Oil cooled transformers will be installed outdoors in bays equipped with oil containment basins, drainage and collection systems, oil/water separation systems and fire-proof walls.
- Distribution of equipment in the rooms will be harmonious, observing the criteria of people safety and space.
- The temperature inside electrical rooms will be controlled with central air conditioning units equipped with appropriate filters to eliminate dust inside.
- The air conditioning equipment will be located in electrical rooms or other area designated for this equipment with an appropriate amount of free space to enable access to all air conditioning components for maintenance purposes.
- Rooms with substations will be adequately ventilated. If natural air circulation is used as ventilation system, the minimum evacuation and air admittance surface will be of 20 cm<sup>2</sup> by each kVA power in transformers, with a minimum of 0.1 m<sup>2</sup>. If forced ventilation is used, a minimum of 20 renewals/hour of room total air volume will be required.
- Except otherwise indicated electrical rooms will have two entrances located in both opposite sides of it as minimum; one of them with window for personnel entrance and the other one for equipment and personnel access to the room. There will be fire-resistant escape doors to be opened with anti-panic bar. Outside the rooms all access doors will include stairways and access platforms.
- Indoor lighting will be execute based on tight fluorescent equipment of nominal power 2 x 36 W, and will be required an indoor illumination level of 500 lux. Indoor

lighting of will include at least two emergency lighting equipment of nominal power 50 W each.

- Electrical Rooms must be oversized in 20% for future enlargement.
- The rooms will have dimensions indicated in equipment layout drawings. They will be built as a metallic superstructure, mounted over structural steel beams for convenience installation over foundations or piles.
- Main structures of electrical rooms will be designed to withstand without damages or permanent strains all mechanical efforts caused by shipment, seismic movements and movements during its erection.
- The prefabricated rooms will have a NEMA 4 index protection for exposure to weather, except for site conditions recommend NEMA 4X. Distribution equipment and electrical controls installed inside will have a standard general protection NEMA 12. Will be painted according to index protection
- Electrical installations inside rooms will be executed by using racks and conduits of steel and zinc or hot galvanized.
- Each substation will be equipped with smoke and flame detectors connected to the main plant system or F&G system. Main panels will be equipped with flame combat inside.
- Data network points (computers) and telephones will be provided in every substation and will be incorporated into the main plant systems.
- The rechargeable battery room will be designed to facilitate exhaust and limit hydrogen concentrations in the rooms.
- Capacitor bank and reactor will be considered to Harmonic Filters and power factor correction in the electrical system. It must be supply by vendors.
- The supplier will be warranty quality of energy (power factor & harmonics) in the point of coupling connect (PCC) warranty by supplier. It must be supplied by vendors.

#### Variable Frequency Drives (VFD):

- The frequency drive will be a complete unit capable of controlling the speed of an induction motor (squirrel cage) by using PWM (Pulse Width Modulated) or by controlling torque and speed and by DTC (Direct Torque Control) inversion and will be defined by the designer according to project requirements.
- For high inertia loads or when the motor could be pulled by any load, the frequency drive will have a braking chopper if active front technology is not used. It is when the frequency drive is not able to make a regenerative braking.
- The manufacturer of frequency drive will comply with requirements of harmonic distortion of currents and voltages injected to the net indicated in IEEE-Std. 519-



1992 standard related with quality and service security, in all ranges of drive operation. If necessary, the supplier will include filters in drive input to comply with this request.

- The manufacturer, if necessary, will consider installation of dv/dt filters in drive output to reduce electromagnetic contamination and voltage peaks in electric motors.
- Frequency drive cabinets will be of metallic modular structure and self-support type, NEMA 12 index protection.

#### Motor Control Centers (MCC):

- The MCC will be SMART type using Modbus or Device-Net Protocol.
- The equipment will have a set of vertical sections with capacity for six combined units of FVNR starters NEMA 1 size or one starter NEMA 6 by each vertical section. Modules larger than NEMA 6 will not be installed in the MCC. The minimum size of combined starters will be NEMA 1.
- The MCC installation will have space enough for future vertical sections in both ends.
- All motor starters will be FVNR (Full Voltage Non-Reversing) withdrawable type, except otherwise indicated in single line diagrams. Each starter will have the necessary plugs to connect power, control and communications.
- Each starter switch will be molded case type with adjustable instantaneous magnetic protection. Switch positions will be sent to the control system through the communications bus.
- The MCC will have multi-function metering equipment at the incoming.
- All isolating materials will be fire-retardant, auto extinguish type, and electric arc and humidity resistant.
- There will be a 20% of spare space in each low voltage MCC. Those spaces will be equipped with the installation of all elements necessary for the starters, but without including the starters. Spare starters will be specified when the design is complete and sizing is finished.

#### Switchgear & Medium Voltage (MV) Motor Control Centers (MCC):

- The Switch will be Metal-Clad type, manufactured as per Standard ANSI C37.20.2 and ANSI C37.20.7. (Arc resistance).
- Withdrawable switches of switchgears will be vacuum arc extinction type and operated by stored energy by springs which will be loaded manually or through

electric motor. The operation will be with spring electro mechanic trip. Each switch will include an operation counter.

- A lightning arrester (surge protection) will be used in the incoming cell.
- The on load fuse disconnected will be metal-enclosed type, and three phase operation. It will include a heavy duty manual operating mechanism by spring.
- Starters (fuse-contactor set) used in motor operation will be withdrawable type, metal-enclosed, magnetic operation, suitable for multiple operations with nominal load or overload.
- For protection and measure systems multifunction relays will be used and suitable to be connected to the main control system.
- Auxiliary voltage available is 125 VDC.
- Include communication switches, one per board.

#### Unitary Substations:

- In case of using unitary substations, they will have a medium voltage cell in the incoming section, a power transformer and a medium or low voltage cells in the outgoing section.
- Feeding cells for transformers include a vacuum switch type, with energy stored for closing or opening. They will also include multifunction relay with phases overload protection (50/51) and residual overload (50G/51G).
- The cells will be metal-clad type with vacuum switches and will be connected to the transformer through bars or cables with same isolation level than the protected equipment and adequate ampacity of normal operation currents and short circuit. The same principle will also be valid for unitary substations with medium voltage primary and secondary sides if necessary. If so, metal-clad cells will be installed in both ends of the transformer.
- Transformers will be sealed type, three phase, two windings, self-refrigerated, immersed in mineral oil for outdoor installation and Dry type if installed inside a room. Transformers connection group will be Dyn11 with accessible neutral, through bushing.
- Unitary substation will not include low voltage panels.

#### Motors:

- Selection criteria for electric motor voltages and number of phases according to power, is indicated in the following table:

POWER	VOLTAGE	PHASES
Smaller than 0,37 kW	230V	1 (2W+Grd)
0,37 kW to 261 kW	575V	3 (3W+Grd)
262 kW to 300 kW (using soft star or VFD)	575V	3 (3W+Grd)
Above 300 Kw	4000V	3 (3W+Grd)

Table 10.1-5.: selection criteria for electric motor voltages

- All induction motors will be designed for starting with nominal voltage. Operations requiring controlled torque starting or speed control, the different type of motors will be individually considered. The letter indicating NEMA design (which indicates current inrush) will be determined according loads starting torque requirements.
- Normal starting torques will require NEMA B design. When a high starting torque is required, a NEMA C or D type will be selected. In case of permanently low speed operating motors, they will NEMA D type.
- Induction motors with squirrel cage type rotor will be used for constant speed applications. When variable speed is required, they will be connected through a frequency converter. Motor controlled by frequency converters will comply with NEMA standard MG 1, Part 31.
- Generally, selection of motor environmental protection type will be as follows:

Power	Exposed to weather	Water wells	Indoor Clean and dry	Indoor Dusty and moisture
Up to 0,37 kW	TEFC – TENV	TENV	TEFC - TENV	TEFC - TENV
From 0,37 to 200 kW	TEFC	TENV	TEFC	TEFC
Above 200 kW	TEFC - WP-II	TENV	TEFC	TEFC – WP-II

Table 10.1-6.: selection of motor environmental protection

- TENV: Totally Enclosed, Non-Ventilated
- TEFC: Totally enclosed fan cooled
- WP-II: Weatherproof, Type II
- Motor isolation will be class F with temperature rise class B. Service factor will be 1.15
- WP-II type motors will have space heaters to avoid condensations.

- Each power motor equal or greater than 56 kW will be provided with two (2) RTD installed in each winding; power motors equal or greater than 90 kW will be provided with one (1) RTD in each bearing. All RTD units will be PT-100.
- For outdoor installation motors greater than 18.5 kW space heaters will be provided (120VAC – 60Hz)
- Power motors greater than 370 kW will include surge protection and vibration switches. The main terminal box will include capacitors and solid state vibration switches with 4-20 mA transducers, as requested in the data sheets. These vibration switches will be used to detect bearing problems.
- These motors will be Premium efficiency type, in particular motors up to 370 kW and NEMA A or B design. Their full load efficiency will comply with the values indicated in NEMA Premium Specification according to MG-1-2003.

#### Uninterruptible Power System (UPS):

- Critical systems such as PLCs for process areas, Substation Supervisory and Control System, etc. will be equipped with redundant power supply and static transfer switches to transfer the load without disarming the network system.
- The UPS will be used specifically in electrical services requiring 100% of service security and without any type of system breakdowns. The installation will be mandatory in centralized control systems or DCS and instruments and processes control installations. In any case, the use of this equipment will be determined in the project, according to their particular application.
- UPS systems will be solid state type. Its design will include all the components necessary to make a complete system.
- UPS system will include the rectifier, inverter, batteries, isolation output transformer, static bypass switch and panel board. Transformers will be dry type, nominal power 2.5, 10 or 15 kVA, as required. UPS batteries will have autonomy of 2 hours minimum.
- The UPS design will include protection devices, breakers, filters, instruments and alarms to ensure the equipment integrity and high service reliability. It will also include a manual bypass switch to allow maintenance tasks without operation interruptions.
- The UPS must be sized to feed other electronic equipment like PLC, DCS. The UPS must also be sized to withstand starting currents of loads as well as their harmonic components.

#### Dry Transformers:

- Transformers will be designed, constructed and rated in accordance with UL, CSA, NEMA, ANSI, IEEE, and OSHA standards
- Typical performance data must be submitted for approval on all transformers. Factory tests must be made in accordance with the latest revisions of ANSI Test Code C57.12.91 for Dry Type Transformers. Performance data provided must contain but not be limited to:
  - (a) No load losses.
  - (b) Full load losses.
  - (c) Polarity and phase rotation.
  - (d) Impedance at reference temperature.
  - (e) Efficiencies at 25, 50, 75, and 100% load.
  - (f) Regulation at 100% and 80% power factor.
  - (g) Audible sound level.
  - (h) Dimensions and weight.
  - (i) Applied potential test. (j) Induced potential test.
  - (k) Excitation current.
  - (l) IR, IX, and IZ percentages.
  - (m) Reference and ambient temperature.
- Core and windings will withstand any effort produced by short-circuit currents.
- Transformers will not release gases and will not have risk of explosion. The risk of fire will be kept at its minimum level.
- Tap changer will be located on primary side.
- Transformer enclosure will be UL/NEMA Type 2 and UL 3R.

#### Batteries & Battery Chargers:

- Batteries will be stationery type, maintenance free, Ni-Cd type. Battery container will be sealed type, heat and strokes resistant with transparent plastic walls.
- Batteries will be provided with self-support battery charger with automatic and manual control. The charger will completely recharge the batteries without overload during its operation and keeping drainable current according to batteries load curve.

#### Distribution Centers (DC):

- The DC must be metal enclosed, manufactured according to NEMA 12 construction with withdrawable air circuit breakers type. Main bars will be high conductivity copper, rectangular cross section without edges and covered with non-hygroscopic isolating material, flame retardant and ozone resistant.

- Circuit breakers will be operated by stored energy spring for the opening. Energy for closing will be provided through and electric motor and manually with a breaker handle. All circuit breakers will include a solid state protection device incorporated in the breaker with the following independent adjustable operations:
  - Opening due to overload
  - Instantaneous opening due to overcurrent
  - Time delay opening due to overcurrent
  - Instantaneous opening due to ground overcurrent
  - Time delay opening due to ground overcurrent
- Additional external protection relays to circuit breaker protections will not be considered. Closing and opening operations will be made electrically and will also pushbutton stations be provided for local closing and opening and remote closing and opening operations.
- A 10% of spare space is required.

#### Switchboards:

- Lighting and instrumentation switchboards will be designed to operate at full load and will be NEMA 12 manufactured with molded case circuit breakers. Outlet feeder circuit breakers will be provided with differential protection.
- In lighting switchboards each circuit breaker will be sized 1.65 times bigger than the load to be fed.
- Each board will have a 15% of spare space and 10% of equipped spares.

#### Auxiliary Outlets:

- Receptacles for welding machines will be three phases, 480V, 60 A, 4 poles 3 phases + ground differential residual included. Each receptacle will serve an area with a coverage radius of approximately 50m.
- General use receptacles will be single phase, 120 V (phase + neutral + ground). Each receptacle will serve an area with a coverage radius of approximately 15 m.

#### Bus Ducts:

- Bus ducts will be used when current is equal or higher than 2.000 A.
- Bus ducts will be designed based in NEC, Article 364, ANSI/UL 857 -1989 Bus-ways and Associated Fittings, NEMA BU1-1988 Bus-way.
- Bus ducts will be compact capsule shape type and will be circular or rectangular shape type.

- Copper or aluminum bus ducts will be designed for a maximum temperature increase of 50°C at ambient temperature of 40°C.
- Bus ducts protection degree will be NEMA 4.
- For altitudes over 1000 m., the manufacturer will have to de-rate the current and voltage at the moment of designing the duct.

#### 10.1.1.5 Grounding & grounding grid

- Grounding connection systems will consist of local grounding grids for different areas where will be connected to ground all electrical equipment. Local distribution substations and electrical rooms will have their own local grounding grids interconnected through guard wires or others, mostly when soil characteristics are high resistant, which allow to obtain better possibilities of ground connections.
- When required, due to high resistance soils, chemical products and special additives will be used to improve soil conditions complying with grid resistance values and safety voltages. It will be fulfilled final resistance values of combined grounding grids, established in standards. It will be considered the following criteria:
  - Low voltage grounding grids with resistance lower than or equal to 5 ohm and with step and touch voltages lower than calculated safety values.
  - Medium voltage grounding grids with step and touch voltages lower than calculated safety values.
- If necessary, grounding connection designs will comply with stated in ANSI/IEEE-80, IEEE Guide to Safety in Alternating-Current Substation Grounding Standard and other national standards indicated in previous paragraphs.
- All equipment such as transformers and motor control center will be individually grounded with a copper wire and sized to be connected it directly to grounding systems through thermal weld junctions.
- All metallic structures will be connected directly to the grounding system as well as electrical trays and racks. Cable trays will be routed by a bare copper wire which will connect them every ten (10) meters approximately.
- In order to protect people against indirect contacts, neutralization and differential protection methods will be used. The neutralization method will be achieved by connecting the equipment cases to neutral through an auxiliary conductor. The connection of this conductor to neutral will be made at the starting point of the protected installation (panels and low voltage boards grounding connection or transformer neutral).

- It will be mandatory the use of differential protections in those boards feeding power outlet circuits.
- Designs of grounding grids must obligatory be made after earth resistivity measurements and geo-electric analysis to determine soil composition and characteristics and finally, grid resistance calculation according to the geometry, determining complete and correct fulfillment of grounding resistance, step and touch safety voltage values as well.
- Earth resistivity measurements will be achieved through Schlumberger or four electrodes methods. This information will be processed through Mooney-Orellana method comparing collected data with pattern curves to earth land composition, layers, thickness and resistivity; and then perform grounding grid calculation. It will also be accepted the use of software for earth resistivity calculation and layers thickness.
- Grounding grid calculation will be made with phase to ground short circuit current values under the most unfavorable conditions of current magnitude and fault duration corresponding to effective expected time for failure clearance.
- Grounding grids will be made using N° 250 AWG bare stranded copper wire. Connections to grounding grid will be made using N° 2/0 AWG, 19 threads of Class B (ASTM B8) soft copper conductors.
- Grounding grid buried connections will be made with thermal weld junctions.
- Local grounding grids will be interconnected through duct banks installation and distribution lines. If possible, peripheral metallic structures of each building will be connected to this grid.
- For those grounding grids used to ground instrumentation installations and process equipment controls the recommendations previously stated will be followed. Regardless of the previously stated, recommendations and conditions suggested by manufacturers and suppliers of PLC and DCS will prevail without compromising validity warranties.
- All buried connections will be of thermal weld type.

#### 10.1.1.6 Surge arresters

- Surge arresters will be installed to protect equipment and installations against over voltages generated by lightning which could propagate electromagnetic waves through the installations, as well as over voltages which could be generated from energisation or de-energisation of overhead lines or cables.
- In distribution systems, it is mandatory the installation of distribution type surge arresters in overhead lines and in medium voltage switchgears. Surge arresters will



be installed in those places where an overhead line changes to an underground cable, or where two equipment are connected to a medium voltage overhead line. Surge arresters designs and tests will comply with what stated in ANSI/IEEE C62.11-1999, Metal-Oxide Surge Arrester for Alternating-Current Power Circuits, e IEC 60099-4 Ed. 2.0-2004, Surge Arresters - Part 4: Metal-Oxide Surge Arrester without Gaps for A.C. Systems Standards.

- Selection and application of surge arresters will comply with what is stated in ANSI/IEEE C62.22-1997, IEEE Guide for Application of Metal-Oxide Surge Arrester for Alternating-Current Systems.
- Main topics to be considered in protection designs against over voltages are the following:
  - Phase-ground surge arresters connection.
  - Grounding connection characteristics of power electrical system.
  - Consideration of zinc oxide (ZnO) surge arresters application.
  - Minimum main parameters to be considered in surge arrester selection will be the following:
    - $V_m$ , System Maximum Voltage (kV).
    - $V_{co}$  MCOV, Maximum Continuous Operating Voltage (kV).
    - $V_r$ , Nominal Voltage (kV).
    - $I_n$ , Discharge Nominal Current (kA; 8/20 us).
    - Energy absorption capacity, Single Impulse Energy Capability (kJ/kV).
    - TOV, Temporary Over voltages (kV).

#### 10.1.1.7 Lightning protection

- When necessary the installations to be protected against lightning taking into account area keraunic levels will be the following:
  - Overhead power lines.
  - Metallic columns.
  - High Buildings
  - Metallic Structures, in general.
- All installations that, due to their characteristics are exposed to lightning from electrical storms, will consider protection systems with three basic parts which will provide the low impedance grounding path required:
  - Interception system or lightning arresting system -also known as air terminals-, to ground lightning through Franklin bars, Faraday cages or guard conductors. These will be installed over the highest points of buildings or structures to be protected.
  - Grounding discharge conduction system must be through conductors. The path to the ground electrode must be as short as possible, trying to avoid abrupt bends



getting the lower impedance path. Bends will have a radius bigger than 20cm considering high frequency waves produced by lightning discharges. To get this goal two independent grounding paths will be designed. Grounding paths will be separated from each other by no more than 30m if possible.

- Grounding system by mean of electrodes or grounding grids adequate for discharging energy dissipation.
- In addition it will also be considered:
  - Interconnections or links between adjacent metallic structures to keep them at the same electrical potential and preventing them from lateral flashing or electric arcs.
  - In general the protection systems against atmospheric discharges in medium voltage overhead lines will be done with guard conductor along the line, copper or aluminum conductors downwards through each line structure and combined with zinc oxide surge arresters installed in energized overhead lines.
  - Protection systems against atmospheric discharges will comply with what is stated in NFPA 780-1997 standard, Standard for the Installation of Lightning Protection Systems, especially in material quality selection for air terminals and grounding conductors, it is Class I or Class II, depending on the height of the structure to be protected, up to 23m or over 23m, respectively.
  - To determine the zones to be protected by the lightning arresting system -defined as per NFPA 780 standard like adjacent space to protection system against atmospheric discharges substantially immune to direct lightning discharges- the Rolling Sphere Method will be applied.

### 10.1.1.8 Lighting project

LOCATION	LUX
Process Buildings	250
Electrical equipment room	250
Offices, laboratories and meeting rooms	400
Transformer bays	100
Control rooms	500
Yards	25
Walkways, stairs, galleries and hallways	100
Conveyors	100
Substation yards	100
Storage rooms and deposits	150
Storage yards	30
External areas	100
Parking Lots	20
Analysis Laboratories	500
Dining Halls	150
Locker Rooms	150
Restrooms	150
First aid medical clinics	250
Kitchens	150
Cargo and Passenger Elevators	30
Substation Indoor	300
Administrative Office	500
Maintenance Shop	300
Emergency Lighting	100

Table 10.1-7.: Lighting levels

-  For rooms or areas not listed above lighting levels from IESNA Lighting Handbook will be used. Indoor rooms lighting uniformity levels (Avg. Lux / Min Lux) will be equal to 2 or better. Outdoor lighting uniformity level will be equal to 4 or better. Outdoor lighting general areas including storage areas, roads, and parking areas will have a maximum uniformity level (Max Lux / Min Lux) equal to 6 or better.
-  Depreciation Factor: 0,75 or 0,65 where the place is very duty or dusted

#### Lighting Systems:

- In indoor lighting projects circuit simplicity will be intended and a maximum esthetic-efficient compatibility of the system. Fluorescent lighting fixtures in medium height rooms, watertight fluorescent lighting fixtures for process areas and electrical rooms will be preferred. For higher rooms floodlights with halogen lamps will be used.
- Sodium lighting fixtures with high efficiency long life lamps will be used in outdoor areas, roads and parking areas. Outdoor lighting system will be controlled by photocells.
- Light-emitting diode (LED) fixtures to reduce maintenance and increase shelf life will be accepted.
- Nominal voltage for incandescent, fluorescent, sodium and halogen lamps and LED fixtures will be 120V-277V.
- The project will include emergency lighting fixtures located in working areas to guarantee the security of personnel. Emergency escape lighting fixtures will be installed in closed rooms.
- Lighting fixtures based on fluorescent lamps will have electronic ballasts and an emergency battery in the same fixture. If lighting fixtures use a different type of lamp, the emergency illumination will be obtained by 2x55 Watt units, fed by rechargeable batteries.

#### Protection Systems:

- The configuration of the protection system, sizing of switchgears, incoming and outgoing feeder circuit breakers will be according to what is stated in single line diagram diagrams.
- Protection relays will be electronic and multifunction type, with protection functions and selecting operation curves, ANSI, IEC, IAC y BS142 standards, with or without integration of electrical variable measurement in the same device. They will also have industrial standard communication protocols like ModBus or DeviceNet, through RS-485 communication ports. It will be available a RS-232 communication port for device internal parameters set up using a remote PC or a Pc connected directly to the device.
- Other communication ports will be available to establish links with other protocols such as Profibus or others, if required.
- Minimum device protection functions to be considered are:
  - 50/51 Instantaneous and time delay phase overcurrent.
  - 50/51N Instantaneous and time delay neutral overcurrent.

- 50G/51G Instantaneous and time delay residual overcurrent.
- 81 Frequency relay.
- 86 Lockout function.
- 27/59 Undervoltage and overvoltage function.

#### Measurement Systems:

- Measurement systems to be considered in the electrical power system will be to achieve two basic objectives:
  - Control and record of electrical systems variables to establish electrical supply quality performance and how available utilities determined in project design are used.
  - Control and record of electrical systems variables for accounting and financial purposes, process distribution costs and calculation of electrical energy cost impact in operation costs. These records will be used as reference to check invoicing values from the distributor company.
- Considering the objectives mentioned above, minimum electrical system variables to be measured will be the following:
  - Voltages between phases and from phases to neutral.
  - Phases and neutral currents.
  - Active power.
  - Reactive power.
  - Active energy.
  - Reactive energy.
  - Power Factor.
  - Range of harmonic components of currents and voltages.
- Measurements of primary variables will be made through measurement schemes, based on current and power transformers with 0.5 measurement accuracy class or better, processed and recorded by the application of digital measurement devices of standard trademarks and models of common application in industrial plants. These devices will be suitable for multiple variable measurement, histogram data event records and industrial standard communication protocols such as Modbus or DeviceNet through RS-485 communication port. Measurement devices will also have a RS-232 communication port for device internal parameters set up using a remote PC or a PC connected directly to the device.
- Other ports will be available to establish communication links with other protocols such as Profibus or others, if required. Measurement devices will be installed in incoming and outgoing feeder cells of medium voltage distribution switchboards.

- Power variables will be measured with dedicated digital instruments or will be included in the system protection relays.

#### Signal & Alarm Systems:

- Signals and alarms of the electrical system will be located in a digital alarm board in the switchboards. They will be flush mounted, ISA-2A operation sequence, 125 VDC and will capacity of open communication protocol, like ModBus or DeviceNet. The designer will define for each project, the convenience of centralizing alarm signals in only one location or the distribution of signals considering local alarm panels in each column of switchgears.
- The alarm panel will be based on luminous and acustic signals. It will have luminous cells, alarm buzzer and will be supplied with four (4) pushbuttons to control the following: buzzer silence, alarm acknowledgment, alarm cancellation and lights test.
- When sizing the alarm panels, there will be considered the following minimum alarms:
  - Circuit breakers alarm and trip signals, including vacuum failure, spring load motor failure, control circuit failure and operation and protection relays internal failure.
  - Onload fuse disconnecter signals, including open and closed status and fuse operation signals.
  - Transformer alarm and trip signals, including winding temperature, cooling liquid level, sudden pressure relay and pressure release valve operation.
  - Summary of alarms and failure signals, and if required, details of specific alarm signal.
- In addition to previously stated the emulation of alarm signals in control system or DCS which could be transferred through RTU relays and measurement instruments by means of a data communication bus.

#### Harmonic Distortion & Flicker:

- Electrical system designs with regard to Energy Quality of Harmonic Contamination and Flicker will comply with national and international standards, in special with standard:
  - IEEE 519 992 Recommended Practices and Requirements for Harmonic Control in Electric Power Systems.

- As general rule designs will include the necessary equipment to mitigate harmonic and flicker distortion with sintonized filters to harmonic frequencies which could be present in the system due to non-lineal loads installation.
- Another design consideration corresponds to the selection of equipment. Even though loads are typically non lineal, due to their design characteristics and manufacturing standards they will comply with maximum harmonic distortion limits allowed in standards previously mentioned.
- The option of installing only one set of tuned harmonic filters must also be considered. This set will have two functions: power factor improvement and harmonic mitigation.

#### 10.1.1.9 Electrical material characteristics

##### Conductors:

- Power cables with 90°C operation temperature, 130°C overload temperature and 250°C short circuit temperature will be used.
- Conductors exposed to oil, grease, solvent, vapors, gas, smoke or other substances which could damage the jacket of the conductor or its isolation will be selected to be suitable to the environment.
- If required, high flexibility cables, Superflex type, according to equipment or interconnection requirements will be used.
- In tunnels, inside the mine and concourse areas it will be considered flame retardant, free emission toxic gas and free halogen material emission cables.
- Power and control cables will be Armor protection.

##### Medium Voltage Cables:

- Medium voltage cables will be high conductivity copper type, 5, 15 and 35 kV class, with XLPE cross linked polyethylene isolation with screen and PVC jacket and Armor, 133% isolation level. If high flexibility is required Ethylene Propylene Rubber (EPR) will be accepted.
- Multi core cables up to 250 MCM and single core cables up to 350 MCM will be used. For cross sections cables greater than 350 MCM, two or more single core cables will be used per phase.
- Cables will be specified with a minimum isolation of 133 percent.

##### Low Voltage Cables:

- Motor control center and low voltage distribution panel incoming main feeders will be designed with a 20 percent of reserve capacity over the power required by the project.
- The minimum cross section for power cables will be #12 AWG, multi core copper. In lighting circuits, the minimum cross section will be #14 AWG.
- Conductors installed inside rooms, mills, storehouses and similar will be THHN / THHW type.
- Outdoor installed conductors will be copper type, with XLPE cross linked polyethylene isolation with PVC jacket and Armor for 90°C, weather and sun light rays resistant. Conductors and cables to be used as power feeders will be copper multi core type up to 250 MCM and for greater cross sections single core copper cables will be used.
- Each circuit will have its own neutral, not being allowed to share these conductors in racks and cable trays.

#### Control Cables:

- Motor control cables will be multi conductor with cross linked polyethylene isolation (XLPE) and Armor.
- The minimum cross section will be #14 AWG for control circuits and # 16 AWG for instrument circuits with analogic signals.
- The minimum wire quantity of conductors will be seven (7) and multi-conductor cables type to be used will be 3c, 5c, 7c, 9c, 12c, 19c, 26c.

#### Conductor Sizing:

- To determine the conductor cross sections, three conditions will be considered:
  - Sizing by Current Capacity (Permanent Thermal Capacity Normal Operation).
  - Sizing by Short Circuit Capacity (Thermal Capacity during a Short Circuit).
  - Sizing by Voltage Drop
- Analysed these three conditions, the larger conductor cross section will be selected.

### 10.1.1.10 Electrical installations

#### Outdoor Installations:



- According to the Project requirements outside buildings would be avoided buried pipes.
- Aerial cable trays to lay wires will be used.
- Heavy duty, hot dipped galvanized steel cable trays with covers will be used.
- The fill rate of the cable trays will be calculated as per the NEC guidelines plus 30% for future use.
- In the case of cable tray installations involving various levels, the highest voltage cables will be installed in the lowest level tray. Lowest voltage cables will be installed in the highest trays. In addition, cable trays will be separated based on the voltage type and level of the installed cables.
- Installation of direct burial cables is acceptable for road and general areas lighting.
- The cable trays in general will be supported by racks for piping installations.

#### Indoor Installations:

- Hot dipped galvanized rigid metal conduits according to ANSI C80-1 standard will be used in indoor installations. Eventually, for corrosive environment conditions Schedule 80 PVC conduit will be used. Fittings for open air conduits installation will be hot dipped galvanized type. Stainless steel will be used for bolts, nuts, clamps and washers up to 3/8" and sizes bigger than 3/8" will be hot dipped galvanized type.
- The installation of cable trays is acceptable as long as cables trays have an easy access to inspection. Hot dipped galvanized cable trays will be used unless cable trays are installed in corrosive environments where PVC or fiber glass (FRP) cable trays will be used.
- PVC or fiber glass cable trays will be flame retardant, halogen free, toxic fume emissions free, resistant to moisture and chemical products and deformation resistance due to heat as well.
- A 2/0 AWG bare copper grounding conductor will be installed in the same cable tray and each cable try section will be bonded to this conductor by means of a ground clamp.

Ducts:

- The duct allowable fill area will be according to NEC adjustment factors for 1, 2, 3 or more conductors:

Number of conductors	1	2	3 or more
Duct allowable fill area	50%	31%	35%

Table 10.1-8.: NEC adjustment factors

Cable Trays:

- Whenever possible, based on practical and economic factors, cables will be installed in cable trays.
- Heavy duty, hot dipped galvanized steel cable trays will be used.
- The fill rate of the cable trays will be calculated as per the NEC guidelines plus 30% for future use.
- In the case of cable tray installations involving various levels, the highest voltage cables will be installed in the lowest level tray. Lowest voltage cables will be installed in the highest trays. In addition, cable trays will be separated based on the voltage type and level of the installed cables.

Electrical Noise Segregation:

- For noise separation and voltage levels IEEE 518 Guide for the Installation of Electrical Equipment to Minimize Electrical Noise Inputs to Controllers from External Sources will be used.

## 10.1.2 Electrical Package Equipment design criteria (3786-TARG-E-DC-000-002)

The purpose of this document is to describe the general concepts for the Electrical Package Equipment Design Criteria for the new, Greenfield Pig Iron Production Plant project, owned by North Atlantic Iron Corporation, located in Port Saguenay, Quebec, Canada.

### 10.1.2.1 Reference Documents

Present document is complementary with following documents:

3786-TARG-E-DC-000-001	Electrical Installations - Design Criteria
3786-TARG-E-DC-000-002	Conceptual Design Automation - Design Criteria

Table 10.1-9.: Electrical package reference documents

### 10.1.2.2 Electrical rooms

- According to the Project requirements the electrical rooms will be prefabricated and comply with Electrical Installations Design Criteria 3789-TARG-E-DC-000-001 POINT 4.9
- Cable entry will be at the top / bottom of the panels to be confirmed in each case.
- Equipment will be dimensioned considering own consumption In addition to the remaining area loads, these charges will be reported in each case.

### 10.1.2.3 Power supply

- Each control and power room will be fed in 4160V – 60 Hz – 3 Phase – 3 Wires or 600V – 60 Hz. - 3 Phase – 3 Wires, according to electrical consumptions.

### 10.1.2.4 Communications

- Following standard communication protocols will be used:

- Medium and High voltage equipment: IEC-61850
- Low voltage and miscellaneous equipment's: Ethernet/IP – Modbus TCP.

#### 10.1.2.5 Lighting

- Lighting fixtures considered in each skids, will include normal and emergency lighting as indicated in document 3789-TARG-E-DC-000-001 "Electrical Installations Design Criteria".

#### 10.1.2.6 Electrical scope

- Supplier will supply all equipment, instruments, accessories, junction boxes, cables, and panels within mechanical packaged equipment boundaries. Instrumentation devices on a packaged unit will be consistent with the facility in which the packaged unit will be installed. The associated installation and materials will meet the same standards as the rest of the facility.
- Equipment will include all the necessary instruments and control panels to assure the control, indication, alarm and protection, and the different subsystems. All on skid conduits and wiring installation are part of Supplier's scope of supply. In addition, Supplier will provide all engineering and standard documentation required to design, select, install, connect and calibrate all instrumentation materials supplied within the mechanical packaged equipment.
- Supplier will furnish all material and equipment which is not specifically mentioned or shown in the specifications but which is necessary in order to provide a proper and complete electrical and instrumentation system.
- Local control stations (LCS) comprised of Stop (mushroom type) and Start pushbuttons located near the equipment being controlled, to enable line-of-sight operation. All motors will have a dedicated LCS.
- The start button will be operational when the respective drive is selected to "Local" from the HMI or LOS. The start function will be used for maintenance and testing.
- Local control boxes will be placed on field, as close as possible to the drives involved. Conditions of space and ergonomics for easy access for Maintenance People must be considered.

#### 10.1.2.7 Documentation

- The following Data and Documents will be required to equipment Vendor as they apply at each particular case:

ITEM	DATA, DRAWINGS & CERTIFICATES
1	Exception List
2	Electrical equipment room
3	Set of plan and views drawings, with general dimensions and equipment loads.
4	One Line Diagrams
5	Installation, operation & Maintenance instructions
6	Technical Information and Catalogues
7	Load Summary (including all motor & auxiliary loads – indicating nominal voltage)
8	Power Transformer Calculations
9	Estimated Packing List, with overall dimensions and weights per each main item to be supplied.

Table 10.1-10.: list of documents provided by each vendor for the electrical packages

### **10.1.3 Mechanical Design Criteria (3786-TARG-X-DC-000-001)**

The purpose of this document is to describe the general concepts for the Mechanical Design Criteria for the new, Greenfield Pig Iron Production Plant project, owned by North Atlantic Iron Corporation, located in Port Saguenay, Quebec, Canada.

Present Design criteria in conjunction with design standards and engineering practices establish the basis for the engineering design for mechanical design and mechanical activities including design, supply, fabrication, erection, inspection, testing and identification for all mechanical equipment involved in PURE FONTE LTÉE project.

This document defines the minimum technical requirements to develop the mechanical design and mechanical equipment specifications for the engineering design team and where applicable for external design consultants engaged to complete design work for the project directly or as part of the external design of major plant areas.

The criteria contained in this document must be understood as guide in design process, subject to be changed some of them for a specific application, according to the project general conception and to standards and codes stated in the Standards and Codes chapter. Any change must be highlighted in italic or bold fonts.

In addition to present design criteria, there are indicated parameters and special conditions which must be considered for the execution of mechanical equipment & installations design.

Mechanical Equipment & Installations must be designed under complete resources exploitation concept, focusing in safety for people, equipment's and efficient use of energy and process continuity.

#### **10.1.3.1 Codes & Standards**

All equipment will comply with the requirements of Canadian laws, regulations, codes and standards. Where other Codes and Standards are used, they will be used in addition to the above. In the event of conflicting requirements between codes and standards used, the more demanding will apply. In the event of conflicting requirements between codes and standards used that are equally demanding, the Canadian requirements will apply.

The following organizations will form a part of this specification, to the extent indicated by references contained within this specification or attachments:

AABC	Associated Air Balance Council
ACGIH	American Conference of Governmental Industrial Hygienists
ISO	International Standards Commission
ISA	Instruments Society of America
AGMA	American Gear Manufacturers Association
ABMA	American Bearing Manufacturing Association
AFBMA	Anti-Friction Bearing Manufacturing Association
AISE	Association of Iron & Steel Engineers/Associate for Iron & Steel Technology
AISI	American Iron and Steel Institute
AISC	American Institute of Steel Construction
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials International
API	American Petroleum Institute
AWS	American Welding Society
AWWA	American Water Works Association
AMCA	Air Conditioning and Refrigeration Institute
ARI	Air Conditioning and Refrigeration Institute
ASLE	American Society of Lubrication Engineers
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
CGA	Compressed Gas Association
CICS	Canadian Institute of Steel Construction
CSA	Canadian Standard Association
CWS	Canadian Welding Society
FM	Factory Mutual
HIS	Hydraulic Institute Standards
HRAI	Heating, Refrigerating and Air Conditioning Institute of Canada
MSHA	Mine Safety and Health Administration
MPTA	Mechanical Power Transmission Association
NFPA	National Fire Protection Association
NFPA	National Fluid Power Association
NFC	National Fire Protection Association
UL	Underwriters Laboratories

NFPI	National Fluid Power Institute
NEMA	National Electric Manufacturers Association
NEC	National Electrical Code (published by National Fire Protection Association, NFPA)
OSHA	Occupational Safety and Health Administration (USA)
ULC	Underwriter's Laboratory of Canada
EJMA	Expansion Joint Manufacturing Association
DIN	Deutsches Institute fur Normung
JIS	Japanese Institute of Standardization
JIC	Joint Industry Council
CEMA	Conveyor Equipment Manufacturers Association
NOM	Normas Oficial Mexicana
IEEE	Institute of Electrical and Electronic Engineers
BSI	British Standards Institution
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
MSS	Manufacturer's Standardization Society
ANCA	Air Moving and Conditioning Association
CMAA	Crane Manufacturers Association of America
FEM	Federación Europea de la Manutención
IEC	International Electro technical Commission
NACE	National Association of Corrosion Engineers
TEMA	Tubular Exchange Manufacturers Association
TCS	Transport Canada Standards Respecting Railway Clearances (TC E-05)
SSPC	The Society for Protective Coatings
SI	International System of Units
SAE	Society of Automotive Engineers

Table 10.1-11.: Applicable standards to mechanical design

Bidder can use any other generally recognized national/international standards, provided they are equal or more demanding. Bidder will list all standards, regulations and specifications to be used for design, manufacture, erection and testing of equipment.

Units used in all the projects documents, reports, technical specifications, drawings, data sheets and others will be metric - as per " Standard Practice for the use of International Metric System of Units " — SI (Metric System).



### 10.1.3.2 Safety

The consideration of personnel and equipment safety in all stages of the project is priority. Equipment must be equipped with preventive devices against accidents.

#### Personnel Protection:

- Safety showers and eye washer stations will be designed and specified. Accessibility, water temperature, supply pressure and indication will be considered to maximize its effectiveness.
- The free space around equipment required for maintenance, will be no less than 1.0 m.
- Vertical ladders, over to 2.5 m high will have protection cages.
- Platforms and fixed stairways rising 1.2 m over the floor level will have handrails and appropriate access.
- Provision for lockable isolation of piping, hoppers, movable mechanical equipment and services for maintenance and/or equipment entry would be incorporated into the design and layout.
- Personnel protection guards would be provided to all exposed, moving components. Provide heat shields where personnel can come in contact with hot surfaces (> 60°C) and which are not protected by insulation blankets or guards.

#### Noise Level:

- The maximum acceptable compounded noise level for all equipment will be 90 dB at a distance of 1 meter.
- Outdoor equipment will be also required to comply with the acoustic design specifications to assure that the total noise produced is within the acceptable level in the surrounding area.
- Some equipment (pumps, fans, compressors) may be placed inside of acoustic insulated rooms and must use silencers.
- Major control valves and motors will require noise emission predictions and would include acoustic attenuation.
- Acoustic insulation materials will be waterproof, easily removable and robust to enable regular removal and refitting over the equipment useful life.

#### Maximum Weight Handled Manually:

- Equipment components which are required to be handled manually will not exceed the maximum weight of 25 kilograms for a single person and 40 kilograms for two persons. For lifting weights over 40 kilograms, suitable mechanical means will be provided to prevent injury.

### 10.1.3.3 General Requirements

#### Mechanical Equipment Design:

Mechanical equipment design will consider:

- Low life cycle costs;
- Specific characteristics of materials and products;
- Design capacity for continuous operation with minimum downtime;
- Design calculations will take into account starting of the equipment under fully loaded conditions after any stoppage;
- Selection of mechanical equipment with a proven record in similar operation;
- Standardization of assemblies components and lubricants selected to cover a broad range of applications in order to reduce warehouse inventory;
- Equipment design with maximum shop-fabricated components and shop-assembled packages;
- Equipment, parts and components origin will be, as much as possible from local supply;
- All equipment and/or materials for the specified service will be new and with a Supplier guarantee that the spare parts will be available in the future. Prototypes will be not accepted;
- Only standard sized components from reputable manufacturers would be supplied. Bidder's selected manufacturer would carry stock and distributor servicing near project area. Bidder is advised that it is PURE FONTE LTÉE's intention to standardize equipment by selecting appropriate standard equipment;
- Characteristics of the site, considering climatic conditions, altitude, environment, corrosion, temperature, traffic and interactions with mobile equipment or people, and others;
- Supplier's guarantees for the operation, the efficiency, and the mechanical quality of the offered equipment, according to the design requirements;
- The equipment will be designed with due regard to personnel safety, environmental protection, manufacture, erection, inspection, testing, cleaning, maintenance, repair and satisfactory operation under specified conditions;

- Motor and driven equipment sets are to be integral assemblies in accordance with PURE FONTE LTÉE's specifications and that motor would not be shipped separately. Best efforts would be made to ship pump/fan/ turbine drives uncoupled;
- Major components, covers, guards and base frames would have readily accessible eyes and sling points to allow convenient lifting and positioning of the equipment using an overhead hoist or crane. Use the same material as the parent material for lifting eyes, alignment pads and all similar attachments;
- All units will be expressed in SI (International System of Units);
- Maintenance access platforms at all drives and walkways for equipment maintenance, housekeeping, and safety; suspended supports, where practical, for conveyors in tunnels and galleries to facilitate cleaning; and tunnels with sloped floors for easy cleanup;
- All equipment would be designed for 24 hours, 365 days continuous operation unless otherwise specified;
- Material containing asbestos will not be incorporated into the works;
- Equipment containing polychlorinated biphenyls (PCB) will not to be used;
- Equipment containing Chlorofluorocarbons (CFC) will not to be used.

#### Equipment Layout:

- Plant areas and equipment modules will be arranged for safety, process and operation and maintenance requirements. Stairways would be located to accommodate travel between floor, platform levels and emergency exits;
- Equipment would be supplied in assemblies for ease of field installation. Benchmarking would be used for ease of alignment of components during installation;
- Walkways and platforms would be designed to allow normal operation and maintenance traffic flow to proceed expediently from one plant area to adjacent areas without the retracing of paths as in accordance with ISO 14122. parts 1/2/3/4 or agreed equivalent or better;
- Application of ladders requires the PURE FONTE LTÉE's engineer approval;
- Monorail or overhead crane access would be provided to all equipment components (> 40 kg) requiring periodic removal for maintenance. Structurally designed davits or hinges would be provided where mobile equipment is inaccessible and/or overhead lifting devices are impractical;
- Non-slip sloped floors and drains/sumps would be provided in areas where there is a requirement for the collection of chemical spillage and/or wash down of equipment

- Sources of ignition would be eliminated or controlled in the presence of a flammable atmosphere. Where possible locate electrical switchgear outside of classified areas;
- Information would be provided for handling hazardous substances in the Vendor bid response.

#### 10.1.3.4 Mechanical equipment requirements

##### Pumps:

- Description: Pumps receive potential energy and transform part of that energy into kinetic energy and pressure, moving the pumped fluid from one point to another.
- Pump specification will require the maximum standardization as possible, including the maximum utilization of the same type of pump, coupling, base mounting and motor.
- All moving parts of the pumps will have removable metallic protection.
- All pumps will be accessible by either a mobile crane or a hoist to assist pump and drive maintenance and operation.
- The rated operating point will have a flow equal or near the Best Efficiency Point (BEP), a sizing of +/- 10% of the BEP will be acceptable.
- The pressure increase from the rated operating point to the shut-off will be between 5% and 20%. For pumps operating in parallel, the pressure increase will be between 10% and 20%.
- The pump's driver will be sized and rounded up to the next standard existing diameter becoming bigger than the design calculated diameter. Motors will be selected for the maximum flow rate.
- The pumps will be a plot system curves using the above calculated values, on an appropriate manufacture's curve and determine the maximum duty conditions.
- The selection of the pumps will have a calculation of available kilowatt (kW) power and plot onto the manufacture's head curves. Check possible contingency in the pump from curves when the pump is operating at maximum flow.
- The pump's connections, for suction and discharge, will be flanged and in conformity with ASME (ASME/ANSI B16 - Standards of Pipes and Fittings).
- Pumps will be, whenever possible, directly driven by the motor and have couplings in the manufacturer's standard. When reduction speed is required, vendor will size, supply and assemble the entire set of direct drive or gearboxes.
- All pumps will have relief system.

##### Agitators:

- Motor power will be not less than 125% of calculated shaft power.
- Gear reducers and couplings will be designed with a service factor of 2.0 and sized for 100.000 hours of continuous use.
- The first critical speed of shafts will not be less than 150% of maximum operation speed.
- The torque protection system will be fitted as specified by vendor required.
- Roller bearings will have lubrication with oil bath and be fitted with oil level control device.
- Roller bearings will be designed to operate at least 50.000 hours under nominal conditions.
- All dynamic moving parts must have metallic protection.
- Mechanical seals must be able to be replaced without removal of shaft or drive train and shafts will be made in the number of sections required for easy maintenance reasons.

#### Blowers & Compressors:

- Blowers are used to provide the flow of the gas and Compressors are used to provide the increase of the gas pressure. The characteristics of the blower or the compressor can have a profoundly variation depending on the application type which is intended.
- Compressors for instrumentation air will be oil free.
- The design, construction, operation, inspection and tests will be according to API Standard 672 last revision.
- All dynamic moving parts must have metallic protection.
- Roller bearings will be designed to operate at least for 50.000 hours under nominal conditions.
- The blowers and compressors will have individual acoustic protection.
- The blowers will be designed and manufactured for heavy service according to the operational requirements of the process.

#### Fans:

- Operating points of the fans will be below the 80% of the maximum static pressure on the performance curve.
- The first critical speed will be not less than 130% of fan speed at rated performance.
- Fans will be industrial centrifugal type. They will be heavy-duty equipment of proven design.

- Impellers for the fans will be a single thickness welded construction, determined by the Bidder.
- Impellers will be statically and dynamically balanced on the shaft prior the shipment, in accordance with ANSI S2.19-1999 (r2004) standard for balance quality of rotating rigid bodies.
- Impellers and shaft will be thermally stress relieved prior to final machining.
- Bidders will supply a single inlet box arrangement for exhaust fan and fan casing will be horizontally split for impeller and shaft removal without disturbing duct connections.
- Fan casing will be completed with heavy duty, air tight, quick opening inspection and clean out doors located on the scroll in the opposite side of the fan discharge. Inlet box will be provided with a similar inspection door.
- Dampers for fresh air fan will be provided with a Variable Inlet Vane (VIV) type, located at fan inlet.
- Dampers for exhaust fan will be of multi-parallel blade type located at inlet box opening.
- Damper actuators and linkage will be sized to deliver 3 times the maximum calculated damper operating torque.

#### Mechanical Power Transmission:

Power transmission is the transference of power from its generation place to another one where it is applied to perform its work.

#### V-Belt Drivers:

- Belt Drivers will be designed to transmit the design torque and the motor starting torque.
- In general, V-Belt Drivers will be avoided in equipment demanding high torque (over 75 HP) and in highly dusty atmospheres.
- The minimum and maximum number of belts per driver will be 2 and 5 respectively. For multi belt drivers, matched sets will be used.
- The drive ratio for belt drivers will not exceed 3:1 for general applications and 2:1 for pump drivers.
- V-Belt Drivers will be limited to applications requiring speed reduction ratios of less than 6:1 and belt speeds of less than 25 m/s.
- Minimum arc of contact on smaller sheave will be 120°. Drive and driven sheaves and sprockets will be installed with a minimum of overhang on the shaft.

- Non-stock profiles will be avoided. The preferred V-Belt profile is 3V/5V/8V style and driver ratios will be selected so that standard pulley sizes are used.

#### Roller Chain and Sprocket Driver:

- All components will conform to ANSI/ASME B29.1M-1993 (Precision Power Transmission Roller Chains, Attachments and Sprockets).
- Standard roller chain and sprockets will be rated for steady loads with a minimum service factor of 1.2 based on driver nameplate power rating.
- All chain drivers will be enclosed in a dust free, oil-tight casing with seals, oil filler cap, dipstick and drain plug. The casing will be split along the centerline of the main sprockets, and fitted with inspection doors for all sprockets.
- Chain drivers will be arranged such that the tension side of the chain is on the bottom and both the tension and slack sides of the chain are at no more than 45° from horizontal.
- Drive ratios will be selected so that standard sprocket sizes are used. Maximum sprocket ratios will not exceed 3:1. Minimum wrap angle will not be less than 120°.

#### Drivers and Shafts:

- All shafts will be provided with all components and parts according to the manufacturer's standard design, for example, motor and reducers.
- All drivers and shafts will be designed using the ASME/ANSI for the torque transmission, the type and the load levels.
- Drivers will be designed so that the temperature of lubricants and components does not exceed manufacturer's design limits.
- Shafts and rotating assembly will be designed so that the operating speed is above or below the critical or first harmonic speeds by at least 20% of the critical speed.

#### Speed Reducer and Gears:

- Speed reducers and gears will be manufactured, totally enclosed, built, tested and rated as specified by AGMA Class II standard 2015-1 Class A7.
- Speed reducers will have cut tooth gears, rolling contact bearings and seals of appropriate design on shaft extension for duty indicated.
- Gear quality will be suitable for heavy-duty applications and will be designed for a service life greater than 100,000 hours.

- Separate motor and gear reducer type drives are preferred. In general, drivers will be direct connected type using induction type electric motors with couplings and gear reducers.
- All speed reducers and gears elements in continuous service will be rated in accordance with a minimum service factor of 1.5, based on the driver nameplate horsepower and 24 hours operation.
- The thermal rating will not be less than the motor nameplate power rating. Service factors for applications where extreme repetitive shocks occur, or where high-energy loads must be absorbed, will not be less than 2.
- Right angle, parallel shaft, and concentric shaft gear reducers are acceptable. Compactness of design, right angle shaft mounted or foot mounted reducers are preferred for belt conveyors and feeders. Worm gear reducers will be avoided.
- Gearboxes will be fitted with an oil level indicator, positive lock type oil filler cap, oil drain, magnetic drain plug and removable filtered air breather vent. Casings will be designed so that internal access is possible without disturbing the shafts or the bearings.
- The sealing systems for shaft extensions will effectively retain the lubricant in the housings and resist the entrance of abrasive dust and water. Taconite seals (labyrinth type).
- Fabricated gears cases will be stress relieved before machining
- All speed reducers thermal rating will be rated in accordance with AGMA standards and will not be less than the motor power.
- All enclosed gears will be protected in lubricant during shipment.

#### Coupling:

- Shaft couplings for direct drive equipment will be of the all-metal and heavy-duty flexible type.
- Flexible elements, in couplings, will be removable without disassembly of other driving components.
- All couplings will be grease free unless specifically required by design and will be complete with keyways and tapered hubs with split compression type bushing.
- Coupling will be selected in accordance with the manufacturer's recommendations based on the nature of the driving and driven torques, with a minimum service factor of 1.5 applied to the rated motor torque or braking torque, whichever is larger. The service factor for couplings will not be less than 1.5 (2.0 for fans and agitators), based on the drive nameplate motor power.



- Fluid couplings will be extended delay type when specified on the data sheet. Fluid couplings will be capable of 5 equally spaced start-ups per hour at maximum design load.
- Controlled torque couplings to prevent damage to the motor in case of equipment stall, will be considered where applicable.
- Any coupling alignment rejected will be re-aligned by the Contractor until the measurements will be within the required tolerance.
- Couplings will be aligned such that parallel and angular measured errors at the coupling periphery do not exceed the manufacturer's recommendations.
- Coupling halves will be aligned where the peripheral and angular differences between the couplings flanges are measured as the shafts are rotated through 360°. Peripheral and angular readings alignment will be taken at 0°, 90°, 180° and 270°.
- These measurements will be taken at the opposite extremity of the coupling hub.
- Flexible couplings will be provided for all drivers, except V-Belts and Chain Drivers.
- For fluid couplings, the fluid of the each coupling will be recommended by the manufacturer and approved by the owner. The approved fluid will be suitable for the particular duty and ambient conditions. The amount of fluid used will be adjusted in accordance with manufacturer's instruction before and during start up, to produce the required torque capacity.

#### Bearing and Pillow-Blocks:

- Bearings will be selected by the equipment manufacturer for each specific application. If possible, bearings will be standard type and size.
- Bearing selection will be in accordance with the Anti-Friction Bearing Manufacturers Association (AFBMA/ANSI).
- Operating temperatures for oil or grease in bearings will not exceed the bearing manufacturers recommended for any particular application and its specified lubricant.
- All bearings will be at least; dust-tight, re-greaseable, self-aligning, anti-friction roller bearings of the multi-cylinder, spherical or tapered roller type, selected to provide industry standard or applicable code L10 life
- The L10 life will be calculated for the maximum speed and radial and axial loads resulting from rated motor power. The equipment manufacturer will indicate applications where standard equipment does not meet industry standard L10 life.
- Where exterior bearings are applied, bearing seals will be a multiple labyrinth or piston ring type to protect the bearings from dust and water intrusion.

- Double seal arrangement, with a special cap that includes grease channels, a grease fitting and a purge hole (grease purge type seal), will be used in outdoor applications or dirty environments.
- Ball or Roller type anti friction bearings will be provided unless specifically approved by the Engineer.
- Bearings in plumber block type housings will be spherical self-aligning type.
- All bearings will be mounted on tapered adaptor or withdrawal sleeves unless otherwise approved by the Engineer.
- Unless otherwise specified, externally mounted bearings will be housed in cast, split type housings for shafts up to and including 12" diameter.
- Non-driving shaft ends will not protrude through housings and will be blanked with a closure plate.
- Where zero speed sensing is required, the shaft will extend through the bearing.
- Bearing tolerances will be as per the ANSI/AFBMA, equivalent tolerance class ABEC/RBEC-3 or Class 2, as appropriate, unless noted otherwise in the equipment specification.

#### Tanks:

- In general, tanks for liquid storage will be vertical or horizontal cylindrical type.
- Steel tanks will be designed and built in accordance with API 620 and 650 standard and potable water tanks will be designed in accordance with AWWA standard.
- Storage Tanks will have a corrosion allowance of 3.2 mm for steel unless otherwise instructed.
- Design pressure (12F Tanks) will be 7 kPag for tanks with a storage capacity of less than 64 m<sup>3</sup>, and 3.5 kPag for tanks with a storage capacity of up to 80 m<sup>3</sup>.
- Tanks will be designed with a minimum 10% freeboard for surges. Overflow will be designed for 150% of combined inflow capacity, and routed to the floor, which will be sloped to a sump or trench.
- Tanks not designed for flooded condition will be protected from an overflow situation by the provision of an overflow pipe.
- Tank materials will be specified on individual data sheets and drawings.
- Tank design will include all baffles, nozzles, vents, drains, lifting and grounding lugs, stairs, ladders, platforms and guardrails.
- Each tank will be supplied with two 750 mm access openings, one on top and one on the tank side with centerline 1,200 mm above ground level.
- Tanks will be fitted with a clean-out nozzle to allow complete drainage of tank
- Corrosion conditions imposed by the content or the atmosphere must be considered for the selection of the thickness plates and the steel type to be used.

Unless different indicated, it will be manufactured with carbon steel ASTM A-36 or equivalent

- Pipes, flanges, bolts, nuts and couplings will be constructed in accordance with the respective ASTM and ANSI standards. For example: ASTM A-106, ASTM A-105, ASTM A-193, ASTM A-194, ANSI B-16.5, etc.
- Tanks will be vented or rupture disk equipped to prevent vacuum damage when drained or it will be designed for full vacuum service.

#### Expansion Joints:

- Expansion joints are systems operating at other than ambient temperature will be analyzed for thermal expansion/contraction requirements. Expansion joints will be located to minimize compound movement.
- Expansion and/or vibration isolation joints will be installed between fans and ductwork and major equipment.
- These equipment will be provided with metallic bellows, internal linings, insulating cushion, beveled ends for stub welding with the ducts, fixation bars for moving and transport. Eyebolts will lift the assembly.
- Bellows would be designed to allow their deformation with the minimum stress, with a sufficient number of metal sheets in order to have high flexibility.

#### Heat Exchangers:

- Heat exchangers will be designed, manufactured, welded, tested and inspected according to ASME (Boiler and Pressure Vessel Code) and TEMA (Tubular Exchanger Manufacturer Association) or equivalent.
- The requirements of ASME and TEMA codes or other regulations will be considered as the minimum required.
- These equipment will be adequate for specified operation conditions and will have the necessary facilities for maintenance and structure repairs like ladders, platforms, monorail beams and others.
- Pipes will be seamless and its thickness will be according to pressure (inlet and loss) and specified operating temperatures
- The temperature for the determination of allowable stress on bolts, studs, nuts and gaskets will be the same of their respective flange.
- For heat exchangers with more than one shell in series, different design temperatures will be established for each shell according to their operating temperatures.

- For all parts contacting both fluids the choice of material will be based on the corrosion characteristics of both fluids and on the following temperature criteria:
- Both fluids with minimum design temperature higher than 15°C, the temperature for material selection is based on the temperature of the hottest fluid;
- One of the fluids with minimum design temperature less than 15°C, the temperature for material selection is based on the temperature of the coldest fluid;
- The temperature for material selection is based on the design temperature of component.
- Carbon steel tubes seamless when used for corrosive services or temperatures over 200°C, will have the following tests as additional requirement in accordance with ASTM A-214:
  - Susceptibility corrosion test;
  - Eddy Current test.
- The main flanges will be designed in accordance with ASTM B16.5 standard and related among the types below:
  - Neck flange: welded neck flange of forged steel can be used at any pressure class and diameter;
  - Slip-on flange: slip-on flange of forged steel can be used for pressure classes between 150 to 300 and any diameter. The slip-on flange cannot be used when the corrosion allowance is over 3 mm;
  - Ring type flange: ring type flange made of forged steel seamless will be selected for design pressure up to 290 psi (equivalent 20 bar or 2000 kPa).
- Forged steel flanges having all dimensions exactly according to ASTM B16.5 standard are accepted for working pressures and temperatures up to the limits established in this specification, without special calculations.
- The flanges with any other dimensions or construction system must be calculated by ASME code.
- The tubesheets may be forged or manufactured from plate. The forged construction will be preferred and, if the tubesheets are made with welded plates, the weld will be subject to full ultrasound and X-Ray test.
- Expansion joints can only be used when defined by specific study and its use is prohibited in the lethal service situations and in equipment operating with gas at pressure exceeding 3600 psi.
- The expansion joint will be pre-stretched during assembly in order to reduce the stresses in the joint when the exchanger starts up.
- All body welded joints will be inspected with full X-Ray, magnetic particle and penetrating liquid, including the welds of the bellows with the body.

- All external body will have an excess in the threaded length equal to the thickness of the nut after tightening. The excess in the threaded length enables use of bolt tensioning devices during tightening.
- Except when otherwise specified, the joints for all heat exchanger girth flanges will be selected according to:
  - For pressure class 150 and 300, with design temperature between 0°C and 250°C: non asbestos plain face carbon steel double jacketed gasket type for tongue and groove flanges.
  - For pressure class 150 and 300, with design temperature under 15°C and 250°C, or pressure class 400 and 600 for any design temperature: non asbestos plain face austenitic stainless steel double jacketed gasket type for tongue-and-groove flanges.
  - For pressure classes 600 operating with gas or steam or pressure classes 900 and higher, for any design temperature: solid metallic joint for tongue/groove face flange or tongue/groove with nubbin face flange. In this case, the joint material will not form galvanic pair with the flange and its hardness will be 30 Brinell Hardness less than the hardness of the flange face. The following maximum hardness values show values related to joint material:

Joint Material	Maximum Hardness
Carbon Steel	90
Alloy Steel 1 a 5% Cr	130
Stainless Steel 304 or 316	130
Stainless Steel 304L or 316 L	110

Table 10.1-12.: Joint material hardness

Pressure Vessels:

- Pressure Vessels will be designed, manufactured, tested and inspected according to ASME (Boiler and Pressure Vessel Code), last edition and the requirements in this specification.
- The requirements of ASME standard will be considered as a minimum and eventual local regulations applicable to the supply will be respected.
- Specifications criteria to the materials for vessels components:

Class of the vessel part considered	Basic Vessel Material		
	Carbon steel	Carbon steel for low temperatures	Alloy steel, stainless steel & non-ferrous metals
I	Same shell material	Same shell material	Same shell material
II	Same shell material	Same shell material	Material with the same "P-Number" of the shell material
III	Same shell material	Carbon steel for low temperatures	Material with the same "P-Number" of the shell material
IV	Materials specified for each case	Materials specified in each case	Materials specified for each case
V	Carbon steel of structural quality	Carbon steel of structural quality	Carbon steel structural quality
VI	Carbon steel of structural quality	Carbon steel of structural quality	Material with the same "P-Number" of the shell material

Table 10.1-13.: Vessel material specification criteria

- Material class:
  - Class I: Parts of the wall pressure vessel in contact with process fluids (shells, covers, nozzle neck, among others) and other pressurized parts in contact with the process fluids (tubesheets). This class also includes welded internal parts of the vessel submitted to main efforts like rings, plates and others supporting elements of trays, grids, internal covers, among others. This class also includes the reinforcements (any type) of the openings on the wall pressure vessel.
  - Class II: Parts of the wall pressure vessel that are not in contact with the process fluids, excepting the reinforcements of the openings (included in Class I), external reinforcement, vacuum reinforcement and others.
  - Class III: Internal welded parts in the vessel, but not submitted to main efforts (baffles, deflectors, vortex-breaker and others). External welded parts in the vessel, submitted to efforts in operation: supports of any type (as for example, skirts, columns, cradle and others) and elements to supports (as for example, ladders, platforms, external piping and others). For the supports, this class includes only the parts of the supports directly welded on the vessel or very close to it. Other parts of the supports, not directly welded on the shell, can be classified in group V.
  - Class IV: Internal disassembly parts (not welded on the vessel), as for example, trays, bubblers, grids, sustaining beams, distributors and others.

- Class V: Parts of supports of any type not included in Classes III and IV. For all the parts of this Class the design temperature is always the environment temperature.
- Class VI: External parts, directly welded on the vessel, but submitted to efforts only in assembly, maintenance, disassembly and other situations. For all the parts of this Class the design temperature is always the environment temperature.
- All pressure vessels designed according to ASME standard, including its supporting structures, will be checked for the following conditions: assembly, test, normal operation and shutdown.
- Stress efforts, allowable stresses and thicknesses that will be considered for each of the conditions are detailed in the table below:
  - Note 1: includes shell and welded accessories; excludes external and internal removable accessories.
  - Note 2: efforts caused by wind have not to be considered designing horizontal vessels, however, it will be considered in their foundations and structures design.
  - Note 3: includes removable internal accessories; excludes internal or external insulation and external accessories.
  - Note 4: includes removable internal accessories, internal or external insulation, external accessories and piping.
  - Note 5: in special cases in condition III, it may be necessary to consider the simultaneous effect of other acting loadings, such as thermal dilatation of the vessel itself, thermal dilatations of piping and other structures connected to the vessel, fluctuations of pressure, dynamic efforts caused by the movement of internal fluids and vibrations.
  - Note 6: for parts that have their thickness reduced during the manufacturing process, the minimum expected thickness will be considered.
  - Note 7: the admissible longitudinal compression stress for all loading conditions, for vessel and supporting skirts will be determined according to ASME standard.

Condition	Loadings	Allowable membrane stresses under traction (note 7)	Thicknesses
I – ASSEMBLY	Consider: <ul style="list-style-type: none"> <li>• A self-weight of the vessel (note 1);</li> <li>• Efforts due to wind action;</li> </ul>	Admissible stresses from norm table for vessel material at the ambient temperature, with an increase of 20%.	Nominal plates thicknesses (note 6)
II – TEST	Consider: <ul style="list-style-type: none"> <li>• Internal pressure of hydrostatic test;</li> <li>• Weight of vessel completely filled with water (note 1);</li> <li>• All dead loads supported by vessel</li> <li>• during the test (note 3);</li> </ul>	The maximum stress cannot exceed 80% of material yield stress at the environment temperature. For non-pressurized parts, the basic allowable stress can be increased 33,3%	Nominal thicknesses or corroded thicknesses (note 6)
III – OPERATION (Note 5)	Consider: <ul style="list-style-type: none"> <li>• Internal or external design pressure at design temperature;</li> <li>• Fluid weight at the operation level;</li> <li>• Vessel weight;</li> <li>• All dead loads supported by the vessel (note 4);</li> <li>• Efforts due to wind action (note 2);</li> </ul>	Allowable stresses from norm table for vessel material at the design temperature, excepting below section that established supporting skirt.	Corroded thicknesses (note 6)
IV – SHUTDOWN	Consider: <ul style="list-style-type: none"> <li>• Internal or external pressure at design temperature;</li> <li>• Vessel weight;</li> <li>• All dead loads supported by the vessel (note 4);</li> <li>• Efforts due to wind action (note 2).</li> </ul>	Admissible voltages of the tables of the norm for the material of the vessel at the design temperature with the addition of 20%.	Corroded thicknesses (note 6)

Table 10.1-14.: Vesse material characteristics



- The maximum admissible operation pressure to be indicated on the identification plate will be calculated based on the nominal thickness of the plate, under conformed and cored condition. The maximum admissible operation pressure will not be limited by the reinforcements of the nozzles.
- All the connections will be flanged type. Drilling will comply with ASME norm for the pressure class specified.
- Flanges with up to and including 24" will comply with ASME B16.5 standard. Flanges greater than 24" will be in accordance with ASME 16.47 standard.
- The manufacturer of the vessel will supply and install all the lugs, clips and supports welded on the vessel surface.
- The nozzles reinforcement will be calculated for the maximum admissible pressure verified for the equipment sidewall and to resist external efforts.
- For any pressure vessel is obligatory that all welded joints of the shell and covers to have at least radiographic inspection points.
- For dished heads and other pressed or formed parts, a suitable thickness increase in the plates will be provided to compensate the reduction of thickness during the pressing or forming, so that the final thickness of the finished part has at least the value calculated or the value specified in the drawings.
- For stainless steel vessels and non-ferrous metals, the minimum corroded thickness will not be less than 2mm. And the minimum corroded thickness of removable parts, parts welded directly on the shell and the angle welded throat will be 3mm.
- Unless expressly otherwise specified, the alignment of plates with different thickness, on the body or on the heads of the vessel will be made through the internal surface.

#### Hydraulic & Pneumatic Systems:

- All hydraulic components, fabrication and welding will be conforming to appropriate ASME, ANSI and ASTM standard. Bending of pipe and welding of pipe is not permitted.
- Hydraulic and Pneumatic system will be design for minimal disassembly for equipment removal and maintenance. Unions or swaged connections will be provided in tubing at accessible locations for equipment removal and maintenance.
- Hydraulic and Pneumatic system will be permanently supported to eliminate static deflection and vibration during operation in addition to meeting all code requirements. Valves, instruments and other components will be independently supports.
- Tubing and piping material will be 316 Stainless Steel and wall thickness will meet ASME B31.3 requirements as a minimum.

- All contractors supplied hydraulic and pneumatic system will be shop assembled and tested. Hydraulic lines will be pickled, neutralized and sealed before shipment and will require a minimum of field fit.
- Hydraulic power packs will be supplied complete, including tanks, valves, pumps, motors, and oil coolers where required, covers and auxiliaries mounted on a common skid type base frame and constructed as a single unit. Provision will be made for retaining the full contents of the tank would a leak occur within the power pack. A sheet metal cover to exclude dust and hose down water will enclose the power pack (except for oil cooler). The cover will be designed to prevent debris collection on its upper surface and will have hinged lightweight removable panels to provide total access for inspection and maintenance.
- All equipment associated with each unit, with the exception of cylinder mounted valves, will be contained within that unit and its control panel and will be complete with appropriate electrical terminals for all power, control and signal cabling and hydraulic takeoff points for external piping to operating cylinders.

#### Lifting & Hoisting Equipment:

- Overhead cranes, hoists and other lifting facilities will comply with the design and manufacturing requirements as stipulated in ISO standards and OSHA requirements.
- All equipment weighing more than 25 kg will have or will be provided with convenient lifting attachment points. The attachment points will be either standard proprietary lifting eyes or custom designed lifting lugs.
- Monorail hoists and cranes of more than 2 t capacity will have motorized lift and travel motions. Jib cranes over 5 t will have powered rotation, lift and trolley, if the crane duty warrants this level of assistance.
- All structures will be ASTM A36 steel or similar mechanical properties. All shafts will be SAE 1045 steel or similar mechanical properties.
- The wheels will be manufactured in forged steel ASTM A504 C or similar with minimum Brinell hardness 321 in the canal groove.
- All equipment must be designed and tested at 125% of their nominal capacity.
- The equipment will be designed to allow the crane, trolley and hook to have simultaneous and independent movement.
- The cable length will be enough to reach the lowest point of the operation remaining the length equivalent to at least two cable turns on the drum.
- The traveling cranes will have static breaks for all movements. The brake of the hoists will be sized to 150% of the nominal load capacity.
- Electric Overhead Travelling (EOT) cranes may to be equipped with radio control. The motors will have manual starting using control pendants or remote controls.

- Traveling cranes and hoists will have an independent lighting system proper for load transportation.
- The operation mechanism will be designed to prevent movements which cause excessive vibrations.
- All movement will be continuous, without bumps, with speed and acceleration controlled by frequency inverters.
- Access platforms or catwalks for crane or hoist maintenance, will be provided with safety cable lines for access to the equipment components.

#### Air Compressor System:

- Compressors will be rotary positive displacement type, air-cooled, manufacturer std., designed and constructed for continuous full load operation (heavy duty).
- Compressors will be either lubricated or non-lubricated as specified on the individual compressor Data Sheet.
- The compressor, accessories and instrumentation will be suitable for continuous, unattended operation with the exception of normal periodic inspections.
- Cooling system design will take into account the installation site altitude and conditions stated in the site conditions specification.
- Piping connections at interface will be of ANSI standard sizes and dimensions.
- The thickness of the casing will be suitable for the maximum allowable working pressure. Minimum design pressure of the casing will be 1 1/2 times the maximum allowable working pressure.
- Rotors will be rigid enough to prevent contact between the rotor bodies and the casing and between gear timed rotor bodies at the most unfavorable specified conditions including 110 percent of the relief valve set pressure.
- Shafts will be rolled or forged steel. Forged steel shafting will be furnished for speeds over 3600 rpm.
- All main bearing will be anti-friction type. They will be in metric size and complying with the appropriate ISO recommended dimensions. L10 rated life will be 60,000 hours at design load. Only bearings manufactured by a reputable supplier will be used.
- Shaft seals will be provided to prevent leakage from or into the compressor over the range of operating conditions and during periods of compressor idleness. Seals will be suitable for all conditions that may exist during compressor start-up, normal operation and shut-down.
- Major parts of the rotor assembly will be individually statically and dynamically balanced

- Air and oil coolers will be air cooled type, designed and built in accordance with ASME Section VIII, Division I.
- Piping will conform to the requirements of ASME B31.1. All steel flanges will be in accordance with ANSI B16.5 of the class appropriate for the design pressure and temperature of the flanged connection.
- Intake air filters and silencers will be furnished with the compressor packages. They will be in accordance with the standard design of the compressor manufacturer. Performance and construction features will be described by the compressor Supplier.
- Air dryers will be dual tower adsorptive pressure swing, heat less regeneration type. They will be furnished complete with all interconnection piping, valves and instrumentation intended for fully automatic operation. Activated alumina will be used as adsorptive agent. Requirements regarding to air dew point at air dryer outlet will be as specified in the particular Data Sheet. The air dryer vessel material will be as specified on the individual equipment Data Sheet.
- Pre-filters to removal oil and solids particles and post-filter for solids particles will be mounted on the air dryer skid. The quality of a coalescent filters will be suitable to obtain a quality of air compress according to ISO 8573-1:2010, class 6. For further information about allowable oil contained in the air and removed particle sizes will be in accordance with the particular equipment data sheet. Air receivers will have the capacity specified on the Data Sheet. As general requirements, the air receivers will be made of welded carbon steel, vertical construction provided with the relevant mounting elements (legs or saddles). They will be furnished with at least the following instrumentation and accessories: pressure gauge, automatic drain and pressure safety relief valve the design of which will consider the event that an open fire occurs around the equipment.
- Pressure vessels of air receivers and air dryers will be designed, constructed, code stamped and tested in accordance with ASME Section VIII, Div.1, Pressure Vessel Code, Rules for Construction of Pressure Vessels.
- Welding or weld repair of pressure parts and components will be in accordance with ASME Section VIII, Section IX and Supplier's procedures which will conform to all applicable codes and standards.
- Supplier will furnish a control system consisting of a PLC based in local control panel within a cabinet mounted on the compressor skid.
- The Packaged Equipment must be operable from the PLC supplied with the package.
- This PLC will repeat controls, status and alarms to the central control system via a digital communication link. This communication will be one of the following protocols:
  - Profibus DP, Ethernet, Devicenet, Control Net, Modbus+ or Modbus RTU

#### Fire Protection System:

- The plant will be equipped with fire protection systems according to the criteria included in this document, with the objective of providing a high degree of safety in the facilities.
- Each area or facility will be individually evaluated for potential fire hazards and the fire protection system will be defined for that area or facility.
- Special consideration must be taken for equipment and material at the plant site related to the climatic conditions. See Technical Specifications for Site Conditions.
- Yard hydrants will be provided for adequate coverage around the facility.
- Portable fire extinguishers will be provided to cover all operating level of the facility.
- In general, all process buildings, service buildings and the utility buildings will be protected by an underground fire water main and hydrant system.
- The underground fire water mains will be interconnected or looped with suitably located post indicator valves to allow partial isolation of the system for repair and maintenance while the balance of the system is operational. Piping materials will meet the requirements of General Specification for Piping Material Classes and will be certified by UL/FM or approved local company.
- All hydrants will be located at a minimum of 12 m and a maximum of 45 m, from the building being protected. Yard hydrants will be protected with guard posts.

#### Data Centers & Control Rooms:

- Data center and control room will be protected by a FM-200 based automatic fire extinguishing system.
- FM-200 discharge nozzles will not be located within 3 m of positions where personnel could be subject to direct exposure of the discharging agent.
- The FM-200 fire extinguishing system will be designed in accordance with NFPA 2001, Clean Agent Fire Extinguishing Systems.
- Ventilation/air conditioning systems for the protected areas will be shut down when a fire is detected.

#### Firewater Supply/Distribution System:

- Firewater supply systems will be designed in accordance with NFPA 22.
- In locations where a gravity system alone is not adequate to achieve/maintain the required fire main pressure; a firewater pumping system will be provided.

- This system will typically include a combination of three pumps – an electric motor driven main pump, a diesel engine driven back-up pump and a jockey pump, arranged in accordance with NFPA 20. Local controller panels will be provided for each pump in order to activate and monitor their operation. The system will be monitored and alarm in a continuously manned location. The installation will be designed for adequate protection against weather conditions, including freezing and corrosion.
- Firewater distribution systems will be designed in accordance with NFPA 24.
- Firewater mains will be of ample size, with a minimum nominal diameter of 6-in. (150 mm).
- Sectional valves, with suitably located post indicators, will be contemplated to allow partial isolation of the system for repair and maintenance while the balance of the system remains operational. In no case there will be more than 8 hydrants and sprinkler/spray/standpipe systems isolated in any sub-sections.
- All underground carbon steel pipes and fittings will be coated and wrapped in accordance with NFPA. Suitably resistant High-Density Poly-Ethylene (HDPE) piping may be used for underground fire mains. They will be of certified material.

#### Heat, Ventilation & Air Conditioning (HVAC) Systems:

- The HVAC systems will provide a suitable environment for people and equipment. To obtain the above, the following aspects will be considered in the design:
  - Pressurization
  - Ventilation
  - Heating
  - Humidity
  - Air Conditioning
- Air conditioning units will be air-cooled, single-package, single-zone, unless otherwise indicated.
- Electrical heaters are preferable to other heating system. Safety thermostat, Klixon or similar will be installed in order not to exceed the fixed limit temperature.
- All ventilation systems will have filtered intake air, with one or two stages, to obtain the required air quality, except process building general with ventilation areas.
- Pressurization systems will be calculated with all access doors and openings closed and providing the minimum air volume which satisfies internal heat loads generated and ventilation requirements.
- For comfort, air distribution velocity within the spaces would not exceed 0.26 – 0.38 m/seg.

- The noise level of the equipment will not exceed 85 dBA at a distance of 1 meter, in any direction, from any major bounding surface.
- The main duct air velocity is 300-400 m/min and branch duct air velocity is 180-275 m/min to achieve the design goals desired and so that the fittings, takeoffs, etc. are designed for proper streaming flow.
- Galvanized sheet metal commercial grade is recommended for all ducts.
- Flexible ducts will be avoided, except maximum 1.5 m long flexible duct branches may be used for connection to diffusers above concealed ceilings
- Electrical equipment and devices will be designed in accordance with electrical Codes, Standards and requirement for electrical equipment specified in Technical Specifications N° 3786-TARG-E-DC-000-002; “Electrical Package Equipment”.
- Control System will include all dampers, relays, transformers, thermostats, humidity controllers, etc. required to maintain the specified conditions.
- Outdoor conditions are shown on Technical Specification “Site Conditions”.
- Indoor design parameters will be as follow:

TEMPERATURE		RELATIV	VENTILATION /		PRESSURE	FILTRATION
WINTER	SUMMER	HUMIDIT	RATES			QUALITY
DB°C	DB°C	%	Air Velocity	M <sup>3</sup> / person	(Pa)	%
20	22	50	Frontal	Note 1	+50	60 - 80
			Velocity less than 0.1 m/s	17		

Table 10.1-15.: Indoor design conditions

● Notes:

1.- Pressurization defines the minimum air quantity.

- Cooling and heating loads will be calculated using software based on ASHRAE Handbook Fundamentals, transfer’s function, as a guide.
- Where pressurization is specified, this area will be supplied with a minimum of 2 air changes per hour of clean, filtered outside air in excess of any exhaust air from area.
- Minimum outside air supplied to any normally occupied conditioned area will be 10 percent of the total circulated flow rate or 1 air change per hour, whichever is greater.



### 10.1.3.5 Maintenance & inspection

- Man ways and circular openings for inspection or access will meet the minimum requirements of the applicable codes and standards.
- Permanently installed davits will be used for man way and vessel covers weighing more than 40 kg, where frequent access is required. Hinges may be fitted where davits are not practical if approved by the Supplier.
- Lifting lugs and similar fittings will be designed and installed in accordance with applicable codes and standards. Lift lugs will be painted Yellow or identified by other means.

#### Vibration Control:

- Dynamic and vibration loadings from machinery will be isolated from the supporting structure.
- Minimum balance quality for rotating equipment will be according to ISO 7919 standard — Mechanical vibration of non-reciprocating machines.
- Vibration levels of electric motors will be in accordance with project specification for Electric Motors, but in no event will it exceeds the limits prescribed above for mechanical equipment.
- None of the vibration components, including those for unbalance, misalignment or any mechanical or electrical problem will exceed 50% of the overall vibration amplitude.
- In general, the vibration amplitude in the axial direction will not exceed 50% of any vibration in the radial direction.
- Where structural steel is part of the equipment supply, the natural frequencies of the structure will avoid the equipment operating frequency by at least 30%.

#### Lubrication:

- All mechanical operating parts, unless noted, will be provided with means of lubrication suited to the operating conditions.
- All equipment will be supplied with a detailed drawing showing a lubrication flow diagram, piping arrangement, lubricant manufacturer, type quantity and frequency of lubrication.
- Manual or automatic lubrication systems will be evaluated on the basis of the type of lubrication, frequency of lubrication and quantity of lubricant required.



- Lubrication systems will be automatic, wherever practicable and will be designed to permit lubrication with equipment running. If manual system is used, the application points will be grouped for convenience.
- All grease fittings will be readily accessible for greasing without removing guards. For equipment requiring multiple lubrication points, the lubrication fittings will be piped to one side where service platform or walkway access is available.
- Lubrication of gears and bearings will be by means of an internal splash system unless otherwise specified. Sight glasses will be provided.
- Oil bath system that require large amounts of oil for recharging would be installed with piping and barrel pumps to transfer the oil to the equipment from an easily accessed platform.
- Lubrication automatic systems would be equipped with control panels at the facility centralized locations. The automatic dispensing station will be enclosed if necessary and located so as to be accessible to trucks for re-charging.
- The vendor will provide a detailed list of lubricants used showing brand, type and location used.
- All grease fittings will be standard button head type.
- Grease lubrication is preferred on low speed equipment where the risk foreign matter ingress is high and there will be long periods between required attentions.
- Grease lubrication equipment operating temperature must be below 90°C.
- All grease nipple bulkheads will include a hinged dust cover to protect the nipples.
- Unless otherwise specified, all equipment to be lubricated will be thoroughly flushed with approved flushing oil, in accordance to the manufacturer's recommendations.
- Rotating equipment will be rotated during flushing to ensure complete penetration of the oil. All lubrication lines will be cleaned by blowing through with compressed air and then flushing with oil or grease before final connection of the lubricating circuit. Flushing oil may be re-used, provided it is filtered and cleared by some means approved by the owner.
- Before any test running is carried out, any points on installed equipment, which require greasing, will be inspected and greased. The grease used will be in accordance with the manufacture's recommendation.

#### Welding Process:

- All welding will be adequate for the specified design and mechanical requirements and will comply with the requirements of CSA and AWS standards.
- All welding will be performed by qualified welders and will be supervised by a fully qualified welding supervisor.

- Welding will be executed in accordance with approved welding procedures and will be full penetration, full strength and free from undercut and slag inclusions. Crater effects at the ends of weld runs will be eliminated.
- Welding will generally be continuous and butt welds will be full penetration unless specified otherwise in the drawings or specification.
- All critical items and items exceeding 38 mm in thickness fabricated by welding will be post-weld stress relieved by heat treatment (PWHT) on completion of welding and before final machining.
- Welding will be subject to inspection in accordance with the quality plan. For principal welds, radiographic records will be submitted. Additional examination may be required in the event that visual inspection reveals faulty welding.

#### Shop Tests:

- The Quality Assurance plan to be implemented by the Contractor will furnish details of the extent of shop and testing procedures followed to guarantee soundness of materials and verification of critical dimensions and motions prior to shipment.
- All welds will be complete, have weld craters filled, weld spatter and other debris removed and be suitably prepared for examination or surface treatment. All non-destructive test records will be traceable to the welds that have been tested.
- The Contractor will perform radiographic examination on pressure boundary components and fittings.
- The equipment's will be fully assembled in the fabrication shop and mechanically tested prior to shipment. The tests may be witnessed by an agency of the Owner's nomination.
- The equipment will be completely assembled and shop tested prior to shipment to ensure correct operation of all components.
- Testing procedures will be approved prior to commencement of testing.
- Any faults or incorrect operation occurring during testing will be remedied to the satisfaction of the Owner before proceeding further.
- After testing, the equipment will be thoroughly inspected for any excessive wear or defective parts. Any parts found to be defective will be replaced, not repaired. Any out of balance parts of the equipment will be rectified. The equipment will then be re-run and re-tested.
- Noise levels will be tested in the works, if practical, and if type tests reports are unavailable. Type tests reports will be accepted only if tests were carried out on equipment identical to that being supplied and under operating conditions similar to the intended use. Equipment exceeding the maximum allowable noise will be rejected.

- All non-destructive examinations and tests, including hydrostatic tests, will be done in accordance with relevant standards.
- Vessels will be dried and cleaned to the satisfaction of the Owner, following the satisfactory testing of each vessel.

#### Pre-Assembly of Equipment:

- The Contractor will maximize the level of offsite assembly and testing for all supplied equipment.
- All self-contained, pre-assembled equipment will be completely wired and pre-piped, with wiring and piping brought to conveniently located and clearly identified terminals & appropriate junction boxes for connection to external wiring and piping by others.
- Where a package must be divided into two or more sub-assemblies for shipping or installation purposes, wiring, conduit and piping will be provided cut, fabricated and pre-formed as required for interconnection of the sub-assemblies which make up the equipment package.
- Piping systems will thoroughly be flushed after assembly. Systems will be drained prior to shipment and open ports capped or plugged.

#### Painting:

- All carbon steel or cast steel exterior surfaces will be prepared primed and painted as per manufacturer's standard.
- The following will not be coated:
  - Underside of steel column base plates supported on concrete foundations;
  - Steel surfaces embedded in or bonded to concrete;
  - Stud welded shear connectors;
  - Traffic surface of crane rails;
  - Stainless steel and other corrosion-resistant materials;
  - FRP tanks and pipes;
  - Insulated components (primer only);
  - Machined surfaces;
  - Insides of bins and chutes (unless primer only is specified).

#### **10.1.4 Material Handling Design Criteria (3786-TARG-X-DC-000-002)**

The purpose of this document is to describe the general concepts for the Material Handling Design Criteria for the new, Greenfield Pig Iron Production Plant project, owned by North Atlantic Iron Corporation, located in Port Saguenay, Quebec, Canada. Present Design criteria in conjunction with design standards and engineering practices establish the basis for the engineering design for mechanical design and mechanical activities including design, supply, fabrication, erection, inspection, testing and identification for all material handling equipment involved in PURE FONTE LTÉE project.

Material Handling Equipment & Installations must be designed under complete resources exploitation concept, focusing in safety for people, equipment's and efficient use of energy and process continuity.

##### **10.1.4.1 Codes & Standards**

Same as the mechanical equipment

##### **10.1.4.2 Safety**

Same as the mechanical equipment

##### **10.1.4.3 General Requirements**

Same as the mechanical equipment

##### **10.1.4.4 Material Handling equipment requirements**

- Every piece of material handling equipment will be readily maintainable without having to empty upstream equipment. Generally, this means that any piece of material handling equipment immediately downstream of any place where material is stored or accumulated will be able to be isolated.

- When handling wet or sticky material, precautions will be taken to ensure that material will not build up on belts, in chutes, hoppers or bins. These precautions will involve:
  - Proper design of angles for bins, chutes and hoppers;
  - Proper selection of liner materials;
  - Appropriate belt cleaners on belt conveyors;
  - Cleaning devices on comminution equipment;
  - Wash systems on screens.
- Access openings will be provided on bins and chutes for inspection and cleaning.
- Mass flow bins and hoppers may be necessary in some circumstances and will be considered on a case-by-case basis.
- When handling dry products the following precautions will be taken against fugitive dust emission:
  - Eliminate or reduce free fall of dusty material;
  - Collect dust at transfer points and recycle into the process.
- All maintainable components of the material handling equipment will be able to be isolated from each other for maintenance purposes and would be reflected in the P&ID's (e.g., slide gate or rod gate to isolate hopper from feeder to allow maintenance of feeder without dumping contents of hopper)

#### Hoppers & Bins:

- The design of hoppers and bins would provide low maintenance and easier inspection.
- The design will maximize the "mass flow" of the material.
- Hoppers, bins and chutes will have their sidewalls minimum slope from the horizontal, according to the material handled.
- Design will be done in order to reduce, as much as possible, the replacement of worn plates.
- The dropping material from a large height would be avoided as much as possible.
- Big capacity hoppers will have an inspection and maintenance scuttle.
- ASTM A-36 steel will be used for construction unless another steel type will be specified. Minimum thickness will be 6 mm
- The hoppers and mobile hoppers design must ensure safe, efficient and trouble-free operation.

#### Belt Conveyors & Flex-O-Wall Conveyors:

- Belt Conveyors and ancillary equipment will be manufacturer's standards extra heavy-duty design suitable for the operation specified herein and on the data sheets. The design, construction and performance of the equipment will be in accordance with the codes and standards listed on present document.
- Belt Conveyors will be designed on the basis of ISO, CEMA or DIN Code Standards, including accessories, such as head drive, gravitational counterweight, backstops, and all structural service platforms, in accordance with the safety standards of the project. All calculations will be made in SI units or English with the results converted to SI units.
- Conveyor capacity will be designed to meet the requirements of CEMA standards in terms of volumetric capacity. To minimize spillage a maximum loading of 80% will be generally used.
- Edge tensions, convex and concave curve design and the associated belt tensions will be designed according the manufacturer's recommendations to prevent excessive idler pressure.
- Belt widths will be selected according to availability of standard components. An attempt will be made to minimize the number of different belt widths.
- The following factors will be considered when selecting conveyor belts:
  - The steady operating tension at any section of the conveyor will not exceed 100%, or fall below 10%, of the rated tensile capability of the belt;
  - The accelerating or braking tension will not exceed 150%, or fall below 5%, of the rated tensile capability;
  - The maximum speed for belt conveyor will depend on the belt width. To minimize risk of spillage, belts will be designed conservatively with respect to speed and loading. This will be evaluated on a case by case basis;
  - Heat resistant belt will be used for hot materials where temperatures exceed 60-65°C (CEMA).
- Complete drive systems will be provided. The preferred drive system will include a shaft- mounted helical or helical-bevel gear reducer.
- Conveyor drivers will be designed to start a fully loaded conveyor.
- All upwards inclined conveyors will be fitted with a holdback of adequate capacity to prevent the reversal of the conveyor when stopped under full design load.
- All downwards conveyor will be fitted with appropriate brakes capable to reduce the belt stopping time and prevent flooding of the next equipment.
- Belt conveyors will be supplied with belt cleaning devices, designed for the duty of the belt and the type of material being handled by the belt
- Scraper blades will be easily accessible and changed without the use of bolts.
- At discharge points, the scrapers will be arranged to feed the scrapings into the transfer chutes.

- Take-ups will not be positioned under feed or transfer points or anywhere susceptible to spillage from other parts of the plant.
- Provision will be made on all gravity take-ups for easy and swift raising or lowering of the take-up weight for maintenance purposes.
- For bridge supported conveyors, the conveyor framework will include walkways along the full length with safety handrails.
- The deck plate will extend beyond the end of the skirts at loading points, according to recommendations.
- Conveyors safety and guarding will be designed according to OSHA requirements.
- Each belt conveyor will be equipped at least with the following:
  - Misalignment Switches;
  - Under speed detectors;
  - Pull Cord;
  - Belt Rip for overland conveyor;
  - Slip detection Switches;
  - Safety beacon and horn for conveyor starting.
- Power transmission is the transference of power from its generation place to another one where it is applied to perform its work.

#### Belt Feeders:

- Conveyor loading will be at a minimum angle of inclination, preferable horizontal, unless prevented by design constraints.
- Variable-speed drive mechanism will be used for control of feed rates.
- When loading a belt a tapered reclaim slot (increasing in width) with a self-relieving incline in the direction of feeder travel will generally be provided.
- The vibrating feeders will be of the manufacturer's heavy duty electromechanical design suitable for the services and capacities specified.
- The feeders will be provided with abrasion resistant liners with manufacturer's recommended thickness.
- The feeders will be supplied with vibration absorbers and suspension hooks for hanger mounting.
- Skirts and discharge chute will be reinforced and protected by liners and the skirts will be tapered away from the bottom of the feeder.

#### Vibrating Feeders:

- The vibrating feeders will provide continuous long-term service under typical mining environmental conditions.

- The vibrating feeders will be electromechanical type, heavy-duty design, with natural frequency based coil spring drive, adjustable eccentric weights and rotating weights guards.
- All surfaces subject to abrasive wear or corrosion will be lined or protected. Liners will be easily replaceable and made in sections not exceeding 30 kg. Wear at the feed end is anticipated to be severe. The design will take into account the protection for the different components, and ease methods of removal, replacement and fastening.
- Vibrating feeders will have grease fittings and heavy duty roller bearings, motors will be factory grease packed and furnished with sealed ball bearings.
- The vibrating feeders will be provided with lifting lugs to facilitate handling by crane.

#### Screw Conveyors:

- Design capacity of conveyors will be based on transport of moderately abrasive material. Screw conveyors will be typically side feed.
- Construction material is generally carbon steel for dry service applications. Stainless steel will be used for wet service applications.
- Screw conveyor troughs will be furnished in standard length or standard lengths multiples. Dust seals must be provided and must be designed to prevent material entering in the bearings.
- Flanged covers will be provided with waterproof seals and with provision for quick opening for inspection and/or clean out from the platform side. Inspection points and opening for dust hood will be provided at each feed point.
- Screw conveyor flights will be standard sectional helical flights with pitch equaling the diameter of the screw.
- Shafts will be standard size and ample diameter to suit the duty.
- Bearing maintenance will be capable to perform without disconnecting feed inlets. Bearings will have labyrinth seals.
- Complete drive system will be provided, including reducing equipment, guards, coupling, coupling guards, motor mounting bracket, and motor.
- Conveyor will be capable to start from a fully loaded condition.
- For screw feeders installed directly at the bottom of a hopper, start-up load will take into account starting with a full hopper.

#### Transfer Towers / Screening Towers:

- The transfer towers will consist in a metallic structure and provided with removal covering and lateral sealing in order to avoid dust emission to environment.



- Service water points will have to be foreseen in each level of the transfer towers platforms, with "quick coupling type" connections.
- Monorails will be considered in transfer towers and located where it is necessary use hoist for maintenance purposes. Indication of the capacity of each hoist must be provided.

#### Transfer Chutes:

- Skirt boards will be continuous along several loading points and close-centered on the belt.
- Steel chutes, hoppers and bins will be welded construction with bolted connections for installation and loose flanges where necessary for field fitting and adjustment.
- Head boxes and chutes will be designed to withstand impact without deformation or failure of any structural steel members and will be made with mild steel of 6 mm thickness plate as minimum.
- Rock boxes will be incorporated at transfer points where excessive wear is anticipated except with sticky materials.
- Chute widths will be standardized as possible to uniform liner sizes. For sticky materials, chutes and transfer points will be made 50% larger than needed to minimize blockage.
- Chute direction fitting turns will be preferably by segments of long radius elbows. Wear plates will be bolted and must be easily replaceable.
- Material design trajectories for head boxes and chutes will take into account:
  - Material size distribution;
  - Maximum lump dimension;
  - Adhesion between the material and the conveyor belting;
  - Air resistance to material flow.

#### Screen:

- Rated and design capacity for the classification range of material to be processed and all other operating conditions will be ensured in any operating situation.
- The panel mesh frame fastening system will be designed to minimize screen frame change out time and the number of fastening components, while maintaining adequate tightness.
- Mesh material (polyurethane, rubber, or wire mesh) will be suitable for the abrasiveness and friction inflicted by the material being processed.

- Devices will be provided to prevent the unit's vibration from being transmitted to the surrounding structures, platforms and stairs. The use of an isolation frame may be proposed as an option for satisfying the requirements above.
- The unit's vibration amplitude (stroke) and frequency will be adjustable through mechanisms mounted on it.
- Vibration sensors will be provided to detect abnormal vibration.
- The Screen Unit will have lifting lugs for handling, assembly and maintenance, each of them capable of supporting the entire assembly.
- Water spray system, if required, will consist on a distribution system covering the entire screening surface. The distribution system will be easily removable for mesh change out.
- All mechanical, electrical and instrumentation equipment will be readily and safely accessible for maintenance, for both, scheduled and unscheduled activities.
- The screen design proposed will have been successfully used in applications similar to the application specified in this document.
- The screen will include such instrumentation as required to ensure safe, efficient and reliable operation. Any system that requires protection will be provided with sensors to trigger alarms and, when necessary, cause the unit to be automatically stopped.
- All instruments will be weather and dust-proof and adjustable during operation.

#### Traveling Cranes & Hoists:

- All overhead and lifting equipment will be designed to meet the Crane Manufacturers Association of America (CMAA), OSHA standards and regulations and the applicable Canadian and Provincial codes.
- All hoists will conform to the standards of the Hoist Manufacturer's Institute (HMI).
- Cranes and hoists will be of vendor standard specifications suitable for the service requirements specified on the data sheets and specifications.
- The Vendor's scope of supply will include the design, fabrication, inspection and testing and supply of hoists as specified in the data sheets and specifications.
- Monorail hoists and cranes of more than 2 tons capacity will have motorized lift and travel motions. Jib cranes over 5 tons capacity will have powered rotation, lift and trolley. Hoists and cranes will be gear type for smooth rotation.
- The rated capacity of each lifting device will be marked on the trolley and, where applicable, on the underside of monorail beams and bridge girders. The capacity will be legible from the operating floor.

- All equipment guards over 23 kg will be fitted with readily accessible lifting lugs, eyes or sling points as appropriate for installation, erection and maintenance. All lifting points will be clearly identified.
- All equipment components over 23 kg mass will be furnished with lifting lugs to allow convenient lifting and positioning of the equipment to facilitate installation, erection and maintenance. Lifting lugs will be positioned to minimize the handling hazards. Where lifting attachment points are to be provided, they will be either standard proprietary lifting eyes or engineered lifting lugs. The lifting eyes or lifting lugs will be located at the centroid of the weight, such that the item remains horizontal and stable whilst being lifted. All lifting points will be clearly identified. Heavy equipment will be skid mounted with the capability to be lifted from any direction. Each lifting point will be designed for lifting a minimum of 1.5 times the component weight. Lifting eyes will be protected by a plug during operation.
- Overhead cranes will be certified as required by the applicable codes and standards.
  - Overhead electric travelling cranes will conform to ANSI B30.2 and CMAA specifications 70 and 74 or similar (FEM standard). The cranes will meet the requirements service in accordance with CMAA specifications.
- The equipment will be designed to allow the crane, trolley and hook to have simultaneous and independent movement.
- The cable length will be sufficient to reach the lowest point of the lifting operation, plus at least two cable turns in the drum.
- The traveling cranes will have static brakes for all movement in order to maintain the equipment position. Hoist brakes will be designed for 150% of the nominal load capacity.
- The design for the traveling cranes and hoists will consider normal movements for load lifting purposes. Docking houses will be provided for outside travelling cranes.
- Major overhead travelling cranes will be designed with service platforms and proper stair access at the end of crane runway to facilitate maintenance work. The crane will be provided with a catwalk and lifeline along the full length of the crane travel for maintenance access.

#### Belt Drives:

- Bidder would select Belt Drives for any equipment/systems as per MPTA (Mechanical Power Transmission Association) Standards (or agreed equivalent or better)

#### Gear Speed Reducers:

- Gear Speed Reducers would be designed as per AGMA (American Gear Manufacturing Association) Standards (or agreed equivalent or better)

#### Roller Chain & Sprockets:

- Roller chain and sprocket drive would be designed as per ASME B29.100 or agreed equivalent or better

#### Drive Guards:

- Guards are to fit closely around all rotating machinery including shafts, couplings, V-belts, and chains.
- Guards would be constructed from suitable plate and/or expanded metal mesh in accordance with OSHA (or agreed equivalent) standards.

#### Couplings:

- Bidder would select Couplings for all equipments/systems as per standard Mill practice or MPTA (Mechanical Power Transmission Association) Standards (or equivalent or better)

#### Bearings:

- Selection procedure and ratings: Per ABMA-9 (American Bearing Manufacturing Association) and ABMA 11 or equivalent (ball and roller bearings respectively)

#### Failsafe Features:

- The machinery, equipment and process line will be brought to a safe stop upon failure of electrical power, control power, hydraulic power or control components. The system will remain "at rest" until restoration of service, and the controls are reset unless otherwise specified. If an unscheduled stop would result in an unsafe condition then the failure will be announced by audible and visual alarms and standby or stored power will be provided that will permit a delayed or gradual stop under manual or automatic means.
- In the event of a failure in the controls, manual controls will be provided that will permit the system to be brought to a safe state of operation or to a stop.

#### Base Plates:

- All equipment and motors will be mounted on common base plate, with provision made for easy removal of the motor and pump rotating element.

#### Pumps:

- Bidder will provide pumps according to a recognized international standard. Bidder will state which standard(s) will be followed.
- Each pump unit will be complete in all respects and will include prime mover, coupling and guard, bedplate, holding down bolts and all integral piping.

#### Hydraulic Power Units:

- The hydraulic unit and equipment will be of standard design selected to meet the specified operating conditions with special emphasis on safety, efficiency, reliability and maintainability.
- The design of hydraulic systems will provide for smooth movement of hydraulic activators (pumps, motors, cylinders), free from sudden stop and start effects and be capable of either continuous or stop/start operation.
- The Hydraulic Systems would be designed to control operating viscosity in plant operating condition. The equipment will be designed and supplied to provide continuous, long-term service under the ambient and environmental conditions that will prevail on site.
- All equipment and design will conform to the standards of NFPA (National Fluid Power Association) or equivalent or better.

#### Tanks at atmospheric pressure:

- This section refers to the requirements for above ground liquid storage tanks vented to atmosphere where the working conditions do not exceed the static pressure due to the liquid stored.
- Tanks will be in accordance with the relevant specifications taken from the national/international standards as per API 620/650 or equivalent code. Tanks will be designed to withstand all loads imposed on them during construction, operating and maintenance.

#### Pressure Vessels:

- Pressure vessels will be in accordance with the relevant specification from international standards ASME Boiler and Pressure Vessel Code Section VIII, Div-I.
- The design conditions will allow for the most severe combination of internal and external loads and forces to which the vessel may be subjected.
- All vessels will incorporate suitable lifting lugs.

#### 10.1.4.5 Maintenance and Inspection

- Man ways and circular openings for inspection or access will meet the minimum requirements of the applicable codes and standards.
- Permanently installed davits will be used for man way and vessel covers weighing more than 40 kg, where frequent access is required. Hinges may be fitted where davits are not practical if approved by the Supplier.
- Lifting lugs and similar fittings will be designed and installed in accordance with applicable codes and standards. Lift lugs will be painted Yellow or identified by other means.

#### Vibration Control:

- Dynamic and vibration loadings from machinery will be isolated from the supporting structure.
- Minimum balance quality for rotating equipment will be according to ISO 7919 standard — Mechanical vibration of non-reciprocating machines.
- Vibration levels of electric motors will be in accordance with project specification for Electric Motors, but in no event will it exceeds the limits prescribed above for mechanical equipment.
- None of the vibration components, including those for unbalance, misalignment or any mechanical or electrical problem will exceed 50% of the overall vibration amplitude.
- In general, the vibration amplitude in the axial direction will not exceed 50% of any vibration in the radial direction.
- Where structural steel is part of the equipment supply, the natural frequencies of the structure will avoid the equipment operating frequency by at least 30%.

#### Lubrication:

- All mechanical operating parts, unless noted, will be provided with means of lubrication suited to the operating conditions.

- All equipment will be supplied with a detailed drawing showing a lubrication flow diagram, piping arrangement, lubricant manufacturer, type quantity and frequency of lubrication.
- Manual or automatic lubrication systems will be evaluated on the basis of the type of lubrication, frequency of lubrication and quantity of lubricant required.
- Lubrication systems will be automatic, wherever practicable and will be designed to permit lubrication with equipment running. If manual system is used, the application points will be grouped for convenience.
- All grease fittings will be readily accessible for greasing without removing guards. For equipment requiring multiple lubrication points, the lubrication fittings will be piped to one side where service platform or walkway access is available.
- Lubrication of gears and bearings will be by means of an internal splash system unless otherwise specified. Sight glasses will be provided.
- Oil bath system that require large amounts of oil for recharging would be installed with piping and barrel pumps to transfer the oil to the equipment from an easily accessed platform.
- Lubrication automatic systems would be equipped with control panels at the facility centralized locations. The automatic dispensing station will be enclosed if necessary and located so as to be accessible to trucks for re-charging.
- The vendor will provide a detailed list of lubricants used showing brand, type and location used.
- All grease fittings will be standard button head type.
- Grease lubrication is preferred on low speed equipment where the risk foreign matter ingress is high and there will be long periods between required attentions.
- Grease lubrication equipment operating temperature must be below 90°C.
- All grease nipple bulkheads will include a hinged dust cover to protect the nipples.
- Unless otherwise specified, all equipment to be lubricated will be thoroughly flushed with approved flushing oil, in accordance to the manufacturer's recommendations.
- Rotating equipment will be rotated during flushing to ensure complete penetration of the oil. All lubrication lines will be cleaned by blowing through with compressed air and then flushing with oil or grease before final connection of the lubricating circuit. Flushing oil may be re-used, provided it is filtered and cleared by some means approved by the owner.
- Before any test running is carried out, any points on installed equipment, which require greasing, will be inspected and greased. The grease used will be in accordance with the manufacture's recommendation.

Welding Process:

- All welding will be adequate for the specified design and mechanical requirements and will comply with the requirements of CSA and AWS standards.
- All welding will be performed by qualified welders and will be supervised by a fully qualified welding supervisor.
- Welding will be executed in accordance with approved welding procedures and will be full penetration, full strength and free from undercut and slag inclusions. Crater effects at the ends of weld runs will be eliminated.
- Welding will generally be continuous and butt welds will be full penetration unless specified otherwise in the drawings or specification.
- All critical items and items exceeding 38 mm in thickness fabricated by welding will be post-weld stress relieved by heat treatment (PWHT) on completion of welding and before final machining.
- Welding will be subject to inspection in accordance with the quality plan. For principal welds, radiographic records will be submitted. Additional examination may be required in the event that visual inspection reveals faulty welding.

#### Shop Tests:

- The Quality Assurance plan to be implemented by the Contractor will furnish details of the extent of shop and testing procedures followed to guarantee soundness of materials and verification of critical dimensions and motions prior to shipment.
- All welds will be complete, have weld craters filled, weld spatter and other debris removed and be suitably prepared for examination or surface treatment. All non-destructive test records will be traceable to the welds that have been tested.
- The Contractor will perform radiographic examination on pressure boundary components and fittings.
- The equipment's will be fully assembled in the fabrication shop and mechanically tested prior to shipment. The tests may be witnessed by an agency of the Owner's nomination.
- The equipment will be completely assembled and shop tested prior to shipment to ensure correct operation of all components.
- Testing procedures will be approved prior to commencement of testing.
- Any faults or incorrect operation occurring during testing will be remedied to the satisfaction of the Owner before proceeding further.
- After testing, the equipment will be thoroughly inspected for any excessive wear or defective parts. Any parts found to be defective will be replaced, not repaired. Any out of balance parts of the equipment will be rectified. The equipment will then be re-run and re-tested.



- Noise levels will be tested in the works, if practical, and if type tests reports are unavailable. Type tests reports will be accepted only if tests were carried out on equipment identical to that being supplied and under operating conditions similar to the intended use. Equipment exceeding the maximum allowable noise will be rejected.
- All non-destructive examinations and tests, including hydrostatic tests, will be done in accordance with relevant standards.
- Vessels will be dried and cleaned to the satisfaction of the Owner, following the satisfactory testing of each vessel.

#### Pre-Assembly of Equipment:

- The Contractor will maximize the level of offsite assembly and testing for all supplied equipment.
- All self-contained, pre-assembled equipment will be completely wired and pre-piped, with wiring and piping brought to conveniently located and clearly identified terminals & appropriate junction boxes for connection to external wiring and piping by others.
- Where a package must be divided into two or more sub-assemblies for shipping or installation purposes, wiring, conduit and piping will be provided cut, fabricated and pre-formed as required for interconnection of the sub-assemblies which make up the equipment package.
- Piping systems will thoroughly be flushed after assembly. Systems will be drained prior to shipment and open ports capped or plugged.



#### Painting:

- All carbon steel or cast steel exterior surfaces will be prepared primed and painted as per manufacturer's standard.
- The following will not be coated:
  - Underside of steel column base plates supported on concrete foundations;
  - Steel surfaces embedded in or bonded to concrete;
  - Stud welded shear connectors;
  - Traffic surface of crane rails;
  - Stainless steel and other corrosion-resistant materials;
  - FRP tanks and pipes;
  - Insulated components (primer only);
  - Machined surfaces;
  - Insides of bins and chutes (unless primer only is specified).



REV.	DESCRIPTION	DATE	PROJ.	EXEC.	CHECK.	APPR.
1	ISSUED	4/4/18	SAG	SAG	MES	MES
0	FOR INFORMATION	08/24/2016	SAG	SAG	MES	MES
A	PRELIMINARY	05/20/16	RUC	RUC	RUC	TEI

	<p><b>PURE FONTE LT E</b>  <b>PIG IRON PRODUCTION PLANT FEASIBILITY STUDY</b>  <b>CUSTOMER N 1 21</b></p>
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	<p>TENOVA          TECHINT ENGINEERING &amp; CONSTRUCTION</p>
	<p>SECTION 10 – PLANT EQUIPMENT  <b>CHAPTER 10 2</b>  <b>EQUIPMENT LIST</b></p>

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	ESC.: N/A	JOB: CD-335	

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# FIGURES AND REFERENCES

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## 10.2 Equipment List

This chapter presents different equipment lists:

1. Main equipment list: describing item by item the mechanical and mechanical related equipment.
2. Electrical equipment list
3. Instrumentation equipment list

Given the nature of this study, a Class 2 feasibility as per AACE standards, some mechanical, electrical and instrumentation equipment may not be detailed in the above mentioned lists, but still taken into consideration as part of the capex evaluation, within the accuracy level foreseen for this FS.

## 10.2.1 Main Equipment List

The equipment list for this Feasibility Study has been divided following areas:

1. Iron ore pellets receiving area
2. Iron ore pellets storage area
3. Material handling
4. Fines and sludge briquetting plant
5. Dri area
6. Eaf area and ancillaries
7. Continuous pig casting
8. Auxiliary services and utilities

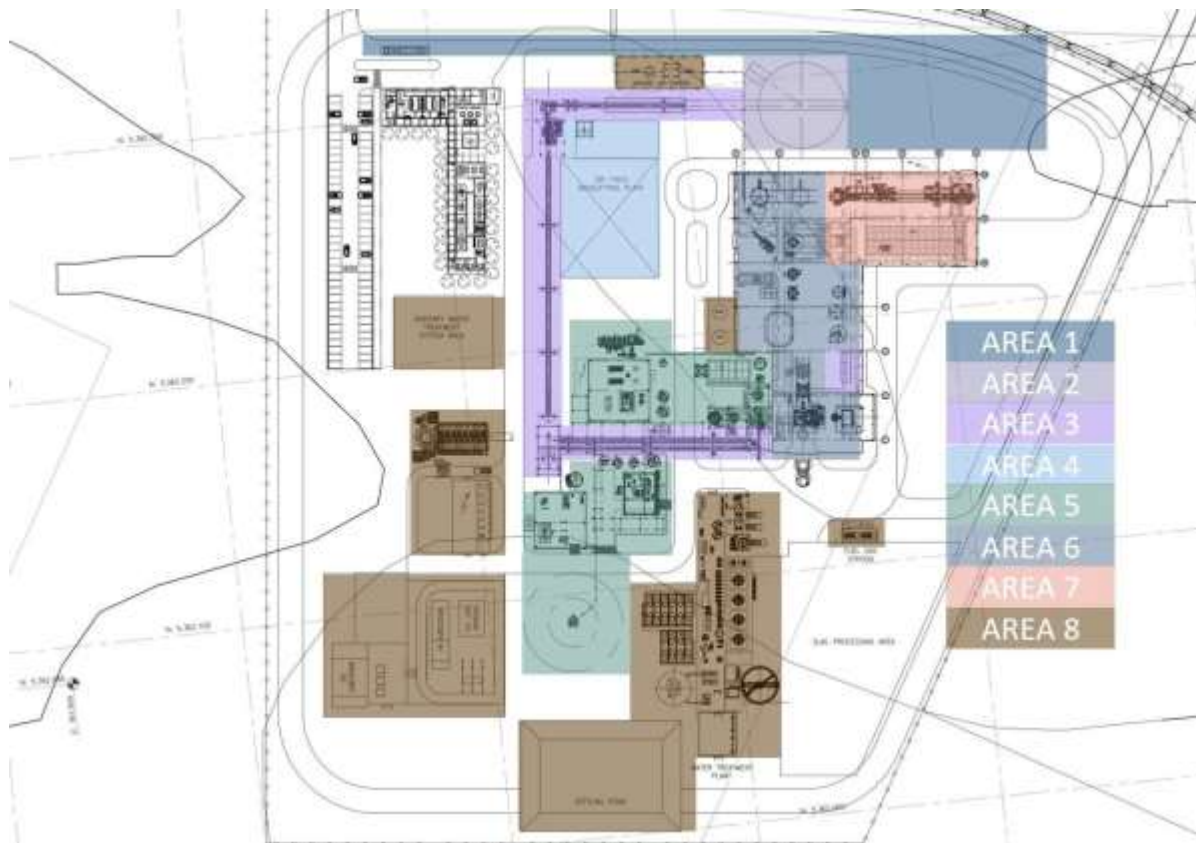


Figure 10.2-1.: Area division of the plant



# CD-335 Equipment List



AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit		
													Rev.	Fluid	[KW]
<b>0</b>	<b>GENERAL OF THE PLANT</b>														
0	0.1	00		TK-000-01	Main water tank			1300	m3			50000		10000	14000
0	0.2	00		PM-000-01	Water distribution pump	1		100	m3/h		5.5				
0	0.3	00		PM-000-02	Water distribution pump	1 stdby		100	m3/h		5.5				
0	04				<b>Air compressor and dryers</b>										
0	<b>0.4.1</b>	<b>25</b>		<b>DR-025-01</b>	<b>Dryer</b>	<b>1</b>									
0	0.4.1.1	25			EAP HR-1500 Heated Desiccant Dryer (480V/3)	1					15	2884			
0	0.4.1.2	25			3 Valve Bypass	1									
0	<b>0.4.2</b>	<b>25</b>		<b>AC-025-01</b>	<b>Air compressor</b>	<b>1</b>									
0	0.4.2.1	25			ELGI Model E110-100 GS Air Cooled Rotary Screw Compressor	1		1272	m3/h	compressed air	110	3600	3400	1972	1620
0	0.4.2.2	25			Air Receiver Vertical tank	1		10	m3						
0	<b>0.4.3</b>	<b>25</b>		<b>DR-025-02</b>	<b>Dryer</b>	<b>1</b>									
0	0.4.3.1	25			EAP HR-1500 Heated Desiccant Dryer (480V/3)	1					15	2884			
0	0.4.3.2	25			3 Valve Bypass	1									
0	<b>0.4.4</b>	<b>25</b>		<b>AC-025-02</b>	<b>Air compressor</b>	<b>1</b>									
0	0.4.4.1	25			ELGI Model E110-100 GS Air Cooled Rotary Screw Compressor	1		1272	m3/h	compressed air	110	3600	3400	1972	1620
0	0.4.4.2	25			Air Receiver Vertical tank	1		10	m3						
0	<b>0.5</b>	<b>25</b>		<b>UT-025-01</b>	<b>Service Air KO Drum</b>							<b>2300</b>		<b>4398</b>	<b>1067</b>
											<b>151</b>	<b>65</b>			



# CD-335 Equipment List



AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit		
													Rev.	Fluid	[KW]
<b>1 IRON ORE PELLETS RECEIVING AREA</b>															
1	1.1	10	HO-1/2	HO-115-01	Discharge Payloader Hopper, in Steel with support and bolted wear protection 12 mm. thickness	2		500	mtph	Iron Ore Pellet		20900	3500	2500	3500
1	1.1.1	10		VF-115-01	Vibrating Feeder electromechanical VM/1-2	2		500	mtph		6.4				
1	1.1.2	10		CV-105-01	technological structures, columns	1									
1	1.2	10	EL2	CV-360-02	Vertical belt conveyor B=1000 mm. l=14 ml. H=100ml., slope 90° Without handrails, walway, support structures	1		500	mtph	Iron Ore Pellet	250	52000	22000	49000	1400
1	1.2.1	10		M-CV-360-02	Drive Motor	1									
1	1.2.2	10		R-CV-360-02	Speed Reducer	1									
1	1.2.3	10			technological structures, columns, handrail, platform, covers	1						76000			
					Truck Scale	1									
1	1.3				Thurman Extreme Duty DB 8560 Truck Scale, Electronic Low Profile, Steel Deck	1		122	t	trucks			21300		3350
1	1.3.1				THURMAN MODEL IS 3000 DIGITAL READOUT	1									
1	1.3.2				FACTORY INSTALLED FULL LENGTH DOUBLE HIGH RUB RAILS	1									
1	1.3.3				AUTO RAISE/LOWER (WITH THERMAL HEATER) BARRIER GATE										
1										Totals	256.4	148.9			





# CD-335 Equipment List



AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit		
													Rev.	Fluid	[KW]
<b>2 IRON ORE PELLETS STORAGE AREA</b>															
2	2.1	10		DM-210-01	Dome	1		46000	Ton	Iron Ore Pellets		125000		30000	35000
2	2.1.1	10		HO-210-01	Hopper	1									
2	2.1.2	10		GV-210-01	Gate valve	1		150	t/h						
2	2.1.3	10		HO-210-02	Hopper	1									
2	2.1.4	10		GV-210-02	Gate valve	1		150	t/h						
2	2.1.5	10		HO-210-03	Hopper	1									
2	2.1.6	10		GV-210-03	Gate valve	1		150	t/h						
2	2.1.7	10		HO-210-04	Hopper	1									
2	2.1.8	10		GV-210-04	Gate valve	1		150	t/h						
2	2.1.9	10		HO-210-05	Hopper	1									
2	2.1.10	10		GV-210-05	Gate valve	1		150	t/h						
2	2.1.11	10		HO-210-06	Hopper	1									
2	2.1.12	10		GV-210-06	Gate valve	1		150	t/h						
										Totals		125			



# CD-335 Equipment List



AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit		
													Rev.	Fluid	[KW]
<b>3 MATERIAL HANDLING</b>															
3					MHS Iron Ore Pellets										
3	3.2	20	BC1	CV-320-01	BC/1 Inclined belt conveyor	1		150	mtph	Iron Ore Pellet	30	38000	170000	11500	800
3	3.2.1	20		M-CV-320-01	Drive Motor	1									
3	3.2.2	20		R-CV-320-01	Speed Reducer	1									
3	3.2.3	20			BC/1 structures, columes, handrail, walkway, belt conveyor support frame	1						37800			
3	3.3	20	VD1	DV-320-01	VD/1 -Diverter with support and bolted wear protection 12 mm. thickness and discharging chutes	1		150	mtph	Iron Ore Pellet		610	1100	2000	
3	3.4	15	VA1	VS-315-01	VA/1-2 Vibrating screen, double net selection, useful net 1250x3500, complete, final net passage 6,0 mm. (max. 3/4%)	1		150	mtph	Iron Ore Pellet	5	1700	1250	3500	
3	3.5	15	VA2	VS-315-02	VA/1-2 Vibrating screen, double net selection, useful net 1250x3500, complete, final net passage 6,0 mm. (max. 3/4%)	1		150	mtph	Iron Ore Pellet	5	1700	1250	3500	
3	3.6	26		CV-326-01	TC/1 Horizontal/vertical chain conveyor, tot. Height 18 ml., horizontal axis 15 ml., sigle chain, with charging and discharging chutes	1		30	mtph	Iron Ore Pellet	7.5	6000		18000	15
3	3.7	30	S1	SL-327-01	S/1 Bin, capacity 210 m3, without support structures, stairs and technological structures,only the bin body	1		210	m3	Iron Ore fines		19000			
3	3.7.1	15	S1	VB-315-01	Vibrating bottom, 2500 mm. diameter, runned by electromechanical vibrator, dischrage mouth DN400	1		100	m3/h		2	400			2500
3	3.7.2	15	S1	SV-310-01	Manual slide valve	1		100	m3/h			35			
3	3.7.3	15	S1	FV-310-01	Pneumatic fly valve	1		100	m3/h			45			
3	3.7.4	15	S1	UB-310-01	telescopic Discharger	1		100	m3/h			150			



# CD-335 Equipment List

AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit			
													Rev.	Fluid	[KW]	[kg]
3	3.7.5	15	S1		Radar type continuos level	1						1				
3	3.7.6	15	S1		Maximum vibration type level (800 mm. rope)	1						1				
3	3.7.7	15	S1		Minimum vibration type level (7000 mm. rope)	1						1.5				
3	3.7.8	15	S1		Technological structures, stairs, handrails, service platform, support, lateral side panels, covering panels ect., complete	1						145000				
3	3.8	30	BC2	CV-330-01	BC/2 Inclined belt conveyor B=800 mm. l=18 ml. H=11, 3°	1		150	mtph	Iron Ore Pellet	7.5	6100	18000		800	
3	3.8.1	30		M-CV-330-01	Drive motor	1										
3	3.8.2	30		R-CV-330-01	Speed Reducer	1										
3	3.8.3	30		CH-330-01	Feed chute	1										
3	3.9	30	S2	SL-330-01	Coating Station Bin, capacity 40 m3, only the bin body, with charging equipment, pipe ect	1		40	m3	Portland Cement		8500				
3	3.9.1	30	S2	BL-330-01	Pneumatic transport blower	1										
3	3.9.2	30	S2	FI-330-01	Dedusting filter, 54 m2	1		54	m2		7.5	950				
3	3.9.3	30	S2	RV-330-01	Pneumatic fly valve, DN250, con EV and position switches	1						40				
3	3.9.4	30	S2		Manual slide valve DN250	1						30				
3	3.9.5	30	S2	VB-330-01	Vibrating bottom, 1800 mm. diameter, runned by electromechanical vibrator,	1		30	m3/h		1.1	320			1800	
3	3.9.6	30	S2	LC-330-01	Complete weighing system, capacity 50.000 kg total	1						250				
3	3.9.7	30	S2		Maximum vibration type level (800 mm. rope)	1						1				
3	3.9.8	30	S2		Minimum vibration type level (7000 mm. rope)	1						1.5				
3	3.9.9	30	S2		Technological tower structures, stairs, handrails, service platform, support, lateral side panels, covering panels ect., complete	1						122500				

# CD-335 Equipment List

AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit		
													Rev.	Fluid	[KW]
3	3.10	30	VD2	DV-330-01	Manual diverter with support and bolted wear protection 12 mm. thickness and discharging chutes	1				Portland Cement		550	1100	2000	
3	3.11	30	BCW1	WC-330-01	Weighing belt conveyor, complete, B=400, l=1.200 mm., accuracy: 1% on the max capacity allowable (3,0 ton/h), runned by inverter, range from 10% to 100%	1		3	tph	Portland Cement	0.55	500	1200		400
3	3.11	30	BCW2	WC-330-02	Weighing belt conveyor, complete, B=400, l=1.200 mm., accuracy: 1% on the max capacity allowable (3,0 ton/h), runned by inverter, range from 10% to 100%	1		3	tph	Portland Cement	0.55	500	1200		400
3	3.12	30	VD3	DV-330-02	Diverter with support and bolted wear protection 12 mm. thickness and discharging chutes	1		75	tph	Portland Cement	0.25	610	1100	2000	
3	3.12.1	30	VD3	CH-330-03	Chute ( to vibratory feeders)	1									
3	3.12.2	30	VD3	CH-330-05	Chute (to mixers)	1									
3	3.13	30	VD4	DV-330-03	Diverter with support and bolted wear protection 12 mm. thickness and discharging chutes	1		75	tph	Iron Ore Pellet	0.25	610	1100	2000	
3	3.13.1	30	VD4	CH-330-04	Chute ( to vibratory feeders)	1									
3	3.13.2	30	VD4	CH-330-06	Chute (to mixers)	1									
3	3.14	30	VE1	VF-330-01	Electromagnetic vibrating feeder complete with nr. 01 electric control panel, with support frame and discharging chute, 600V	1		0,3>3	t/h		4A-2P+T	150	1200		400
3	3.15	30	VE2	VF-330-02	Electromagnetic vibrating feeder complete with nr. 01 electric control panel, with support frame and discharging chute, 600V	1		0,3>3	t/h		4A-2P+T	150	1200		400
3	3.16	30	ME1	MX-330-01	Mixing tank complete, capacity 1.000 lt., with nr. 01 local electric control panel, with support frame, pump and pipes	1		1000	litres			1000			
3	3.16.1	30	ME1	AG-330-01	Agitators from mixers	1					1.5				

# CD-335 Equipment List

AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit			
													Rev.	Fluid	[KW]	[kg]
3	3.16.2	30	ME1	GV-330-01	Gate valve	1										
3	3.17	30	ME2	MX-330-02	Mixing tank complete, capacity 1.000 lt., with nr. 01 local electric control panel, with support frame, pump and pipes	1		1000	litres			1000				
3	3.17.1	30	ME2	AG-330-02	Agitators from mixers	1					1.5					
3	3.17.2	30	ME2	GV-330-02	Gate valve	1										
3	3.18	30			Miscellaneous Set of pipes, valves, connections, pumps, instruments, spray for the Coating Station	1						1000				
3	3.19	35	BC3	CV-335-01	Inclined belt conveyor B=800 mm. l=102 ml. H=22ml., slope 13°	1		150	mtph	Iron Ore Pellet	22	31000	102000	22000	800	
3	3.19.1	35	BC3	M-CV-335-01	Drive Motor	1										
3	3.19.2	35	BC3	R-CV-335-01	Speed Reducer	1										
3	3.19.3	35	BC3	CH-335-01	Feed Chute	1										
3	3.19.4	35	BC3	CH-335-02	Discharge Chute	1										
3	3.19.5	35	BC3		technological structures, colums, handrail, walkway, belt conveyor support frame	1						60000				
3	3.19.6	35	BC3	P-CV-335-01	Primary Cleaner	1										
3	3.19.7	35	BC3	S-CV-335-01	Secondary Cleaner	1										
3	3.19.8	35	BC3	S-CV-335-02	Secondary Cleaner	1										
3	3.20	25	RBC/1	CV-325-01	Reversible horizontal belt conveyor, complete, B=800, l=9.300 mm., rollers 108 mm. diameter	1		150	mtph	Iron Ore Pellet	7.5	2100	9300		800	
3	3.20.1	25		M-CV-325-01	Drive motor	1										
3	3.20.2	25		R-CV-325-01	Speed Reducer	1										
3	3.21	25	VD5	DV-330-04	Diverter with support and bolted wear protection 12 mm. thickness and discharging chutes	1		150	mtph	Iron Ore Pellet		610	1100	2000		



# CD-335 Equipment List

AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit		
													Rev.	Fluid	[KW]
3	3.22	55	S3	SB-355-01	Day Bin, capacity 410 m3, only the bin body	1		410	m3	Iron Ore Pellet		81000			
3	3.22.1	55	S3		Radar type continuos level	1						1			
3	3.22.2.	55	S3		Maximum vibration type level (800 mm. rope)	1						1			
3	3.22.3	55	S3		Minimum vibration type level (10.000 mm. rope)	1						1.5			
3	3.22.4	55	VB1	NG-355-01	Nedle bar gate No bars VB/1-2-3	1						55	700	1000	
3	3.22.5	55	VB1	NG-355-02	Nedle bar gate 1 set bars	1						180	700	1000	
3	3.23	55	S4	SB-355-02	Day Bin, capacity 200 m3, only the bin body	1		200	m3	Iron Ore Pellet		40500			
3	3.23.1	55	S3		Radar type continuos level	1						1			
3	3.23.2.	55	S3		Maximum vibration type level (800 mm. rope)	1						1			
3	3.23.3	55	S3		Minimum vibration type level (10.000 mm. rope)	1						1.5			
3	3.23.4	55	VB2	NG-355-03	Nedle bar gate No bars VB/1-2-3	1						55	700	1000	
3	3.23.5	55	VB2	NG-355-04	Nedle bar gate 1 set bars	1						180	700	1000	
3	3.24	55	S5	SB-355-03	Day Bin, capacity 200 m3, only the bin body	1		200	m3	Iron Ore Pellet		40500			
3	3.24.1	55	S3		Radar type continuos level	1						1			
3	3.24.2.	55	S3		Maximum vibration type level (800 mm. rope)	1						1			
3	3.24.3	55	S3		Minimum vibration type level (10.000 mm. rope)	1						1.5			
3	3.24.4	55	VB3	NG-355-05	Nedle bar gate No bars VB/1-2-3	1						55	700	1000	
3	3.24.5	55	VB3	NG-355-06	Nedle bar gate 1 set bars	1						180	700	1000	
3	3.25	45	S3/4/5		Technological structures, stairs, handrails, service platform, support, lateral side panels, covering panels ect., complete	1						190000			



# CD-335 Equipment List

AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit		
													Rev.	Fluid	[KW]
3	3.26	45	BCW3	WC-345-01	Weighing belt conveyor, complete, B=1,000, l=5,000 mm., accuracy: 1% on the max capacity allowable (150 ton/h), runned by inverter, range from 30% to 100%	1		150	t/h	Iron Ore Pellet	7.5	3500	5000		1000
3	3.27	45	BCW4	WC-345-02	Weighing belt conveyor, complete, B=1,000, l=5,000 mm., accuracy: 1% on the max capacity allowable (150 ton/h), runned by inverter, range from 30% to 100%	1		150	t/h	Iron Ore Pellet	7.5	3500	5000		1000
3	3.28	45	BCW5	WC-345-03	Weighing belt conveyor, complete, B=1,000, l=5,000 mm., accuracy: 1% on the max capacity allowable (150 ton/h), runned by inverter, range from 30% to 100%	1		150	t/h	Iron Ore Pellet	7.5	3500	5000		1000
3	3.29	50	BC4	CV-350-01	Inclined belt conveyor B=800 mm. l=69 ml. H=12ml., slope 10°	1		150	mtph	Iron Ore Pellet	22	22605	69000	12000	800
3	3.29.1	50		M-CV-350-01	Drive Motor	1									
3	3.29.2	50		R-CV-350-01	Speed Reducer	1									
3	3.29.3	50		CH-350-01	Feed Chute	1									
3	3.29.4	50		CH-350-02	Discharge Chute	1									
3	3.29.5	50			technological structures, colums, handrail, walkway, belt conveyor support frame	1						31400			
3	3.30	65	BC5	CV-365-01	Inclined belt conveyor for Remet B=800 mm. l=70 ml. H=12ml., slope 9°	1		150	mtph	Iron Ore Pellet	22	23000	70000	12000	800
3	3.30.1	65		M-CV-365-01	Drive Motor	1									
3	3.30.2	65		R-CV-365-01	Speed Reducer	1									
3	3.30.3	65		CH-365-03	Feed Chute	1									
3	3.30.4	65		CH-365-01	Discharge Chute	1									
3	3.30.5	65			technological structures, colums, handrail, walkway, belt conveyor support frame	1						35000			



# CD-335 Equipment List

AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit		
													Rev.	Fluid	[KW]
3	3.31	60	EL1	CV-360-01	Vertical belt conveyor B=1000 mm. l=14 ml. H=100ml., slope 90° Without handrails, walway, support structures	1		150	mtph	Iron Ore Pellet	75	52000	14000	100000	1000
3	3.31.1	60		M-CV-360-01	Drive Motor	1									
3	3.31.2	60		R-CV-360-01	Speed Reducer	1									
3	3.31.3	60			technological structures up to + 15 ml. level, columns, handrail, platform	1						76000			
3					MHS EAF Fluxes										
3	3.35	71	S6	SL-371-01	Lime Bin, capacity 120 m3, only the bin body H=17m from ground, 4m side, square section	1		120	m3	lime		11800	4000	17000	4000
3	3.35.1		S6	FL-371-01	Dedusting filter, 54 m2	1		52	m2		7.5	950			
3	3.35.2		S6		Radar type continuos level	1						1			
3	3.35.3		S6		Maximum vibration type level (800 mm. rope)	1						1			
3	3.35.4		S6		Minimum vibration type level (13.000 mm. rope)	1						1.5			
3	3.35.5		VM	VB-371-01	Vibrating bottom, run by electromechanical vibrator, dischrage mouth DN400	1		100	m3/h		1	400			
3	3.35.6			HO-371-01	Big-Bag discharging hopper, complete with DN300 pneumatic valves and limit switches	1						300			
3	3.35.7			VA-371-01	Manual slide valve DN400	1		100	m3/h			35			
3	3.35.8			VA-371-02	Pneumatic blade valve, DN400, con EV and position switches	1		100	m3/h			45			
3	3.36	71	S7	SL-371-02	Dolomitic Lime Bin, capacity 120 m3, only the bin body, H=17m from ground, 4m side, square section	1		120	m3	lime		11800	4000	17000	4000
3	3.36.1		S7	FL-371-02	Dedusting filter, 54 m2	1		52	m2		7.5	950			
3	3.36.2		S7		Radar type continuos level	1						1			
3	3.36.3		S7		Maximum vibration type level (800 mm. rope)	1						1			
3	3.36.4		S7		Minimum vibration type level (13.000 mm. rope)	1						1.5			
3	3.36.5		VM	VB-371-02	Vibrating bottom, run by electromechanical vibrator, dischrage mouth DN400	1		100	m3/h		1	400			





# CD-335 Equipment List



AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit		
													Rev.	Fluid	[KW]
3	3.36.6			HO-371-02	Big-Bag discharging hopper, complete with DN300 pneumatic valves and limit switches	1						300			
3	3.36.7			VA-371-03	Manual slide valve DN400	1		100	m3/h			35			
3	3.36.8			VA-371-04	Pneumatic blade valve, DN400, con EV and position switches	1		100	m3/h			45			
3	3.37	71	S8	SL-371-03	<b>Bauxite Bin, capacity 120 m3, only the bin body, H=17m from ground, 4m side, square section</b>	1		120	m3	lime		11800	4000	17000	4000
3	3.37.1		S8	FL-371-03	Dedusting filter, 54 m2	1		52	m2		7.5	950			
3	3.37.2		S8		Radar type continuous level	1						1			
3	3.37.3		S8		Maximum vibration type level (800 mm. rope)	1						1			
3	3.37.4		S8		Minimum vibration type level (13.000 mm. rope)	1						1.5			
3	3.37.5		VM	VB-371-03	Vibrating bottom, run by electromechanical vibrator, discharge mouth DN400	1		100	m3/h		1	400			
3	3.37.6			HO-371-03	Big-Bag discharging hopper, complete with DN300 pneumatic valves and limit switches	1						300			
3	3.37.7			VA-371-05	Manual slide valve DN400	1		100	m3/h			35			
3	3.37.8			VA-371-06	Pneumatic blade valve, DN400, con EV and position switches	1		100	m3/h			45			
3	3.38				<b>Technological structures for the lime silos, handrails, service platform + 2,3 ml., support, complete</b>	1						26000			
3	3.39		BCW6	WC-371-01	Weighing belt conveyor, complete, B=800, l=5000 mm., accuracy: 1% on the max capacity allowable (80 ton/h), runned by inverter, range from 30% to 100%	1		80	mtph	lime	4.5	3000	5000		800
3	3.40		BCW7	WC-371-02	Weighing belt conveyor, complete, B=800, l=5000 mm., accuracy: 1% on the max capacity allowable (80 ton/h), runned by inverter, range from 30% to 100%	1		80	mtph	dololime	4.5	3000	5000		800

# CD-335 Equipment List

AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit		
													Rev.	Fluid	[KW]
3	3.41		BCW8	WC-371-03	Weighing belt conveyor, complete, B=800, l=5000 mm., accuracy: 1% on the max capacity allowable (80 ton/h), runned by inverter, range from 30% to 100%	1		80	mtph	bauxite	4.5	3000	5000		800
3	3.42		EL2	CV-372-01	Vertical belt conveyor B=800 mm. l=14 ml. H=37ml., horizontal axial 17 ml., slope 90°	1		80	mtph	lime, dololime, bauxite	18.5	25000	14000	37000	800
3	3.42.1			M-CV-372-01	Drive Motor	1									
3	3.42.2			R-CV-372-01	Speed Reducer	1									
3	3.42.3				technological structures from + 0,0 + + 37,0 ml. level, columns, handrail, platform, stair included, EL2 head and vertical part included	1						40000			
3	3.43		BC7	CV-373-01	horizontal belt conveyor B=650 mm. l=30 ml.	1		80	mtph	lime, dololime, bauxite			8500		650
3	3.43.1			M-CV-373-01	Drive Motor	1									
3	3.43.2			R-CV-373-01	Speed Reducer	1									
3	3.43.3				technological structures, closed bridge with handrail, walkway (nr. 02 B=800 mm.), belt conveyor support frame	1						30000			
3	3.44			CH-373-01	fixed discharging chute with support and bolted wear protection 12 mm. thickness and discharging chutes	1		80	mtph	lime, dololime, bauxite		1500	5000		400
										Totals	299	1233			

# CD-335 Equipment List

AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit		
													Rev.	Fluid	[KW]
<b>4 FINES AND SLUDGE BRIQUETTING PLANT (TBD)</b>															
4	4.1		RH127-F		Hopper for slurry (water sludge). Volume of 8 m <sup>3</sup> . Made in mild steel Th 6 mm with two levels supporting structure with intermediate floor and ladders	1		8	m <sup>3</sup>	sludge		11400	3000	2500	3000
4	4.2		RH114-V		Weighing belt conveyor RH114-V, B=650 mm, with discharge chute and supporting structure	1		3	tph	sludge		1300	2000		650
4	4.3		RH101-V		Inclined belt conveyor RH101-V B= 400 mm; L= 8500 mm, angle of inclination 15°, without walkway, handrails, support structures.	1		3	tph	sludge		850	8500		400
4	4.4		UT147-G		Bag house with fan, supporting structure for filter and dedusting lines as sketch on dwg 16/0203_1502-A	1		2400	m <sup>3</sup> /h	air		4050			
4	4.5		RH139-B		Slurry rotary dryer model BRD-500	1		500	kg/h	vapor	26	17000	8600	3600	3700
4	4.6		RH139-B		Supporting structure of slurry dryer with intermediate floors, with ladders and handrails	1						incl	8600	3600	3700
4	4.7		UT146-C		Flue gas cooler	1				vapor		incl			
4	4.8		UT146-J		Flue gas fan	1				vapor					
4	4.9		UT145-G		Bag house	1				vapor					
4	4.10		UT145-J		Stack	1				vapor					
4	4.11		RH115-L		Crusher	1		2.538	tph	dry sludge		220	640	320	800
4	4.12		RH116-L		Rotary valve	1		2.538	tph	dry sludge		250			
4	4.13		RH 122-G		Vibrating screen. Dimensions: 900x2550x2000. Double possibility of discharge: oversize to exit, material screened unloaded on elevator chain	1		2.538	tph	dry sludge		880	900	2000	2550

# CD-335 Equipment List

AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit		
													Rev.	Fluid	[KW]
4	4.14		CC100-A		Elevator chain conveyor. Size 240x400 Interaxe: 8m. Elevation gain: 12 m. Chain typology: 10160 with discharge chute.	1		2.538	tph	dry sludge		3000	8000	12000	400
4	4.15		UT148-G		Bag house with fan and dedusting lines as sketch on dwg 16/0203_1502-A	1		3500	m³/h	air		820			
4	4.16		RH123-F RH124-F1/F2, RH125-F		Bins battery (40 m³ for Dri Sludge, I.O. Fines and EAF dust, 20 m³ for Solid Binder) with its supporting structure with ladders, handrails and walkway on bins roof. Bins of I.O Fines, EAF dust and Solid binder charged by pneumatic transport, Dri Sludge by chain conveyor	1		140	m³	dry DRI sludge IO fines, EAF dust, binder		46000	14000	11000	4000
4	4.17		RH123-F/125-F		Accessories for bins battery: maximum level switches, continuous levels, filters, pressure transmitters, control pressure valves	1						1600			
4	4.18				Ensilage line (truck discharge line) DN100 for bins RH124-F1, RH124-F2 and RH125-F	1						1645			
4	4.19		RH103-V		Weighing belt conveyor RH103-V, B= 650 mm, with discharge chute and supporting structure	1		2.538	tph	dry DRI sludge		1300	2000		650
4	4.20		RH104-V1		Weighing belt conveyor RH104-V1, B= 650 mm, with discharge chute and supporting structure	1		10.05	tph	IO fines		1300	2000		650
4	4.21		RH104-V2		Weighing belt conveyor RH104-V2, B= 650mm, with discharge chute and supporting structure	1		2,436	tph	EAF dust		1300	2000		650
4	4.22		RH137-J		Weighing screw feeder, with supporting structure and weighing system	1		0.75	tph	solid binder		380	2600		
4	4.23		RH105-V		Belt conveyor RH105-V, B=400 mm, with discharge chute and supporting structure, without walkways	1		15,774 t/h	tph	fines		1100	11500		400
4	4.24		RH106-V		Bucket belt elevator RH106-V	1		15,774 t/h	tph	fines		4150		17000	
4	4.25		RH112-J		Screw feeder	1		15,774 t/h	tph	fines		500			
4	4.26		UT149-G		Bag house with fan and dedusting lines as sketch on dwg 16/0203_1502-A	1		7000	m³/h	air		1030			

# CD-335 Equipment List

AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit		
													Rev.	Fluid	[KW]
4	4.27		RH131-L		Double shaft screw mixer model ZJ65/32 (40 rpm)	1		15.774	tph	finer	18.5	3200	2700		
4	4.28		RH132-F		Buffer bin. Volume of 5 m <sup>3</sup> . Made in mild steel Th. 6 mm. Weighing hopper	1		5	m <sup>3</sup>	mixed fines		2600			
4	4.29		RH133-J		Screw feeder RH133-J	1		19.815	tph	mixed fines		530			
4	4.30		RH134-L		Briquetting Machine Komarek Model B-400-B 460 mm roll diameter 150 mm roll width roll separating force 1067 kN	1		10	tph	mixed fines	86	11795	4015	1762	1956
4	4.31		RH135-G		Vibrating screen. Dimensions: 900x2550x2000. Double possibility of discharge: to manual deviator or material screened unloaded on belt conveyor	1		16,842	tph	briquettes		880	900	2000	2550
4	4.32				Supporting structure with 4 floors, to sustain buffer bin, briquettes machine, vibrating screen, screw feeder and manual deviator							90480			
4	4.33		RH109-V		Bucket belt elevator	1		2,973	tph	briquette fines		4150		17000	
4	4.34		UT154-G		Bag house with fan and dedusting lines as sketch on dwg 16/0203_1502-A	1		6000	m <sup>3</sup> /h	air		950			
4	4.35		RH136-L		Cscrew feeder	1		2,973	tph	briquette fines		354	2800		
4	4.36		RH140-V		belt conveyor BC1 RH140-V, B=500 mm, with discharge chute and supporting structure, without walkways	1		16.842	tph	briquettes		700	4000		500
4	4.37		UT155-G		Bag house with fan and dedusting lines as sketch on dwg 16/0203_1502-A	1		3200	m <sup>3</sup> /h	air		800			
4	4.38		RH136-B		briquette rotary dryer model BRD-500	1		500	kg/h	vapor	26	17000	8600	3600	3700
4	4.39		RH108-V		Briquettes belt elevator	1		16.842	tph	briquettes		6560			450
4	4.40		UT156-G		Bag house with fan, supporting structure for filter and dedusting lines as sketch on dwg 16/0203_1502-A	1		7200	m <sup>3</sup> /h	air		3810			
4	4.41		RH110-V		Briquettes shuttle conveyor RH110-V, B=500 mm, with discharge chute, position sensors and festoons, without dedusting and walkway	1		16.842	tph	briquettes		1300	5500		500



# CD-335 Equipment List



AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit		
													Rev.	Fluid	[KW]
4	4.42		RH126-F1..F3		Briquettes feed bins battery (3 bins of 40 m ) with its supporting structure with handrails, walkway and brackets with rail for shuttle conveyor	1		120	m <sup>3</sup>	briquettes		30000			
4	4.43		RH111-V1..V3		Weigh belt feeders, B=650 mm, with discharge chute and supporting structure	1				briquettes		1300			650
4	4.44		RH113-V		Belt conveyor RH113-V, B=500 mm, with discharge chute and supporting structure, without walkways	1				briquettes		1800	13000		500
<i>Totals</i>											157	278			



# CD-335 Equipment List

AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit		
													Rev.	Fluid	[KW]
<b>5</b>	<b>DRI AREA</b>														
5		00			<i>General Area</i>										
5		00	UT 429-F	TK-500-03	Nitrogen storage tank	1		2200	Nm3/h			132321		30700	3658
5		00	UT 430-F11	UT-500-04	Seal Gas Storage Tank	1		7 - 120	Nm3/h			582		1400	813
5		00	UT 430-F12	UT-500-05	Seal Gas Storage Tank	1		7 - 120	Nm3/h			582		1400	813
5		00	UT 430-F13	UT-500-06	Seal Gas Storage Tank	1		7 - 120	Nm3/h			582		1400	813
5		00	UT 454-F1	UT-500-07	Instrument Air Storage Tank	1		750	Nm3/h			17918		14726	2438
5		00	UT 456-F	UT-500-08	Service Air KO Drum	1		2200	Nm3/h			2315		4398	1067
5		00	n.a.	TL-500-01	Transfer Line										
5		00	n.a.	CH-500-01	Combustion Chamber							20300			
5		00	n.a.	OD-500-01	Reducing Gas Outlet Duct										
5		15			<i>Reactor charging System</i>										
5	5.1	15	RE 250-F	RC-515-01	Rotary charger	1						1472			
5	5.2	15	RE 251-F	LB-515-01	Iron Ore Loading Bin			46	m3	Iron Oxide		27265	3952	7300	3952
5	5.3	15	RE 206-L11/14	VA-515-06	Solids cut off & gas seal valve	4		12	in			1812			
5	5.4	15	RE 201-L11/L14	VA-515-01	Solids cut off & gas seal valve	4		12	in			1812			
5	5.5	15	RE 214-L11/L14	VA-515-02	Presurization valve	4		2	in			364			
5	5.6	15	RE 204-L11/L14	VA-515-03	Valve VS2	4		4	in			384			
5	5.7	15	RE 253-F11	LB-510-02	Iron Ore Pressurized Bin	1		2.1	m3	Iron Oxide		2702		3000	1372 O.D.
5	5.8	15	RE 253-F12	LB-510-03	Iron Ore Pressurized Bin	1		2.1	m3	Iron Oxide		2702		3000	1372 O.D.
5	5.9	15	RE 253-F13	LB-510-04	Iron Ore Pressurized Bin	1		2.1	m3	Iron Oxide		2702		3000	1372 O.D.





# CD-335 Equipment List



AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit		
													Rev.	Fluid	[KW]
5	5.10	15	RE 253-F14	LB-510-05	Iron Ore Pressurized Bin	1		2.1	m3	Iron Oxide		2702		3000	1372 O.D.
5	5.11	15	RE 205-L11/L14	VA-515-04	Solids cut off & gas seal valve	4		12	in			1812			
5	5.12	15	RE 203-L11/L14	JO-515-02	Expansion Joint pressurised	4		12	in			1056			
5	5.13	15	RE 182-L11/L14	VA-515-05	Manual lubricated plug valve	4		12	in			4164			
5	5.14	15	RE 238-L11/L14	VA-515-07	Valve VS2	4		4	in			384			
5	5.15	15	RE 208-L11/L14	VA-515-08	Manual lubricated plug valve	4		12	in			4164			
5	5.16	15			Fittings and spool pieces	1 set						1500			
5		20			<i>Reactor discharging system</i>										
5	5.17	20	RE-210-L	VA-520-01	Manual blocking valve	1		24	in			1360			
5	5.18	20	RE-211-L	JO-520-01	Expansion joint	1		24	in			2304			
5	5.19	20	RE-276-L	RV-520-01	Rotary valve	1		24	in		22.35	10760			
5	5.20	20	RE-278-L	DV-520-01	Diverter valve	1		24 x12	in			1585			
5	5.21	20	RE-215-L11/L12	JO-520-03	Expansion joint pressurised	2		12	in			1188			
5	5.22	20	RE-217-L	VA-520-02	Manual lubricated plug valve	1		12	in			1960			
5	5.23	20	RE-236-L	VA-520-04	Vent Gas Valve VS2	1		4	in			170			
5	5.24	20	RE-223-L	VA-520-05	Manual lubricated plug valve	1		12	in			1960			
5	5.25	20	RE-233-L	JO-520-02	Expansion joint pressurised	1		12	in			594			
5	5.26	20	RE-213-L	VA-520-03	Solids cut-off & gas seal valve VS2	1		12	in			522			
5	5.27	20	RE-255-F		Sampling Bin	1		16	m3			34400			
5	5.28	20	RE 216-L		Gas Seal Valve VS2	1		4	in	DRI		91			
5	5.29	20	RE 200-L		Pressurization valve	1		2	in			170			





# CD-335 Equipment List

AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit		
													Rev.	Fluid	[KW]
5	5.30	20	RE 240-L		Cut-off Valve VS2	1		16	in			522			
5	5.31	20	RE 227-L		Solids cut-off & gas seal valve VS2	1		12	in			522			
5	5.32	20	RE-235-L		Manual lubricated plug valve	1		12	in			1960			
5	5.33	20	RE-232-L11...L14		Expansion joint pressurised	4		12	in			2376			
5	5.34	20	PH 113-L	HO-520-01	Receiving hopper	1						13950			
5	5.35	20	RE-218-L11/L12		Manual lubricated plug valve	2		4	in			1307			
5	5.36	20	RE-237-L		Vent Gas Valve VS2	1		4	in			170			
5	5.37	20	RE 222-L		Gas Seal Valve VS2	1		4	in			91			
5	5.38	20	PH 115-L	HO-520-02	Receiving hopper	1		0.02	m3			1000			
5	5.39	20	RE 224-L		Gas Seal Valve VS2	1		4	in			91			
5	5.40	20	RE 226-L		Depressurization valve	1		4	in			170			
5	5.41	20	RE 285-L	SA-520-01	Hot DRI Sampler	1				DRI		550			
5	5.42	20	PH 134-L	DV-520-02	Diverter valve	1		24 x12	in			1585			
5	5.43	20	PH 141-L11...L14		Expansion joint pressurised	4		12	in			2376			
5	5.44	20	PH 130-L11/L12		Manual lubricated plug valve	2		12	in			3920			
5	5.45	20	PH 189-L11/L12		Vent Gas Valve VS2	2		4	in			340			
5	5.46	20	PH 132-L11/L12		Manual lubricated plug valve	2		12	in			3920			
5	5.47	20	PH 142-L11/L12		Expansion joint pressurised	2		12	in			1188			
5	5.48	20	PH 143-L11/L12		Solids cut-off & gas seal valve VS2	2		12	in			1044			
5	5.49	20			Fittincs and spool pieces	1 set						15000			
5		25			<i>EAF Charging System</i>										



# CD-335 Equipment List



AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit		
													Rev.	Fluid	[KW]
5	5.50	25	PH 112-F11	DB-525-01	EAF Surge Bin	1		115	m3	DRI		138300			
5	5.51	25	PH 112-F12	DB-525-02	EAF Surge Bin	1		115	m3	DRI		138300			
5	5.52	25	PH 210-L11/L12		Manual blocking valve	2		24	in			2720			
5	5.53	25	PH 107-L11/L12		Expansion joint	2		24	in			3374			
5	5.54	25	PH 176-L11/L12		Rotary valve	2		24	in		22.35	21520			
5	5.55	25	PH 108-L11/L12		Solids cut-off & gas seal valve VS2	2		16	in			1866			
5	5.56	25	PH 241-L11/L12		Manual lubricated plug valve	2		12	in			3920			
5	5.57	25	PH 135-L11/L12	DV-525-01	Diverter valve	2		16	in			3170			
5	5.58	25	PH 180-L11/L12		Solids cut-off & gas seal valve VS2	2		16	in			1866			
5	5.59	25	PH 128-L11...L14		Expansion joint non-pressurised	4		16	in			840			
5	5.60	25	PH 147-L11/L12	CH-525-01	Loading Chute 8500mm	2		16	in			3173			
5	5.61	25	PH 145-L11/L12		Solids cut-off & gas seal valve VS2	2		16	in			1866			
5	5.62	25	PH 109-L11/L12		Expansion joint non-pressurised	2		16	in			420			
5	5.63	25	PH 121-L11/L12	CH-525-02	Loading Chute 2000mm	2		16	in			747			
5	5.64	25	PH 114-L	HO-525-01	Receiving hopper	1						13950			
5	5.65	25	PH 149-L	CH-525-03	Rotary Loading Chute 14000mm	1		16	in			2613			
5	5.66	25	PH 131-L11/L12		Expansion joint non-pressurised	2		16	in			420			
5	5.67	25			Fittincs and spool pieces	1 set						10000			
5	5.68	25	PH 649-G	GV-525-01	Gas Venturi	1		29433	Nm3/h			406	2238		508
5	5.69	25	PH 647-F	DS-525-01	EAF Bins Depress stack	1		43825	Nm3/h			11027		10274	2743
5	5.70	25	PH 653-F	BS-525-01	EAF Bins Scrubber	1		300	Nm3/h						



# CD-335 Equipment List



AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit			
													Rev.	Fluid	[KW]	[kg]
5		30			<i>Reactor</i>											
5	5.71	30	RE 221-D	RE-525-01	Reactor					DRI		288600		28800	6800	
5	5.72	30	RE 209-L11/L12		Cluster Breakers	2						1240				
5		40			<i>Natural gas Conditioning</i>											
5	5.73	40		ND-540-01	Natural gas K.O. drum	1		16229	Nm3/h			2896		4456	1067	
5		45			<i>Reduction gas circuit</i>											
5	5.74	45	PG-221-C	HR-545-01	Top gas heat recuperator	1		29.3	t/h			80000				
5	5.75	45	PG 221-F	SD-545-01	Steam Drum	1		29.3	t/h			10000				
5	5.76	45	PG 211-C	PG-545-01	Process gas quench orifice	1		165857	Nm3/h			970	1822		711	
5	5.77	45	PG 312-G	PG-545-02	Process gas venturi	1		165857	Nm3/h		186.5	470	2760		610	
5	5.78	45	PG 313-F	PG-545-03	Process gas separator	1		165857	Nm3/h			20766		10478	2743	
5	5.79	45	PG 231-E	PG-545-04	Process gas quench tower	1		165450	Nm3/h			44463		14535	3200	
5	5.80	45	PG-631-J1	PM-545-03	Humidifier water pump	1		381	t/h		186	1000				
5	5.81	45	PG-631-J2	PM-545-04	Humidifier water pump	1		381	t/h		186	1000				
5	5.82	45	PG 416-F	PG-545-05	Process gas K. O. drum	1		127786	Nm3/h			11457		5973	2591	
5	5.83	45	PG-436-G11/G12	FL-545-01	Process gas compressor filters	2		132086	Nm3/h			4000				
5	5.84	45	PG-436-J	PG-545-06	Process gas compressor	1		129437	Nm3/h		3730	10000		2000		
5	5.85	45	PG-671-E	PG-545-07	Process Gas compressor aftercooler	1		125137	Nm3/h			20736		10827	2286	
5	5.86	45	PG 622-E	PG-545-08	Process gas Humidifier	1		136190	Nm3/h			27165		12783	2438	
5	5.87	45	PG 623-F	PG-545-12	Process gas heater KO drum	1		136190	Nm3/h			12269		5876	2438	
5	5.88	45	PG 650-C		Reactor by-pass quench orifice	1		75000	Nm3/h			900	2080		710	

# CD-335 Equipment List

AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit		
													Rev.	Fluid	[KW]
5	5.89	45	PG 651-F	PG-545-10	Reactor by-pass KO drum	1		217000	Nm3/h			18853		8471	2743
5		50			<i>Process gas heater</i>										
5	5.90	50	PG 302-B	HE-550-01	Process gas heater	1		136190	Nm3/h			1200000			
5	5.91	50	PG 322-J	FA-550-01	Process Gas Heater ID Fan	1		75727/87090	Nm3/h		298	5000			
5	5.92	50	PG 312-J	FA-550-02	Process Gas Heater FD Fan	1		68281/75109	Nm3/h		187	5000			
5	5.93	50	PG 303-L	SA-550-01	Sulphur addition system	1						10000		3000	
5	5.94	50	n.a.	LS-550-01	Oxygen lances and skids	2 sets		4220	Nm3/h			1720			
5		35			<i>CO2 Removal Unit</i>										
5	5.95	35	CO 323-E	AC-545-01	CO2 Absorber Column	1		124666	Nm3/h			80736		28275	2896
5	5.96	35	CO 333-E	GW-545-01	Decarbonated gas washer	1		116561	Nm3/h			19161		8507	2286
5	5.97	35	CO 331-J11	PM-545-01	Gas washing water pump	1		17	t/h		5.6	1000			
5	5.98	35	CO 331-J12	PM-545-02	Gas washing water pump	1		17	t/h		5.6	1000			
5	5.99	35	CO 324-E	SC-535-01	Stripper column	1						54750		32081	3048
5	5.100	35	CO 315-C	OC-535-01	stripper overhead condenser	1						14000	8000		1500
5	5.101	35	CO 313-F	DR-535-01	Sripper overhead condenser KO drum	1						10268		7002	2743
5	5.102	35	CO 325-J11	PM-535-01	Reflux pump	1		13.7	t/h		3.7	1000			
5	5.103	35	CO 325-J12	PM-535-02	Reflux pump	1		13.7	t/h		3.7	1000			
5	5.104	35	CO 347-B	IN-535-01	Incinerator	1		9300	Nm3/h		44.8	14000		3000	
5	5.105	35	CO 316-C	RB-535-01	Reboiler	1		26.5	t/h			20000	8000		2000
5	5.106	35	CO 335-F	CD-535-01	Reboiler condensated drum	1						2336		3702	1372
5	5.107	35	CO 350-J11	PM-535-03	Make-up demin water pump	1		1	t/h		14.9	1000			

# CD-335 Equipment List

AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit		
													Rev.	Fluid	[KW]
5	5.108	35	CO 350-J12	PM-535-04	Make-up demin water pump	1		1	t/h		14.9	1000			
5	5.109	35	CO 336-J11	PM-535-05	Reboliler condensate pump	1		0.4	t/h		1.5	1000			
5	5.110	35	CO 336-J12	PM-535-06	Reboliler condensate pump	1		0.4	t/h		1.5	1000			
5	5.111	35	CO 314-C	SE-535-01	Rich/lean solution exchanger	1						5000			
5	5.112	35	CO 322-J11	PM-535-07	Lean solution circulating pumps	1		156	t/h		149	3000			
5	5.113	35	CO 322-J12	PM-535-08	Lean solution circulating pumps	1		156	t/h		149	3000			
5	5.114	35	CO 320-C	HE-535-01	lean solution heat exchanger	1						3000			
5	5.115	35	CO 330- G11	FL-535-01	Centrifuge filters	1					7.5	2000			
5	5.116	35	CO 330- G12	FL-535-02	Centrifuge filters	1					7.5	2000			
5	5.117	35	CO 327-G	FL-535-03	Mechanical filter	1						1000			
5	5.118	35	CO 337-G	FL-535-04	Activated carbon filter	1		5.6/26	t/h			8407		5164	1829
5	5.119	35	CO 338-G	CT-535-01	Carbon traps	1						1000			
5	5.120	35	CO 317-F	TK-535-01	Solution storage tank	1						10734		8051	5368
5	5.121	35	CO 328-J	PM-535-13	Storage tank pump	1		38	t/h		7.5	1000			
5	5.122	35	CO 340-G	FL-535-05	Solution filter	1						5000			
5	5.123	35	CO 341-F	TK-535-03	Solutions preparation tank	1						8000	4760		2743
5	5.124	35	CO 342-J	PM-535-09	Solution sump pump	1		38	t/h		7.5	1000			
5	5.125	35	CO 343-J	PM-535-10	Solution charging pump	1					1.5	1000			
5	5.126	35	CO 342-J	PM-535-11	Sewage pump	1					2.2	1000			
5	5.127	35	CO 339-G	FL-535-06	Make up solution filter	1						1000			
5	5.128	35	CO 317-G11	SS-535-01	Rich solution strainer	1						1000			



# CD-335 Equipment List



AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit		
													Rev.	Fluid	[KW]
5	5.129	35	CO 317-G12	SS-535-02	Rich solution strainer	1						1000			
5	5.130	35	CO 318-G11	SS-535-03	Lean solution strainer	1						1000			
5	5.131	35	CO 318-G12	SS-535-04	Lean solution strainer	1						1000			
5	5.132	35	CO 321-G11	HF-535-01	Hydrocyclone filter	1						5000			
5	5.133	35	CO 321-G12	HF-535-02	Hydrocyclone filter	1						5000			
5	5.134	35	CO 346-L	AF-535-01	Antifoam metering system	1						1000			
5		55			<i>Steam system</i>										
5		55	CO 337-F	DE-555-01	Deaerator	1		31.1	t/h			20000	5000		2000
5		55	CO 334- J11	PM-555-01	Boiler feed water pump	1		30.5	t/h		56	1000			
5		55	CO 334- J12	PM-555-02	Boiler feed water pump	1		30.5	t/h		56	1000			
5		55	CO 348-B	BO-555-01	Package boiler	1		5	t/h		29.8	70000		3000	
5		70			<i>Flare system</i>										
5		70	PG 639-F	CG-570-01	Flare	1						7000		20000	2000
5		70	PG 640-F	DR-570-01	Flare seal drum	1									
										Totals	5985	3166			



# CD-335 Equipment List

AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit		
													Rev.	Fluid	[KW]
<b>6 EAF AREA AND ANCILLARIES</b>															
6	6.1	25		EA-625-01	Electric Arc Furnace										
6	6.1.1	25	4012	EL-625-01	Electrode Holders (Clamps)	3				copper		incl			
6	6.1.2	25	4013	EL-625-02	Electrode Arms:	3				copper cladde		20510			
6	6.1.3	25	4014	EL-625-03	Electrode Columns:	3				steel;		30000			
6	6.1.4	25	4015	EL-625-04	Column Guide Rollers:	3 sets				steel		7100			
6	6.1.5	25	4017	EL-625-05	Superstructure:	1				steel		29650			
6	6.1.6	25	4018	EL-625-06	Electrode Hydraulic Cylinders:	3						8646			
6	6.1.7	25	4021	EL-625-07	Roof Ring	1				steel		2494			
6	6.1.8	25	4023	HO-625-01	Material Feed Chute:	1				Hardox		500			
6	6.1.9	25	4024	RL-625-01	Roof Lift mechanism	1				steel		6000			
6	6.1.10	25			Roof Lift cylinders	2						1500			
6	6.1.11	25	4025	RM-625-01	Roof Swing Mechanism (Wheel & Carrier Assembly, Pivot Post Assembly)	1				steel		9010			
6	6.1.12	25			Roof swing Cylinder and supports	1						1800			
6	6.1.13	25	4028	LB-625-01	Roof Lifting beams	2				steel		18000			
6	6.1.14	25	4029	EA-625-01	Pedestals:	2				steel		15156			
6	6.1.15			FR-625-01	Upper furnace shell										
6	6.1.16	25	4032	EA-625-02	EAF Full Shell Assembly (upper and lower)							39728			
6	6.1.17	25	4033	EA-625-03	Slag Door Assembly	1				steel pipe to pipe		3025			
6	6.1.18	25			Slag door Cylinder	1						200			
6	6.1.19	25	4038	EA-625-04	Tilting Platform:	1				steel		82000			





# CD-335 Equipment List



AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit		
													Rev.	Fluid	[KW]
6	6.1.20	25			Service Platform (stationary)	1				steel		20950			
6	6.1.21	25	4039	EA-625-05	Tilting Mechanism (stabilizer, locking device, safety stop)	1 set				steel		8000			
6	6.1.22	25			Tilting cylinders (and supports)	2						3850			
6	6.1.23	25	4048	EA-625-06	Instrument Brackets:	1 set				steel		907			
6	6.1.24	25	4049	EA-625-07	Walkways & Platforms:	1 set				steel		7210			
6	6.1.25	25	4053	EA-625-08	Fumes Collection hood	1				pipe to pipe		8680			
6	6.1.26	25	4075	EA-625-09	Hydraulic System:										
6	6.1.27	25		PM-625-01	Piston Type Pump	1		270	l/min	water-glycol (35-55% water)	KW				
6	6.1.28	25		M-PM-625-01	Electric Motor 6 poles	1					75				
6	6.1.29	25		PM-625-02	Piston Type Pump	1		270	l/min	water-glycol (35-55% water)	KW				
6	6.1.30	25		M-PM-625-02	Electric Motor 6 poles	1					75				
6	6.1.31	25		PM-625-03	Piston Type Pump	1		270	l/min	water-glycol (35-55% water)	KW				
6	6.1.32	25		M-PM-625-03	Electric Motor 6 poles	1					75				
6	6.1.33	25		PM-625-04	Fixed Displacement Vane Pump (or Gear Pump)	1		270	m3/h / l/s	water-glycol (35-55% water)	KW				
6	6.1.34	25		M-PM-625-04	Electric Motor 4 poles	1					7.5				
6	6.1.35	25		PM-625-05	Fixed Displacement Vane Pump (or Gear Pump)	1		270	m3/h / l/s	water-glycol (35-55% water)	KW				
6	6.1.36	25		M-PM-625-05	Electric Motor 4 poles	1					7.5				
6	6.1.37	25		TK-625-01	Hydraulic System Tank	1		5000	liters	water-glycol (35-55% water)		1200			
6	6.1.38	25		HE-625-01	Plate Type Heat Exchanger	1									
6	6.1.39	25		AC-625-01	Nitrogen Accumulator	1		300	liters						
6	6.1.40	25		AC-625-02	Nitrogen Accumulator	1		300	liters						





# CD-335 Equipment List



AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit			
													Rev.	Fluid	[KW]	[kg]
6	6.1.41	25		AC-625-03	Nitrogen Accumulator	1		300	liters							
6	6.1.42	25		AC-625-04	Nitrogen Accumulator	1		300	liters							
6	6.1.43	25		HV-625-01	HRR-2 Valve	1										
6	6.1.44	25		HV-625-02	HRR-2 Valve	1										
6	6.1.45	25		HV-625-03	HRR-2 Valve	1										
6	6.1.46	25		HV-625-04	HRR-2 Valve	1										
6	6.1.47	25		HV-625-05	HRDE	1										
6	6.1.48	25		VS-625-01	Hydraulic Valve Stand	1										
6	6.1.49	25		MB-625-01	Manual Hydraulic Block	1										
6	6.1.50	25		PM-625-06	Regulation Vavle Pump	1		40	l/min		KW					??mm x ??mm
6	6.1.51	25		M-PM-625-06	Regulation Vavle Motor	1					3.5					
6	6.1.52	25		TK-625-02	Regulation Tank	1		160	liters			KG			H	Dia
6	6.1.53	25	4076	WS-625-01	Water System - Non Contact (valves, hoses for roof ring, door and hood)	1set						700				
6	6.1.54	25	4078	CA-625-01	Compressed Air (hoses, valves)	1set						200				
6	6.1.55	25	4079	NS-625-01	Argon/Nitrogen System (hoses, valves)	1set						500				
6	6.1.56	25			Argon/Nitrogen Valve Stand	1										
6	6.1.57	25	4083	LS-625-01	Lubrication System:	1 set						300				
6	6.1.58	25	4084	RE-625.01	Refractory:											
6	6.1.59	25	4087	CB-625-01	Secondary Cables:	3 sets						5896				
6	6.1.60	25	4088	SB-625-01	Secondary Bus	1 set				copper		8630				

# CD-335 Equipment List

AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit		
													Rev.	Fluid	[KW]
6	6.1.61	25	4089	HS-625-01	Terminal Head Supports:	1				steel		2000			
6	6.1.62	25	4094	WS-625-02	EAF Weighing System	1						1000			
6	6.1.63	25	4095	TS-625-01	Temperature/Steel Robot Sampling Device with magazine for cartridges and	1						7500			
6	6.1.64	25	4095	SC-625-02	Spout cleaner/opener Robot	1						7500			
6	6.1.65	26			Electrical Equipment	1 set									
6	6.1.66	27			EAF Transformer w/OLTC - 55 MVA	1									
6	6.1.67	28			Level 0 - Field Instruments - (CCTV, limit switches, transmitters, etc.)	1 set									
6	6.1.68	29			Level 1 - PLC, HMI, Panels	1 set									
6	6.1.69	30			Level 2	1 set									
6	6.2	25	4091	SB-670-01	Charging Bucket	1						21000			
6	6.3	25	4092	LS-635-01	Ladle Refractory breakout stand (suction hood movable type, ducts from ladle breakout station to mixing points, ladle refractory breakout stand damper)	1									
6	6.4	25		LS-635-02	Ladle Spout Cleaning Stand	1									
6	6.5	25		LD-635-01	Ladle Dryer (with ladle stand and gas rack)	1						15000			
6	6.6	25		LV-625-01	Ladle Preheater (with ladle stand and gas rack)	1						15000			
6	6.7	25		LZ-625-02	Ladle Preheater (for tapping car)	1									
6	6.8	25	4093	ES-645-01	Electrode Storage & Piccardi Machine	1				steel		3000			
6	6.9	25	4096	LC-630-01	Ladle Car (w/weighing system)	1						33000			
6	6.11	25	4098		Ladles for 120 metric tons capacity										
6	6.11.1	25	4098-1	LA-630-01	Hot Metal Ladle	1		120	metric ton	Hot Metal		23565		4185	3500



# CD-335 Equipment List



AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit		
													Rev.	Fluid	[KW]
6	6.11.2	25	4098-2	LA-630-02	Hot Metal Ladle	1		120	metric ton	Hot Metal		23565		4185	3500
6	6.11.3	25	4098-3	LA-630-03	Hot Metal Ladle	1		120	metric ton	Hot Metal		23565		4185	3500
6	6.11.4	25	4098-4	LA-630-04	Hot Metal Ladle	1		120	metric ton	Hot Metal		23565		4185	3500
6	6.11.5	25	4098-5	LA-630-05	Hot Metal Ladle	1		120	metric ton	Hot Metal		23565		4185	3500
6	6.12	25	4099	SC-630-01	EAF shell transfer car, not motorized, with rails	1						18000			
6	6.13	25		LB-630-02	Shell lifting beam	1						30000			
6	6.14	25		SP-640-01	Shell Maintenance Platform	1						22000			
6	6.15	25	4125	TR-625-01	Furnace Transformer 55 MVA, includes first fill of insulating oil						55000	80000			
6	6.16	05		CR-605-01	Control room										
6	6.17	00		TK-600-01	Oxygen storage tank			2200	Nm3			132321		30700	3658
6	6.18	00		TK-600-02	Nitrogen storage tank			2200	Nm3			132321		30700	3658
										<i>totals</i>	55244	980			



# CD-335 Equipment List

AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit		
													Rev.	Fluid	[KW]
<b>7</b>	<b>CONTINUOS PIG CASTING</b>														
7	7.1	15	D10	PC-715-01	Pig Casting Machine	1		100	mtph	Pig Iron		300000			
7	7.1.1	15		M-PC-715-01	Drive Motor	1									
7	7.1.2	15		R-PC-715-01	Speed Reducer	1									
7	7.2	15		SG-715-01	Splash guards	1 set									
7	7.3	15		PK-715-01	Automatic Pig Knocker	1 set									
7	7.4	15		CH-715-01	Discharge Rocker Chute	1 set									
7	7.5	15		CH-715-02	Sticker Chute	1 set									
7	7.6	15		DS-715-01	Dry Shot Plate System	1 set									
7	7.7	15		CB-715-01	Collecting Box	2									
7	7.7.1	15		M-CB-715-01	Drive Motor	2									
7	7.8	15		MS-715-01	Mold Spray System	1 set									
7	7.9	15		TK-715-01	Pre-Mix Tank	1									
7	7.10	15		AG-715-01	Agitator	1									
7	7.10.1	15		M-AG-715-01	Drive Motor	1					0.5				
7	7.10.2	15		R-AG-715-01	Speed Reducer	1									
7	7.11	15		PM-715-01	Transfer Pump	2									
7	7.11.1	15		M-PM-715-01	Drive Motor	2					1.5				
7	7.12	15		TK-715-02	Mix Tank	1									
7	7.13	15		AG-715-02	Agitator	1									
7	7.13.1	15		M-AG-715-02	Drive Motor	1									



# CD-335 Equipment List

AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit			
													Rev.	Fluid	[KW]	[kg]
7	7.13.2	15		R-AG-715-02	Speed Reducer	1										
7	7.14	15		PM-715-02	Emulsion Pump	1										
7	7.14.1	15		M-PM-715-02	Drive Motor	1					1.5					
7	7.15	15		PM-715-03	Emulsion Pump	1										
7	7.15.1	15		M-PM-715-03	Drive Motor	1					1.5					
7	7.16	15		CS-715-01	Mold Drying System	1 set										
7	7.17	15		SL-715-01	Dry Coating Powder Silo	1										
7	7.18	15		BR-715-01	Drying Burners	1 set		70	Kw							
7	7.19	15		FN-715-01	Fan	1										
7	7.19.1	15		M-FN-715-01	Drive Motor	1					0.5					
7	7.20	15		AK-715-01	Air Knife	1										
7	7.20.1	15		M-AK-715-01	Drive Motor	1					1					
7	7.21	15		BS-715-01	Cooling Catch Basin	1										
7	7.22	15		NZ-715-01	Nozzle Spray System	1										
7	7.23	15		PM-715-04	Pump	1										
7	7.23.1	15		M-PM-715-04	Drive Motor	1					20					
7	7.24	15		PM-715-05	Pump	1										
7	7.24.1	15		M-PM-715-05	Drive Motor	1					20					
7	7.25	15		SH-715-01	Steam Hood	1										
7	7.26	15		FN-715-02	Steam Exhaust Fan	5										
7	7.27	15		D-FN-715-02	Steam Exhaust Damper	5										



# CD-335 Equipment List



AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit			
													Rev.	Fluid	[KW]	[kg]
7	7.27.1	15		M-FN-715-02	Drive Motor	1										
7	7.27.2	15		M-FN-715-03	Drive Motor	1										
7	7.27.3	15		M-FN-715-04	Drive Motor	1										
7	7.27.4	15		M-FN-715-05	Drive Motor	1										
7	7.27.5	15		M-FN-715-06	Drive Motor	1										



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AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit			
													Rev.	Fluid	[KW]	[kg]
7	7.28	15		BL-715-01	Blowers	1										
7	7.29	15	D14	LT-715-01	Ladle Tilter	1						57100				
7	7.29.1	15		M-LT-715-01	Hydraulic Drive Motor	1					35					
7	7.30	15		HD-715-02	Fumes Extraction Hood	1										
7	7.30.1	15		FL-715-01	Pig Front End Loader	1										
7	7.31	30		CH-730-01	Discharge chute	1										
7	7.32	15		MD-715-01	Mold dedusting	1										
										Totals	82	357				



# CD-335 Equipment List



AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit		
													Rev.	Fluid	[KW]
<b>8 AUXILIARY SERVICES AND UTILITIES</b>															
8	8.1	25		825	<b>Water Treatment Plant WTP</b>										
8	8.1.1				EAF Indirect cooling Circuit - High temp users										
8	8.1.1.1	30	AC2	AC-830-02	Air coolers			1410	m3/h						
8	8.1.1.1.1	30			Air cooler bundles	1						12000	3000		12500
8	8.1.1.1.2	30			Air cooler bundles	1						12000	3000		12500
8	8.1.1.1.3	30			Air cooler bundles	1						12000	3000		12500
8	8.1.1.1.4	30			Air cooler bundles	1						12000	3000		12500
8	8.1.1.1.5	30			Air cooler bundles	1						12000	3000		12500
8	8.1.1.1.6	30			Air cooler bundles	1						12000	3000		12500
8	8.1.1.1.7	30	AC2.1	FN-830-09	Axial Fan + electric motor	1					30	1200			2800
8	8.1.1.1.8	30	AC2.1	FN-830-10	Axial Fan + electric motor	1					30	1200			2800
8	8.1.1.1.9	30	AC2.2	FN-830-11	Axial Fan + electric motor	1					30	1200			2800
8	8.1.1.1.10	30	AC2.2	FN-830-12	Axial Fan + electric motor	1					30	1200			2800
8	8.1.1.1.11	30	AC2.3	FN-830-13	Axial Fan + electric motor	1					30	1200			2800
8	8.1.1.1.12	30	AC2.3	FN-830-14	Axial Fan + electric motor	1					30	1200			2800
8	8.1.1.1.13	30			Supporting structure	1						28000	15000		18000
8	8.1.1.1.14	30			Valves and accessories	3									12xDN200
8	8.1.1.1.15	30			Automatic drain and vent valves	3									24x1"dia
8	8.1.1.1.16	30			Isolation and by-pass automatic valves	1									3xDN400
8	8.1.1.2	30	SEI1	TK-830-01	Expansion Tank										





# CD-335 Equipment List



AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit		
													Rev.	Fluid	[KW]
8	8.1.1.2.1	30			Expansion Vessel	1		30	m3			6500		10000	2000
8	8.1.1.2.2	30			Pressurization valves, safety valves and accessories	1						650			
8	8.1.1.3	30	PI2	PS-830-13	Pumping Station										
8	8.1.1.3.1	30	PI2.1	PM-830-01	Horizontal pump & motor	1		470	m3/h		150	1500			
8	8.1.1.3.2	30	PI2.2	PM-830-02	Horizontal pump & motor	1		470	m3/h		150	1500			
8	8.1.1.3.3	30	PI2.3	PM-830-03	Horizontal pump & motor	1		470	m3/h		150	1500			
8	8.1.1.3.4	30	PI2.4	PM-830-04	Horizontal pump & motor	1		470	m3/h	stand-by	150	1500			
8	8.1.1.3.5	30			Valves and accessories	4 set									
8	8.1.1.4	30	MPI2	PS-830-14	Emergency Diesel pump										
8	8.1.1.4.1	30	MPI2.2	PM-830-05	Pump	1		450	m3/h			6000	1850	2750	5500
8	8.1.1.4.2	30	MPI2.1	PM-830-06	Pump	1		450	m3/h			6000	1850	2750	5500
8	8.1.1.4.3	30			Diesel motor with local control switchboard, fuel tank	2									
8	8.1.1.4.4	30			Valves and accessories	2 set									
8	8.1.1.5	30	PS1	PS-830-15	Make up pumping station	1+1		40	m3/h						
8	8.1.1.5.1	30			Horizontal pump & motor	1					15	150			
8	8.1.1.5.2	30			Horizontal pump & motor	1					15	150			
8	8.1.1.5.3	3			Valves and accessories	2 set									
8	8.1.1.6	30	SAI1	TK-830-02	Make up water tank			30	m3			800	6500		2500
8	8.1.1.6.1	30			Isolation valves and accessories	1 set									
8	8.1.1.7	30	GDI1	DS-830-07	Dosing station for corrosion inhib.										
8	8.1.1.7.1	30			Dosing pump	1					0.5				



# CD-335 Equipment List

AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit			
													Rev.	Fluid	[KW]	[kg]
8	8.1.1.7.2	30		PM-830-10	Dosing pump	1					0.5	250				
8	8.1.1.7.3	30		TK-830-05	HDPE Tank	1		500	l							
8	8.1.1.7.4	30			valves, level switch and accessories	1 set										
8	8.1.1.8	30	GDI3	DS-830-08	Dosing station for Biocide											
8	8.1.1.8.1	30		PM-830-11	Dosing pump	1					0.5	250				
8	8.1.1.8.2	30		PM-830-12	Dosing pump	1					0.5					
8	8.1.1.8.3	30			HDPE Tank	1		500	l							
8	8.1.1.8.4	30			valves, level switch and accessories	1 set										
8	8.1.1.9	30	R2	EH-830-01	Electrical heater for EAF circuit											
8	8.1.1.9.1	30			Electrical Heater						150	250				
8	8.1.1.9.2	30			Heater vessel	1										
8	8.1.1.9.3	30			Junction box with temperature control switches	1										
8	8.1.1.9.4	30			Isolation valves and accessories	1										
8	8.1.1.10	30			Valves and process instrumentation	1 set										
8	8.1.2				EAF Indirect cooling Circuit - low temp users											
8	8.1.2.1	30	TI1		Evaporative cooling tower											
8	8.1.2.1.1	30			Concrete tank VI1	1										
8	8.1.2.1.2	30	TI1.1	CT-830-01	Cooling tower			284	m3/h		7.5	4926	7500	4300	2400	
8	8.1.2.1.3	30			Interal parts	2 set										
8	8.1.2.1.4	30	TI1.2	CT-830-02	Cooling tower			284	m3/h		7.5	4926	7500	4300	2400	
8	8.1.2.1.5	30			Interal parts	2 set										



# CD-335 Equipment List



AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit				
													Rev.	Fluid	[KW]	[kg]	Lenght [mm]
8	8.1.2.1.6	30			Valves and accessories	2 set										2 x DN200	
8	8.1.2.1.7	30			By-pass automatic valve	1										DN200	
8	8.1.2.1.8	30			Automatic make-up and blow down system	1										DN50	
8	8.1.2.2	30	PI3	PS-830-16	EAF water pumping station												
8	8.1.2.2.1	30		PM-830-13	Horizontal pump & motor	1		340	m3/h		110	1050	900	1800			
8	8.1.2.2.2	30		PM-830-14	Horizontal pump & motor	1		340	m3/h		110	1050	900	1800			
8	8.1.2.2.3	30			Valves and accessories	2 set										DN350-300	
8	8.1.2.3	30			Automatic make-up system												
8	8.1.2.3.4	30			Isolation valves and accessories	1set											
8	8.1.2.4	30	GDI2	DS-830-09	Dosing station for scale inhibitor												
8	8.1.2.4.1	30		PM-830-17	Dosing pump	1					0.5	250					
8	8.1.2.4.2	30		PM-830-18	Dosing pump	1					0.5						
8	8.1.2.4.3	30			HDPE Tank	1		500	l								
8	8.1.2.4.4	30			valves, level switch and accessories	1 set											
8	8.1.2.5	30	GDI3		Dosing station for biocide												
8	8.1.2.5.1	30			Dosing pump	1					0.5	250					
8	8.1.2.5.2	30			Dosing pump	1					0.5						
8	8.1.2.5.3	30			HDPE Tank	1		500	l								
8	8.1.2.5.4	30			valves, level switch and accessories	1 set											
8	8.1.2.6	30			Valves and process instrumentation	1 set											
8	8.1.3				Pig Casting Machine												



# CD-335 Equipment List



AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit			
													Rev.	Fluid	[KW]	[kg]
8	8.1.3.1	30	PMU	PS-830-18	Make up pumping station											
8	8.1.3.1.1	30		PM-830-19	Horizontal pump & motor	1		40	m3/h		11	150	400		600	
8	8.1.3.1.2	30		PM-830-20	Horizontal pump & motor	1		40	m3/h		11	150	400		600	
8	8.1.3.1.3	30			Valves and accessories	2 set										DN100-80
8	8.1.3.2	30	PI4	PS-830-17	Water pumping station PI4											
8	8.1.3.2.1	30		PM-830-15	Horizontal pump & motor	1		6	m3/h		5.5	80	300		400	
8	8.1.3.2.2	30		PM-830-16	Horizontal pump & motor	1		6	m3/h		5.5	80	300		400	
8	8.1.3.2.3	30			Valves and accessories	2set										DN100-80
8	8.1.3.3	30			Valves and process instrumentation	1 set										
8	8.1.3.4	30			Automatic make-up system	1 set										
8	8.1.3.4.1	30			Isolation valves and accessories	1set										
8	8.1.4				HYL indirect circuit cooling system											
8	8.1.4.1	30	AC1	AC-830-01	Air coolers											
8	8.1.4.1.1	30		AB-830-02	Air coolers bundles	1						12000	12500		3000	
8	8.1.4.1.2	30		AB-830-02	Air coolers bundles	1						12000	12500		3000	
8	8.1.4.1.3	30		AB-830-02	Air coolers bundles	1						12000	12500		3000	
8	8.1.4.1.4	30		AB-830-02	Air coolers bundles	1						12000	12500		3000	
8	8.1.4.1.5	30	AC1.1	FN-830-01	Axial Fan + electric motor	1					37	1200				Ø2800
8	8.1.4.1.6	30	AC1.1	FN-830-02	Axial Fan + electric motor	1					37	1200				Ø2800
8	8.1.4.1.7	30	AC1.2	FN-830-03	Axial Fan + electric motor	1					37	1200				Ø2800
8	8.1.4.1.8	30	AC1.2	FN-830-04	Axial Fan + electric motor	1					37	1200				Ø2800

# CD-335 Equipment List

AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit		
													Rev.	Fluid	[KW]
8	8.1.4.1.9	30			Supporting structure	1						19000	15000		12000
8	8.1.4.1.10	30			Valves and accessories	2set									8x DN200
8	8.1.4.1.11	30			Automatic drain and vent valves	2 set									16 x Ø1"
8	8.1.4.1.12	30			Isolation and by-pass automatic valves	1 set									3 x DN300
8	8.1.4.2	30	T1		Evaporative cooling tower			270	m3/h						
8	8.1.4.2.1	30	T1.1	FN-830-05	Fan+gear reducer	1					45	500			Ø4500 mm
8	8.1.4.2.2	30		CY-830-01	Preassembled PVRF Chymney	1						700			Ø5000 mm
8	8.1.4.2.3	30	T1.2	FN-830-06	Fan+gear reducer	1					45	500			Ø4500 mm
8	8.1.4.2.4	30		CY-830-02	Preassembled PVRF Chymney	1						700			Ø5000 mm
8	8.1.4.2.5	30	T1.3	FN-830-07	Fan+gear reducer	1					45	500			Ø4500 mm
8	8.1.4.2.6	30		CY-830-03	Preassembled PVRF Chymney	1						700			Ø5000 mm
8	8.1.4.2.7	30	T1.4	FN-830-08	Fan+gear reducer	1					45	500			Ø4500 mm
8	8.1.4.2.8	30		CY-830-04	Preassembled PVRF Chymney	1						700			Ø5000 mm
8	8.1.4.2.9	30	V1		Concrete tank	-									
8	8.1.4.2.10	30			Concrete structure of cooling towers	4							7000	12500	7000
8	8.1.4.2.11	30			Internal parts	4 set						2500 each			
8	8.1.4.2.12	30			Valves and accessories	4 set									DN600
8	8.1.4.2.13	30			By-pass automatic valve	1									DN400
8	8.1.4.2.14	30			Automatic blow down systems	1									DN150
8	8.1.4.3	30	P1	PS-830-01	Pumping Station										
8	8.1.4.3.1	30		PM-830-21	Horizontal pump & motor	1		370	m3/h		225	1500	900	1800	



# CD-335 Equipment List



AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit		
													Rev.	Fluid	[KW]
8	8.1.4.3.2	30		PM-830-22	Horizontal pump & motor	1		370	m3/h		225	1500	900	1800	
8	8.1.4.3.3	30		PM-830-23	Horizontal pump & motor	1		370	m3/h		225	1500	900	1800	
8	8.1.4.3.4	30			Valves and accessories	3 set									DN250-350
8	8.1.4.4	30	P2	PS-830-02	Pumping Station										
8	8.1.4.4.1	30		PM-830-24	Horizontal pump & motor	1		570	m3/h		110	1500	900	1800	
8	8.1.4.4.2	30		PM-830-25	Horizontal pump & motor	1		570	m3/h		110	1500	900	1800	
8	8.1.4.4.3	30		PM-830-26	Horizontal pump & motor	1		570	m3/h		110	1500	900	1800	
8	8.1.4.4.4	30			Valves and accessories	3 set									DN400-350
8	8.1.4.5	30	P3	PS-830-03	Pumping Station										
8	8.1.4.5.1	30		PM-830-27	Horizontal pump & motor	1		135	m3/h		37	900	900	1500	
8	8.1.4.5.2	30		PM-830-28	Horizontal pump & motor	1		135	m3/h		37	900	900	1500	
8	8.1.4.5.3	30			Valves and accessories	2 set									DN250-150
8	8.1.4.6	30	P4	PS-830-04	Pumping Station										
8	8.1.4.6.1	30		PM-830-29	Horizontal pump & motor	1		200	m3/h		18.5	900	900	1500	
8	8.1.4.6.2	30		PM-830-30	Horizontal pump & motor	1		200	m3/h		18.5	900	900	1500	
8	8.1.4.6.3	30			Valves and accessories	2 set									DN250-200
8	8.1.4.8	30	F1	FL-830-01	Pressure sand filter										
8	8.1.4.8.1	30			Filters	1						7000		4500	3600
8	8.1.4.8.2	30			Service piping for filters	1set						900			
8	8.1.4.8.3	30			Valves and accessories	1set									
8	8.1.4.8.4	30			Pneumatic box	1set									



# CD-335 Equipment List

AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit				
													Rev.	Fluid	[KW]	[kg]	Lenght [mm]
8	8.1.4.8.5	30			Filtering media (quartz sand)	1set											
8	8.1.4.9	30	F2	FL-830-02	Presssure sand filter												
8	8.1.4.9.1	30			Filters	1						7000		4500		3600	
8	8.1.4.9.2	30			Service piping for filters	1set						900					
8	8.1.4.9.3	30			Valves and accessories	1set											
8	8.1.4.9.4	30			Pneumatic box	1set											
8	8.1.4.9.5	30			Filtering media (quartz sand)	1set											
8	8.1.4.10	30	ES	BL-830-01	Blower												
8	8.1.4.10.1	30			Valves and accessories	1set											
8	8.1.4.10.2	30			Blower and Electric Motor	1set		650	m3/h		15	500	1150	1200		1150	
8	8.1.4.11	30	P8	PS-830-08	Pumping Station												
8	8.1.4.11.1	30		PM-830-33	Horizontal pumps & motor	1		30	m3/h		15	150	400			600	
8	8.1.4.11.2	30		PM-830-34	Horizontal pumps & motor	1		30	m3/h		15	150	400			600	
8	8.1.4.11.3	30			Valves and accessories	2 set										DN100-80	
8	8.1.4.12	25	GD1	DS-825-01	Dosing station for scale inhib.												
8	8.1.4.12.1	25	PD1	PM-825-01	Dosing pump	1		4.2	l/h			250					
8	8.1.4.12.2	25			HDPE Tank	1		500	l								
8	8.1.4.12.3	25			valves, level switch and accessories	1 set											
8	8.1.4.13	25	GD2	DS-825-02	Dosing station for biocide												
8	8.1.4.13.1	25	PD2	PM-825-02	Dosing pump	1		4.2	l/h			250					
8	8.1.4.13.2	25			HDPE Tank	1		500	l/h								





# CD-335 Equipment List

AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit			
													Rev.	Fluid	[KW]	[kg]
8	8.1.4.13.3	25			valves, level switch and accessories	1 set										
8	8.1.4.14	25	GD3	DS-825-03	Dosing station Sulphuric Acid											
8	8.1.4.14.1	25		PM-825-03	Dosing pump	1						70				
8	8.1.4.14.2	25			valves, level switch and accessories	1 set										
8	8.1.4.14.3	25		TK-825-04	PVRF Tank	1		10000	l			350	3600		2000	
8	8.1.4.14	30			Valves and process instrumentation	1 set										
8	8.1.4.15	30			Automatic make-up and blow down system	1 set										
8	8.1.4.15.1	30			Isolation valves and accessories	1set										
8	8.1.5				HYL indirect circuit cooling system-Jacket and equipment closed circuit											
8	8.1.5.1	30	SA1	TK-830-03	Demi water storage tank											
8	8.1.5.1.1	30			Vertical PVRF Tank	1		30000	l				6500		2500	
8	8.1.5.1.2	30			Automatic make-up	1 set						500				
8	8.1.5.1.3	30			valves, level switch and accessories	1 set									DN50	
8	8.1.5.2	30	P6	PS-830-06	Pumping Station											
8	8.1.5.2.1	30		PM-830-35	Horizontal pump & motor	1		150	m3/h		150	950	900		1500	
8	8.1.5.2.2	30		PM-830-36	Horizontal pump & motor	1		150	m3/h		150	950	900		1500	
8	8.1.5.2.3	30			Valves and accessories	2 set									DN250-150	
8	8.1.5.3	30	P7	PS-830-07	Pumping Station											
8	8.1.5.3.1	30		PM-830-37	Horizontal pump & motor	1		210	m3/h		110	950	900		1500	
8	8.1.5.3.2	30		PM-830-38	Horizontal pump & motor	1		210	m3/h		110	950	900		1500	
8	8.1.5.3.3	30			Valves and accessories	2 set									DN250-200	



# CD-335 Equipment List

AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit			
													Rev.	Fluid	[KW]	[kg]
8	8.1.5.4	30	FC1	FL-830-03	Safety Basket Filter											
8	8.1.5.4.1	30			Basket Filter	1		200	µm			200		1500		Ø450
8	8.1.5.4.2	30			Valves and accessories	1 set										DN150
8	8.1.5.5	30	HE1	HE-830-01	Plate Heat Exchangers											
8	8.1.5.5.1	30			Plate Heat Exchangers	1		360	m3/h			2200	850	2150		1500
8	8.1.5.5.1	30			Plate Heat Exchangers	1		360	m3/h			2200	850	2150		1500
8	8.1.5.5.2	30			Valves and accessories	2 set										DN250
8	8.1.5.6	25	GD4	DS-825-04	Dosing station for corrosion agent											
8	8.1.5.6.1	25	PD4	PM-825-04	Dosing pump	1		6.5	l/h		0.09	250				
8	8.1.5.6.2	25			HDPE Tank	1		500	l							
8	8.1.5.6.3	25			valves, level switch and accessories	1 set										
8	8.1.5.7	25	GD5	DS-825-05	Dosing station for biocide											
8	8.1.5.7.1	25	PD5	PM-825-05	Dosing pump	1		6.5	l/h		0.09	250				
8	8.1.5.7.2	25			HDPE Tank	1		500	l							
8	8.1.5.7.3	25			valves, level switch and accessories	1 set										
8	8.1.5.8	30	P5	PS-830-05	Pumping Station											
8	8.1.5.8.1	30		PM-830-31	Horizontal pump	1		360	m3/h		110	1050	900			1800
8	8.1.5.8.2	30		PM-830-32	Horizontal pump	1		360	m3/h		110	1050	900			1800
8	8.1.5.8.3	30			Valves and accessories	2 set										DN350-250
8	8.1.5.9	30			Valves and process instrumentation	1 set										
8	8.1.5.10	30			Automatic make-up and blow down system	1 set										

# CD-335 Equipment List

AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit			
													Rev.	Fluid	[KW]	[kg]
8	8.1.5.10.1	30			Isolation valves and accessories	1set										
8	8.1.6				HYL direct circuit cooling system											
8	8.1.6.1	30	DCL1	DE-830-01	Circular clarifier											
8	8.1.6.1.1	30			Concrete tank for circular clarifier	1										
8	8.1.6.1.2	30			Scraping bridge	1set					0.37	20000		4500		18000
8	8.1.6.1.3	30			Sludge discharging valves	2 set										DN150
8	8.1.6.2	30	P11	PS-830-11	Pumping station											
8	8.1.6.2.1	30		PM-830-39	Horizontal pump & motor	1		50	m3/h		11	450	700			900
8	8.1.6.2.2	30		PM-830-40	Horizontal pump & motor	1		50	m3/h		11	450	700			900
8	8.1.6.2.3	30			Valves and accessories	2 set										DN100-80
8	8.1.6.3	30	P10	PS-830-10	Pumping station											
8	8.1.6.3.1	30		PM-830-41	Horizontal pump & motor	1		95	m3/h		18.5	950	900			1500
8	8.1.6.3.2	30		PM-830-42	Horizontal pump & motor	1		95	m3/h		18.5	950	900			1500
8	8.1.6.3.3	30			Valves and accessories	2 set										DN200-150
8	8.1.6.4	30	P9	PS-830-09	Pumping station	1+1										
8	8.1.6.4.1	30		PM-830-43	Horizontal pump & motor	1		58	m3/h		110	750	700			1200
8	8.1.6.4.2	30		PM-830-44	Horizontal pump & motor	1		58	m3/h		110	750	700			1200
8	8.1.6.4.3	30			Valves and accessories	2 set										DN100-80
8	8.1.6.5	30	FC2	FL-830-04	Duplex filter											
8	8.1.6.5.1	30			Duplex basket filter	1						500	900	1200		550
8	8.1.6.6	30	HE2		Plate heat exchanger											

# CD-335 Equipment List

AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit		
													Rev.	Fluid	[KW]
8	8.1.6.6.1	30	HE2.1	HE-830-03	Heat exchanger	1		40/250	m3/h			900	7000		600
8	8.1.6.6.2	30	HE2.2	HE-830-04	Heat exchanger	1		40/250	m3/h			900	7000		600
8	8.1.6.6.3	30			Valves and accessories	2 set									DN100-250
8	8.1.6.7	25	GD6	DS-825-06	Dosing station for Sulphuric acid										
8	8.1.6.7.1	25		TK-825-05	Horizontal PFRV tank	1		10000	l			350	3600		Ø2000
8	8.1.6.7.2	25		PM-825-06	Dosing pump	1						70			
8	8.1.6.7.3	25			valves, level switch and accessories	1 set									
8	8.1.6.8	30			Valves and process instrumentation	1 set									
8	8.1.7				Sludge treatment system										
8	8.1.7.1	30	P12	PS-830-12	Sludge pumping station										
8	8.1.7.1.1	30		PM-830-45	Horizontal pump & motor	1		30	m3/h		15	250	400		600
8	8.1.7.1.2	30		PM-830-46	Horizontal pump & motor	1		30	m3/h		15	250	400		600
8	8.1.7.1.3	30			Valves and accessories	2 set									DN100-80
8	8.1.7.2	30	IS1	ST-830-01	Static Thickener										
8	8.1.7.2.1	30			Supporting structure (concrete)	1									
8	8.1.7.2.2	30			Static Thickener	1						10000	7000		Ø4000
8	8.1.7.2.3	30			Valves and accessories	1									
8	8.1.7.3	30	SSL1	TK-830-04	Sludge equalization tank										
8	8.1.7.3.1	30			Sludge equalization tank	1		5	m3			2000	2500		Ø2000
8	8.1.7.3.2	30	AG1	AG-830-01	Electric stirrer	1					1.5	500	1750		Ø1000
8	8.1.7.4	30	PF1	PS-830-19	Sludge pumping station										

# CD-335 Equipment List

AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit		
													Rev.	Fluid	[KW]
8	8.1.7.4.1	30		PM-830-47	Horizontal peristaltic pump & motor	1		5	m3/h		11	250	400		600
8	8.1.7.4.2	30		PM-830-49	Horizontal peristaltic pump & motor	1		5	m3/h		11	250	400		600
8	8.1.7.4.3	30			Valves and accessories	2 set									DN100-80
8	8.1.7.5	30	NP1	FP-830-01	Sludge filter press	1									
8	8.1.7.5.1	30			Local control panel for sludge filter press	1									
8	8.1.7.5.2	30	NP1	FP-830-01	Sludge filter press	1		700	kg/h		11	9000	7500	2000	2500
8	8.1.7.6	30	NP2	FP-830-02	Sludge filter press	1		700	kg/h		11	9000			
8	8.1.7.6.1	30			Local control panel for sludge filter press	1									
8	8.1.7.6.2	30	NP2	FP-830-01	Sludge filter press	1		700	kg/h		11	9000	7500	2000	2500
8	8.1.7.7	30	PNP	PS-830-20	Submergible pumping station	1									
8	8.1.7.7.1	30		PM-830-50	Pump + electric motor	1		5	m3/h		11				
8	8.1.7.7.2	30		PM-830-51	Pump + electric motor	1		5	m3/h		11				
8	8.1.7.7.3	30			Valves and accessories	2 set									
8	8.1.7.8	30			Polymer dosing station										
8	8.1.7.8.1	30			Polymer dissolution and storage tank	1									
8	8.1.7.8.2	30			polymer metering pumps	2									
8	8.1.7.8.3	30			Local control panel	1									
8	8.1.7.9	30			Dosing station for H2SO4										
8	8.1.7.9.1	30			Horizontal PVRF Tank	1		5000	litres						
8	8.1.7.9.2	30			dosing pump	1									
8	8.1.7.9.3	30			valves, level switch and accessories	1									

# CD-335 Equipment List

AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit			
													Rev.	Fluid	[KW]	[kg]
8	8.1.7.10	30			Valves and process instrumentation	1set										
8	8.1.8				Waste water treatment plant											
8	8.1.8.1				Ammonia stripping section	1										
8	8.1.8.1.1				Blower with electrical motor	1										
8	8.1.8.1.2				Valves and accessories	1										
8	8.1.8.1.3				Stripping column with internal filling and accessories	1										
8	8.1.8.1.4				Gas washing scrubber with internal filling and accessories	1										
8	8.1.8.1.5				Recirculation pumpwith electrical motor and accessories	1										
8	8.1.8.1.6				Eluate storage tank	1										
8	8.1.8.1.7				Local electrical panel	1										
8	8.1.8.2				Lamella clariflocculator	1										
8	8.1.8.2.1				Carbon steel tank	1										
8	8.1.8.2.2				Electrical stirrer	1										
8	8.1.8.2.3				lamella plates	1 set										
8	8.1.8.2.4				Sludge discharge valves	1 set										
8	8.1.8.2.5				Sludge pumps with valves and accessories	1 set										
8	8.1.8.3				Clarified water tank											
8	8.1.8.3.1				PVRF water storage tank	1		12	m3			350		3000		Ø2000
8	8.1.8.3.2				Pump with electrical motor, valves and accessories	1							650	1000		900
8	8.1.8.3.3				Pump with electrical motor, valves and accessories	1							650	1000		900
8	8.1.8.3.4				Valves and accessories	2 set										



# CD-335 Equipment List

AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit			
													Rev.	Fluid	[KW]	[kg]
8	8.1.8.4		FV1		Pressure Sand filters											
8	8.1.8.4.1				PVRF Filters	1						700		3200		Ø1500
8	8.1.8.4.2				PVRF Filters	1						700		3200		Ø1500
8	8.1.8.4.3				Service piping for filters	2 set										
8	8.1.8.4.4				Valves and accessories	2 set										
8	8.1.8.4.5				Pneumatic box	2 set										
8	8.1.8.4.6				Filtering media (quartz sand)	2 set										
8	8.1.8.5	30			Dosing station for NaOH											
8	8.1.8.5.1	30			PVRF Tank	1		10000	litres			350		3600		Ø2000
8	8.1.8.5.2	30			dosing pump	2						70				
8	8.1.8.5.3	30			valves, level switch and accessories	1										
8	8.1.8.6	30			Dosing station for H2SO4											
8	8.1.8.6.1	30			PVRF Tank	1		2500	litres							
8	8.1.8.6.2	30			dosing pump	2										
8	8.1.8.6.3	30			valves, level switch and accessories	1										
8	8.1.8.7	30			Dosing station for coagulant											
8	8.1.8.7.1	30			PVRF Tank	1		5000	litres							
8	8.1.8.7.2	30			dosing pump	2										
8	8.1.8.7.3	30			valves, level switch and accessories	1										
8		30			Valves and process instrumentation	1set										
8	8.1.9				Make up and service water system											



# CD-335 Equipment List



AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit					
													Rev.	Fluid	[KW]	[kg]	Lenght [mm]	Height [mm]
8	8.1.9.1	45	SA3	TK-845-01	Demi water storage tank	1												
8	8.1.9.1.1	45			PVRF water storage tank	1		10	m3			350		3400	2000			
8	8.1.9.1.2	45	PB2-1	PM-845-01	Pressurization Pump	1					3		900	1000	650			
8	8.1.9.1.3	45	PB2-2	PM-845-02	Pressurization Pump	1					3		900	1000	650			
8	8.1.9.1.4	45			Valves and accessories	2 set									Ø3"			
8	8.1.9.1.5	45	SE2	TK-845-02	Pressurization tank	1		5	m3			150		3000	1500			
8	8.1.9.1.6	45			Valves and accessories	1 set									Ø3"			
8	8.1.9.2		PB-		Industrial water press. System													
8	8.1.9.2.1	30	SE1	VE-830-01	Pressurization tank / Expansion vessel	1		5	m3			150		3000	1500			
8	8.1.9.2.2	30			Valves and accessories	1 set									Ø3"			
8	8.1.9.2.3	30	PB1-1	PM-830-52	Pressurization Pump	1					3		900	1000	650			
8	8.1.9.2.3	30	PB1-2	PM-830-52	Pressurization Pump	1					3		900	1000	650			
8	8.1.9.2.4	30			Valves and accessories	2 set									Ø3"			
8	8.1.9.3	30		DU-830-01	Demineralization unit													
8	8.1.9.3.1	30			Cationic exchange column with local control panel and service valves	1						2100	2300	3050	1300			
8	8.1.9.3.2	30			Anionic exchange column with local control panel and service valves	1												
8	8.1.9.4	30		DS-830-11	Dosing station for HCl (hydro cloric acid)													
8	8.1.9.4.1	30			HDPE Tank	1		500	l		0.18	250						
8	8.1.9.4.2	30		PM-830-54	dosing pump	1												
8	8.1.9.4.3	30			valves, level switch and accessories	1 set												





# CD-335 Equipment List



AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit			
													Rev.	Fluid	[KW]	[kg]
8	8.1.9.5	30		DS-830-12	Dosing station for NaOH											
8	8.1.9.5.1	30			HDPE Tank	1		500	l		0.18	250				
8	8.1.9.5.2	30		PM-830-55	dosing pump	1										
8	8.1.9.5.3	30			valves, level switch and accessories	1 set										
8	8.1.9.6	30		PS-830-21	Eluate Submergible pumping station											
8	8.1.9.6.1	30		PM-830-56	Submergible pump+motor	1					1.5	25				
8	8.1.9.6.2	30		PM-830-57	Submergible pump+motor	1					1.5	25				
8	8.1.9.6.3	30			Valves and accessories	2 set										
8	8.1.9.7	30			Valves and process instrumentation	1 set										
8	8.1.10				Icing Protections											
8	8.1.10.1				Electrical tracing and insulation						150	250				
8	8.1.10.1.1				Electrical tracing of instrument pipes	1 set										
8	8.1.10.1.2				Electrical tracing of valves (where necessary)	1 set										
8	8.1.10.1.3				Electrical tracing and insulation of make-up water tank	1 set										
8	8.1.10.1.4				Insulation of expansion tanks	2 set										
8	8.1.10.1.5				Insulation of pressure sand filters	3 set										
8	8.1.10.1.6				Insulation of pipelines inside WTP area	1 set										
8	8.1.11				Piping relevant to the WTP											
8	8.1.11.1				Piping											
8	8.1.11.1.1				Premounted piping inside WTP area	1set						4000				
8	8.1.11.1.2				Piping inside WTP	1set						70000				



# CD-335 Equipment List

AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit			
													Rev.	Fluid	[KW]	[kg]
8	8.1.12				Steel Structures and Supports											
8	8.1.12.1				Steel Structures and Supports											
8	8.1.12.1.1				Premounted steel structures and supports inside WTP	1 set						10000				
8	8.1.12.1.2				Stairs, gangway, protections and platforms inside WTP area	1 set						5000				
8	8.1.12.1.3				Steel structures and supports inside WTP	1 set						15000				
8	8.2	10		810	<b>Natural gas conditioning plant</b>	1	<i>supplied by Gaz Metro</i>									
8	8.5	80		880	<b>Electrical substation &amp; distribution</b>	1	<i>Scope of supply in the auxiliary equipment section, by ABB</i>									
8	8.7	98		898	<b>Fumes Treatment Plant</b>											
8	8.7.1	98		DC-898-01	Water Cooled Duct from EAF to DOB											
8	8.7.1.1	98			slide sleeve with mechanism and drive	1		44	m3/h	Carbon Steel pipe to pipe		5000				
8	8.7.1.2	98			fixed water cooled duct (31 m2)	1		44	m3/h	Carbon Steel pipe to pipe		5000	10000		950	
8	8.7.1.3	98			hidraulic cylinder and valves for titling	1						150				
8	8.7.1.4	98			supporting structure for w.c.d.	1						4000				
8	8.7.1.5	98			walkways and stairs	1						3000				
8	8.7.2	98		DO-898-01	Drop Out box (DOB)											
8	8.7.2.1	98			Side Walls	1				Concrete			7200	2000	2000	
8	8.7.2.2	98			Refractory lining	1				Refractory						
8	8.7.2.3	98			Water Cooled Roof (15 m2)	1		28	m3/h	Carbon Steel pipe to pipe		2900	7200		2000	
8	8.7.2.4	98			DOB Door (refractory lined)	1				Steel		800		2000	2000	
8	8.7.2.5	98			Door lifting hoist	1						200				
8	8.7.2.6	98			Instruments on board	1										

# CD-335 Equipment List

AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit			
													Rev.	Fluid	[KW]	[kg]
8	8.7.2.7	98			Anti explosion panel	1										
8	8.7.3	98		DU-898-01	WCDucts and Dry Ducts from DOB to main duct											
8	8.7.3.1	98			Supports for WCD	1						1100				
8	8.7.3.2	98			Water Cooled Ducts (20 m2)	1		36	m3/h	Carbon Steel pipe to pipe		5077	5722		1000	
8	8.7.3.3	98			Furnace pressure modulating valve	1					1.5	820				
8	8.7.3.4	98			expansion joints, textile part	1						300				
8	8.7.3.5	98			false air on/off valve	1						152				
8	8.7.3.5	98			primary dry ducts to main duct conjunction	1						6000				
8	8.7.3.6	98			supports for Dry Ducts	1						1200				
8	8.7.4	98		HO-898-01	Canopy Hood											
8	8.7.4.1	98			Canopy Hood	1										
8	8.7.4.2	98			Canopy Hood supporting Structure	1										
8	8.7.4.3	98			Modulating valve on canopy outlet	2					2 x 1,5	2840				
8	8.7.4.4	98			Ducts from canopy to filter	1						100				
8	8.7.4.5	98			Ducts supporting structures	1						20				
8	8.7.5.6	98			expansion joints, textile part	1						500				
8	8.7.5.7	98			walkways and stairs	1						6000				
8	8.7.5	98		DA-898-01	Safety Damper at Filtr Inlet											
8	8.7.5.1	98			Damper	1						450				
8	8.7.5.2	98			Pneumatic Drive	1						100				
8	8.5.7.3	98			instrumentation on board	1						10				



# CD-335 Equipment List



AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit			
													Rev.	Fluid	[KW]	[kg]
8	8.7.6	98		BF-898-01	Bag Filter Metallic Structure											
8	8.7.6.1	98			inlet expansion joint - textile part	1						300				
8	8.7.6.2	98			inlet expansion joint - machanical part	1						1				
8	8.7.6.3	98			filter supporting structures	1						11000				
8	8.7.6.4	98			dust collecting hoppers	1						36400				
8	8.7.6.5	98			filter body	1						40124				
8	8.7.6.6	98			section heads with clean gas valves	1						37800				
8	8.7.6.7	98			roof and penthouse cladding	1						25072				
8	8.7.6.8	98			service stairs	1						5070				
8	8.7.6.9	98			Electrical maintenance hoist	1						500				
8	8.7.6.10	98			Manual maintenance hoist	1						500				
8	8.7.6.11	98			outlet expansion joint - textile part	1						300				
8	8.7.6.12	98			outlet expansion joint - mechanical part	1						1				
8	8.7.7	98		BF-898-02	Bag Cleaning Equipment											
8	8.7.7.1	98			compressed air tank with valves	16 set						2800				
8	8.7.7.2	98			pneumatic accessories	16 set						700				
8	8.7.7.3	98			blowing pipes	160 pcs						0				
8	8.7.7.4	98			cylinder and pneumatic accessories for clean gas valves	16 set						2100				
8	8.7.7.5	98			Cylinder for raw gas valve	16 set						210				
8	8.7.7.6	98			dust level sensors	8 set						6				
8	8.7.7.7	98			hoppers vibrating equipment	12 set						36				



# CD-335 Equipment List



AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit		
													Rev.	Fluid	[KW]
8	8.7.7.8	98			pneumatic accessories	16 set						280			
8	8.7.7.9	98			compressed air main buffer tank	1 set						2000			
8	8.7.7.10	98			dp pressure meter	1 set						20			
8	8.7.7.11	98			abs pressure meter	1 set						20			
8	8.7.7.12	98			pipng for compressed air disttribution inside the filter	1 set						1500			
8	8.7.7.13	98			pipng for compressed air disttribution outside the filter	1 set						1500			
8	8.7.8	98		FE-898-01	Filtration Equipment										
8.7.8.1	8	98			filtering bags	2400 pcs						4320			
8.7.8.2	8	98			bag cages	2400 pcs						20400			
8.7.8.3	8	98			venturi pipes	2400 pcs						3600			
8.7.8.3	8	98			Pneumatic cylinders	16 pcs						128			
8.7.8.3	8	98			Comp'd air tanks	2400 pcs						3520			
8	8.7.9	98		CO-898-01	Dust Collection System										
8	8.7.9.1	98			slide gates below hoppers	16						1872			
8	8.7.9.2	98		CV-898-01/04	longitudinal chain conveyor	2					2 x 3	60000	20430		
8	8.7.9.3	98			rotary valves	2					2 x 0,37	400			
8	8.7.9.4	98		CV-898-02	transversal chain conveyor	1					3	18000	12070		
8	8.7.9.5	98		CV-898-03	vertical chain conveyor	1					9.2	35000	8213	16127 (lift)	
8	8.7.9.6	98			connection frames	6						5000			
8	8.7.10	98		DS-898-01	Dust Storage System										
8	8.7.10.1	98			dust silo supporting structures	1						12720			



# CD-335 Equipment List



AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit		
													Rev.	Fluid	[KW]
8	8.7.10.2	98		SL-898-01	dust silo body	1						7250			
8	8.7.10.3	98			stairs and platforms	1						4500			
8	8.7.10.4	98			fluidization and discharging system	1					2 x 1,1	3500			
8	8.7.10.5	98			silo dust level sensors	1						75			
8	8.7.11	98		FN-898-01/02	ID Fans										
8	8.7.11.1	98			filter outlet duct	1						5000			
8	8.7.11.2	98			anchor bolts for fans	2 sets									
8	8.7.11.3	98		FN-898-01 / 02	fan technological parts	2 sets						7000			
8	8.7.11.4	98		FN-898-01 / 02	fan casing	2 pcs						28600			
8	8.7.11.5	98		FN-898-01 / 02	fan baseframe	2 pcs									
8	8.7.11.6	98			fan inlet ducts	2 sets						4000			
8	8.7.11.7	98			fan outlet ducts	2 sets						40000			
8	8.7.11.8	98			inlet control valves with drive	2 pcs					2 x 1,5				
8	8.7.11.9	98			bearing temperature detection system	2 sets						32			
8	8.7.11.10	98			bearing vibration detection system	2 sets						40			
8	8.7.11.11	98			stairs and ladders	1						8000			
8	8.7.11.12	98			sound insulation	1						2000			
8	8.7.12	98		ST-898-01	Stack										
8	8.7.12.1	98			Fumes Stack	1						76200			
8	8.7.12.2	98			sound insulation inside the stack	1						500			
8	8.7.12.3	98			platform and ladders for stack	1						5500			



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AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit		
													Rev.	Fluid	[KW]
8	8.7.12.4	98			dust emissions detector	1						300			
8	8.7.12.5	98			thermocouples	1						30			
8	8.7.13	98			Medium and Low Voltage Equipment for FTP										
8	8.7.13.1	98		M-SR-685-01 / 02	fan motors	2 pcs					2 x 1000	12800			
8	8.7.13.2	98			MV metal closed cubicle switchboard	1									
8	8.7.13.3	98			cubicle for measuring and protection	1									
8	8.7.13.4	98			LV motors	1 set									
8	8.7.13.5	98			motor control center (MCC)	1 set									
8	8.7.13.6	98			emergency safety relays cabinet	1 set									
8	8.7.13.7	98			UPS cabinet	1 set									
8	8.7.13.8	98			TDA cabinet (low voltage distribution)	1 set									
8	8.7.13.9	98			sensors, solenoids valves, instruments etc.	1 set									
8	8.7.13.10	98			opacimeter	1 set									
8	8.7.13.11	98			broken bag detection system	1 set									
8	8.7.13.12	98			local control boxes	1 set									
8	8.7.13.13	98			junction boxes	1 set									
8	8.8	97		897	<b>Cranes</b>										
8	8.8.1	97		OC-897-01	Bridge Crane - 15 Ton	1					23.5	10000	4570		18000 (span)
8	8.8.1.1	97		M-OC-897-01	Hoist Drive Motor	1					18.2				
8	8.8.1.2	97		R-OC-987-10	Speed Reducer										



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AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit			
													Rev.	Fluid	[KW]	[kg]
8	8.8.1.3	97		M-OC-897-02	Crab transverse motor	2					2					
8	8.8.1.4	97		R-OC-987-11	Speed Reducer											
8	8.8.1.5	97		M-OC-987-03	Overhead travelling motor	2					3.3					
8	8.8.1.6	97		R-OC-987-12	Speed Reducer											
8	8.8.1.7	97			Rail 50x40 mm of for 72 m of building length, including 4 stops			144	linear m							
8	8.8.2	97		OC-897-02	Bridge Crane - 15 Ton (pig casting)	1					23.5	10000	4570		18000 (span)	
8	8.8.2.1	97		M-OC-987-04	Hoist Drive Motor	1					18.2					
8	8.8.2.2	97		R-OC-987-13	Speed Reducer											
8	8.8.2.3	97		M-OC-897-05	Crab transverse motor	2					2					
8	8.8.2.4	97		R-OC-987-14	Speed Reducer											
8	8.8.2.5	97		M-OC-897-06	Overhead travelling motor	2					3.3					
8	8.8.2.6	97		R-OC-987-15	Speed Reducer											
8	8.8.2.7	97			Rail 50x40 mm of for 72 m of building length, including 4 stops			144	linear m							
8	8.8.3	97		OC-897-03	Overhead Crane for Hot Metal Ladles	1		180 (auxiliary 50)	metric tonnes		707	294000			27000 (span)	
8	8.8.3.1	97		M-OC-897-07	Drive Motor						200					
8	8.8.3.2	97		R-OC-987-01	Speed Reducer											
8	8.8.3.3	97		M-OC-897-08	Drive Motor						200					
8	8.8.3.4	97		R-OC-897-02	Speed Reducer											
8	8.8.3.5	97		M-OC-897-09	Auxiliary Mech. Motor						90					
8	8.8.3.6	97		R-OC-897-03	Speed Reducer											
8	8.8.3.7	97		M-OC-897-10	Trolley Motor						18.5					



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AREA	ITEM	SUBAREA	TAG TENOVA	TAG TECHINT	EQUIPMENT TYPE	QTY.	Material Requisition	Design Capacity	Units	Material	Power	WEIGHT (Empty)	Aprox. Main Dimensions per Unit			
													Rev.	Fluid	[KW]	[kg]
8	8.8.3.8	97		R-OC-897-04	Speed Reducer											
8	8.8.3.9	97		M-OC-897-11	Trolley Motor						18.5					
8	8.8.3.10	97		R-OC-897-05	Speed Reducer											
8	8.8.3.11	97		M-OC-897-12	Bridge travelling Motor						45					
8	8.8.3.12	97		R-OC-897-06	Speed Reducer											
8	8.8.3.13	97		M-OC-897-13	Bridge travelling Motor						45					
8	8.8.3.14	97		R-OC-897-07	Speed Reducer											
8	8.8.3.15	97		M-OC-897-14	Bridge travelling Motor						45					
8	8.8.3.16	97		R-OC-897-08	Speed Reducer											
8	8.8.3.17	97		M-OC-897-15	Bridge travelling Motor						45					
8	8.8.3.18	97		R-OC-897-09	Speed Reducer											
8	8.8.3.19	97			Rail of for 182 m of building length, including ancles, anti-vibration band, 4			364	linear m							
8	8.9	96		896	<b>Diesel Fuel Gas station</b>	1	<i>(provided by third party - slag handling company)</i>									
8	8.10	96			<b>Sanitary Water (Norda Stelo)</b>	1	<i>(scope of supply: please refer to the auxiliary equipment section)</i>									



## 10.2.2 Electrical Equipment List

The following pages present the equipment list specifically prepared for electrical equipment.

 		<b>ELECTRICAL EQUIPMENT LIST</b>	<b>TECHINT N°:</b> 3786-TARG-E-EL-000-001  <b>CUSTOMER N°:</b>	Rev: 0
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PIG IRON PRODUCTION PLANT - CLASS 2 FS

TAG TECHINT	DESCRIPTION	QUANTITY	UNIT	ELECTRICAL FEATURES	DIMENSIONS H x W x D (mm)	WEIGHT (Kg)	SINGLE LINE DIAGRAM N°	COMMENTS
<b>161/34,5/4,16 kV SUBSTATION</b>								
SUB-DS-001	Three Pole Vertical Disconnect Switch (motor Operated), c/w manual ground switch	1	Each	170 kV; 31,5 kA; 1250 A			3786-TARG-E-OD-000-001	
SUB-CB-001	HV Circuit Breaker Combined with bushing CTs (1250/5A, MR, 2 on each bushing) + SF6 gas for field filling	1	Each	170 kV; 31,5 kA; 1250 A			3786-TARG-E-OD-000-001	
SUB-VT-001	Voltage Transformer VT	3	Each	170 kV; 170 kV/√3; 115V/√3; 2x0.3 WXYZ			3786-TARG-E-OD-000-001	
SUB-SA-001	ZnO Surge Arrester; c/w insulating base and counter	6	Each	170 kV; 120 kV MCOV; 31,5 kA			3786-TARG-E-OD-000-001	
SUB-TR-001	Power Transformer (Oil Immersed type)	1	Each	161 kV +/-8x1,5% / 34,5 kV/ 4,16 kV; 90 /65 /25 MVA; 31,5 kA; 60 Hz 3 Ph; YNynyn1.			3786-TARG-E-OD-000-001	
SUB-NGR-001	Neutral Grounding Resistor	1	Each	4,16 kV/√3			3786-TARG-E-OD-000-001	
SUB-NGR-002	Neutral Grounding Resistor	1	Each	34,5 kV/√3			3786-TARG-E-OD-000-001	
<b>STATIC Var COMPENSATOR (SVC)</b>								
SUB-SVC-001	SVC System	1	Global	Converter +/- 100 MVA; Three Harmonic Filters, c/w regulation and control			3786-TARG-E-OD-000-002	
<b>SUBSTATION ELECTRICAL CABIN CE-01</b>								
01-SWG-001	MV Indoor Switchgear	1	Each	36 kV; 60 Hz; 3ph; Bus 2500A; 31,5 kA; 1x Incoming Breaker 2500A; 4x Feeder Breaker 1250A; 1x spare Panel	2662x6200x2600	6510	3786-TARG-E-OD-000-002	Dimensions and Weight obtained to ABB offer
01-SWG-002	MV Indoor Switchgear	1	Each	4,16 kV; 60 Hz; 3ph; Bus 4000A; 40 kA; 1x Incoming Breaker 4000A; 7x Feeder Breaker 1250A; 1x spare Panel	2533x5610x1890	6800	3786-TARG-E-OD-000-002 / 003	Dimensions and Weight obtained to ABB offer
01-TR-001	Secondary Unit Substation Transformer (Dry type)	1	Each	34,5 kV/ 0,6-0,346 kV; 630 kVA; 3 ph; 60 Hz; Dyn1	2590x3048x1800	4873	3786-TARG-E-OD-000-002	Dimensions and Weight obtained to ABB offer
01-MCC-001	MCC Substation & Services	1	Each	0,6-0,346 kV; 3 ph/4w; 60 Hz			3786-TARG-E-OD-000-002	TBD By Vendor Substation
<b>ELECTRICAL CABIN CE-10-EAF</b>								
10-EAF-EEQ	EAF electrical Equipment	1	Global	Including: - 34,5 kV Disconnect Switches c/w ground Switch - 34,5 kV; Vacuum Circuit Breaker 2500A; 31,5 kA - Transformer 34,5kV / 660V; 55 MVA; 60 Hz; 3ph; Ucc=8% - CT's, surge arrester and auxiliary equipment.			3786-TARG-E-OD-000-002	TBD by TENOVA



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ELECTRICAL EQUIPMENT LIST

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PIG IRON PRODUCTION PLANT - CLASS 2 FS

TAG TECHINT	DESCRIPTION	QUANTITY	UNIT	ELECTRICAL FEATURES	DIMENSIONS H x W x D (mm)	WEIGHT (Kg)	SINGLE LINE DIAGRAM N°	COMMENTS
<b>ELECTRICAL CABIN CE-02 STEEL MELT SHOP</b>								
02-SWG-001	MV Indoor Switchgear	1	Each	4,16 Kv; 3PH; 1200A; 25kA; 60Hz 1x Incoming Breaker 1200A; 3x Feeder Breaker 1200A	2413x2742x2337	TBD	3786-TARG-E-OD-000-002	Dimensions and Weight obtained to ABB offer
02-TR-001	Dry Type Transformer	1	Each	2500kVA; 4,16/0,6-0,346 kV; Dy11n; NEMA 1 (Indoor Ventilated)	2590x3200x1676	5875	3786-TARG-E-OD-000-002	Dimensions and Weight obtained to ABB offer
02-PWC-001	LV Indoor Power Center	1	Each	600 V; 3ph; Bus 2500A; 42kA; 60Hz; 1x Incoming Breaker 2500A; 3x Feeder Breaker 630A; 1x Feeder Breaker 400A; 4x Feeder Breaker 250A	2300x3040x500	1750	3786-TARG-E-OD-000-002	Dimensions and Weight obtained to ABB offer
02-MCC-001	LV MCC EAF	1	Each	600V; 3 ph; 60 Hz	TBD	TBD	3786-TARG-E-OD-000-002	TBD by TENOVA
02-MCC-002	LV MCC Casting Bay Crane	1	Each	600V; 3 ph; 60 Hz	TBD	TBD	3786-TARG-E-OD-000-002	TBD by VENDOR
02-MCC-003	LV MCC Refractory Bay Crane	1	Each	600V; 3 ph; 60 Hz	TBD	TBD	3786-TARG-E-OD-000-002	TBD by VENDOR
02-MCC-004	LV MCC Lighting & sockets	1	Each	600V; 3 ph; 60 Hz	TBD	TBD	3786-TARG-E-OD-000-002	TBD by VENDOR
02-MCC-005	LV MCC Mat Handling	1	Each	600V; 3 ph; 60 Hz	TBD	TBD	3786-TARG-E-OD-000-002	TBD by VENDOR
02-MCC-006	LV MCC HVAC	1	Each	600V; 3 ph; 60 Hz	TBD	TBD	3786-TARG-E-OD-000-002	TBD by VENDOR
02-MCC-007	LV MCC Workshop	1	Each	600V; 3 ph; 60 Hz	TBD	TBD	3786-TARG-E-OD-000-002	TBD by VENDOR
<b>ELECTRICAL CABIN CE-04 PIG CASTER</b>								
04-MCC-001	LV Indoor MCC	1	Each	0,6-0,346 kV; 3 ph/4w; 60 Hz	N/A	N/A	3786-TARG-E-OD-000-002	TBD by VENDOR
<b>ELECTRICAL CABIN CE-DR-B DRI REDUCING GAS &amp; CO2 REMOVAL</b>								
DRB-ISW-001	MV Indoor Interrupter Switch	1	Each	4,16 Kv; 3PH; 600A; 40kA; 60Hz	2286x915x1524	547	3786-TARG-E-OD-000-003	Dimensions and Weight obtained to ABB offer
DRB-TR-001	Dry Type Transformer	1	Each	1250kVA; 4,16/0,6-0,346 kV; Dy11n; NEMA 1 (Indoor Ventilated)	2286x2590x1524	3882	3786-TARG-E-OD-000-003	Dimensions and Weight obtained to ABB offer
DRB-PWC-001	LV Indoor Power Center	1	Each	600 V; 3ph; Bus 1600A; 42kA; 60Hz; 1x Incoming Breaker 1250A; 2x Feeder Breaker 800A; 1x Feeder Breaker 250A	2300x1640x500	1050	3786-TARG-E-OD-000-003	Dimensions and Weight obtained to ABB offer
DRB-MCC-001	LV MCC Reducing gas & CO2 removal	1	Each	0,6-0,346 kV; 3 ph/4w; 60 Hz	TBD	TBD	3786-TARG-E-OD-000-003	TBD by VENDOR
DRB-MCC-002	LV MCC Lighting, sockets & HVAC	1	Each	0,6-0,346 kV; 3 ph/4w; 60 Hz	TBD	TBD	3786-TARG-E-OD-000-003	TBD by VENDOR



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ELECTRICAL EQUIPMENT LIST




TECHINT N°:  
3786-TARG-E-EL-000-001

CUSTOMER N°:

Rev: 0

PIG IRON PRODUCTION PLANT - CLASS 2 FS

TAG TECHINT	DESCRIPTION	QUANTITY	UNIT	ELECTRICAL FEATURES	DIMENSIONS H x W x D (mm)	WEIGHT (Kg)	SINGLE LINE DIAGRAM N°	COMMENTS
<b>ELECTRICAL CABIN CE-05</b>								
05-SWG-001	MV Indoor Switchgear	1	Each	4,16 Kv; 3PH; 1200A; 25kA; 60Hz 1x Incoming Breaker 1200A; 7x Feeder Breaker 1200A	2413x4570x2337	TBD	3786-TARG-E-OD-000-003	Dimensions and Weight obtained to ABB offer
05-SWG-002	MV Indoor Switchgear	1	Each	4,16 Kv; 3PH; 1200A; 25kA; 60Hz 1x Incoming Breaker 1200A; 4x Feeder Breaker 1200A	2413x2742x2337	TBD	3786-TARG-E-OD-000-003	Dimensions and Weight obtained to ABB offer
05-SWG-003	MV Indoor Switchgear	1	Each	4,16 Kv; 3PH; 1200A; 25kA; 60Hz 1x Incoming Breaker 1200A; 4x Feeder Breaker 1200A	2413x2742x2337	TBD	3786-TARG-E-OD-000-003	Dimensions and Weight obtained to ABB offer
05-VFD-001	MV VFD (Air Fan #1)	1	Each	4,16 Kv; 3PH; 0-75Hz; 2000HP; Direct to line; Cooling type Air	2800x2915x1100	3700	3786-TARG-E-OD-000-003	Dimensions and Weight obtained to ABB offer
05-VFD-002	MV VFD (Air Fan #2)	1	Each	4,16 Kv; 3PH; 0-75Hz; 2000HP; Direct to line; Cooling type Air	2800x2915x1100	3700	3786-TARG-E-OD-000-003	Dimensions and Weight obtained to ABB offer
05-VFD-003	MV VFD (Air Fan #3)	1	Each	4,16 Kv; 3PH; 0-75Hz; 2000HP; Direct to line; Cooling type Air	2800x2915x1100	3700	3786-TARG-E-OD-000-003	Dimensions and Weight obtained to ABB offer
05-TR-001	Dry Type Transformer	1	Each	2500kVA; 4,16/0,6-0,346 kV; Dy11n; NEMA 1 (Indoor Ventilated)	2590x3200x1676	5875	3786-TARG-E-OD-000-003	Dimensions and Weight obtained to ABB offer
05-TR-002	Dry Type Transformer	1	Each	630kVA; 4,16/0,6-0,346 kV; Dy11n; NEMA 1 (Indoor Ventilated)	2286x2286x1981	2228	3786-TARG-E-OD-000-003	Dimensions and Weight obtained to ABB offer
05-TR-003	Dry Type Transformer	1	Each	200kVA; 4,16/0,6-0,346 kV; Dy11n; NEMA 1 (Indoor Ventilated)	2286x1981x1981	1455	3786-TARG-E-OD-000-003	Dimensions and Weight obtained to ABB offer
05-TR-004	Dry Type Transformer	1	Each	200kVA; 4,16/0,6-0,346 kV; Dy11n; NEMA 1 (Indoor Ventilated)	2286x1981x1981	1455	3786-TARG-E-OD-000-003	Dimensions and Weight obtained to ABB offer
05-PWC-001	LV Indoor Power Center	1	Each	600 V; 3ph; Bus 2500A; 42kA; 60Hz; 1x Incoming Breaker 2500A; 2x Feeder Breaker 800A; 1x Feeder Breaker 400A; 2x Feeder Breaker 250A	2300x2040x500	1050	3786-TARG-E-OD-000-003	Dimensions and Weight obtained to ABB offer
05-PWC-002	LV Indoor Power Center	1	Each	600 V; 3ph; Bus 800A; 42kA; 60Hz; 1x Incoming Breaker 630A; 4x Feeder Breaker 250	2300x1040x500	700	3786-TARG-E-OD-000-003	Dimensions and Weight obtained to ABB offer
05-EDG-001	Emergency Diesel Engine Generator including: - Fuel tank 3000 lts - Automatic transfer panel - Battery Bank & Battery Charger - Container	1	Each	600 V; 3ph; 60Hz ; 1250 kVA	4000x12000x2500	18000		Estimated dimensions and weight
05-MCC-001	LV MCC Gas Processing Area (DRI Core Area)	1	Each	600V; 3 ph; 60 Hz	TBD	TBD	3786-TARG-E-OD-000-003	TBD by VENDOR
05-MCC-002	LV MCC Material Handling (DRI Core Area)	1	Each	600V; 3 ph; 60 Hz	TBD	TBD	3786-TARG-E-OD-000-003	TBD by VENDOR
05-MCC-003	LV MCC RMH Euromec (DRI Core Area)	1	Each	600V; 3 ph; 60 Hz	TBD	TBD	3786-TARG-E-OD-000-003	TBD by VENDOR
05-MCC-004	LV MCC Lighting, sockets & HVAC (DRI Core Area)	1	Each	600V; 3 ph; 60 Hz	TBD	TBD	3786-TARG-E-OD-000-003	TBD by VENDOR
05-MCC-005	LV MCC (DRI Bins Area)	1	Each	600V; 3 ph; 60 Hz	TBD	TBD	3786-TARG-E-OD-000-003	TBD by VENDOR
05-MCC-006	LV MCC Iron Ore Handling (Iron Ore Unloading Area)	1	Each	600V; 3 ph; 60 Hz	TBD	TBD	3786-TARG-E-OD-000-003	TBD by VENDOR
05-MCC-007	LV MCC Rail Trucs Unloading Machine (Iron Ore Unloading Area)	1	Each	600V; 3 ph; 60 Hz	TBD	TBD	3786-TARG-E-OD-000-003	TBD by VENDOR
05-MCC-008	LV MCC Lighting, sockets & HVAC (Iron Ore Unloading Area)	1	Each	600V; 3 ph; 60 Hz	TBD	TBD	3786-TARG-E-OD-000-003	TBD by VENDOR
05-MCC-009	LV MCC Bag Filter	1	Each	600V; 3 ph; 60 Hz	TBD	TBD	3786-TARG-E-OD-000-003	TBD by VENDOR

 		<b>ELECTRICAL EQUIPMENT LIST</b>	<b>TECHINT N°:</b> 3786-TARG-E-EL-000-001  <b>CUSTOMER N°:</b>	Rev: 0
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**PIG IRON PRODUCTION PLANT - CLASS 2 FS**

TAG TECHINT	DESCRIPTION	QUANTITY	UNIT	ELECTRICAL FEATURES	DIMENSIONS H x W x D (mm)	WEIGHT (Kg)	SINGLE LINE DIAGRAM N°	COMMENTS
<b>ELECTRICAL CABIN CE-06 MAIN OFFICES</b>								
06-ISW-001	MV Indoor Interrupter Switch	1	Each	4,16 Kv; 3PH; 600A; 40kA; 60Hz	2286x915x1524	547	3786-TARG-E-OD-000-003	Dimensions and Weight obtained to ABB offer
06-TR-001	Dry Type Transformer	1	Each	630kVA; 4,16/0,6-0,346 kV; Dy11n; NEMA 1 (Indoor Ventilated)	2286x2286x1981	2228	3786-TARG-E-OD-000-003	Dimensions and Weight obtained to ABB offer
06-PWC-001	LV Indoor Power Center	1	Each	600 V; 3ph; Bus 800A; 42kA; 60Hz;1x Incoming Breaker 630A; 4x Feeder Breaker 250A;	2300x1040x500	700	3786-TARG-E-OD-000-003	Dimensions and Weight obtained to ABB offer
06-MCC-001	LV MCC Gas Station	1	Each	600V; 3 ph; 60 Hz	TBD	TBD	3786-TARG-E-OD-000-003	TBD by VENDOR
06-MCC-002	LV MCC Main Office Aux. Services	1	Each	600V; 3 ph; 60 Hz	TBD	TBD	3786-TARG-E-OD-000-003	TBD by VENDOR
06-MCC-003	LV MCC Lighting, sockets & HVAC	1	Each	600V; 3 ph; 60 Hz	TBD	TBD	3786-TARG-E-OD-000-003	TBD by VENDOR
<b>ELECTRICAL CABIN CE-WTP WATER TREATMENT PLANT</b>								
WTP-ISW-001	MV Indoor Interrupter Switch	1	Each	4,16 Kv; 3PH; 600A; 40kA; 60Hz	2286x915x1524	547	3786-TARG-E-OD-000-003	Dimensions and Weight obtained to ABB offer
WTP-ISW-002	MV Indoor Interrupter Switch	1	Each	4,16 Kv; 3PH; 600A; 40kA; 60Hz	2286x915x1524	547	3786-TARG-E-OD-000-003	Dimensions and Weight obtained to ABB offer
WTP-TR-001	Dry Type Transformer	1	Each	2500kVA; 4,16/0,6-0,346 kV; Dy11n; NEMA 1 (Indoor Ventilated)	2590x3200x1676	5875	3786-TARG-E-OD-000-003	Dimensions and Weight obtained to ABB offer
WTP-TR-002	Dry Type Transformer	1	Each	2500kVA; 4,16/0,6-0,346 kV; Dy11n; NEMA 1 (Indoor Ventilated)	2590x3200x1676	5875	3786-TARG-E-OD-000-003	Dimensions and Weight obtained to ABB offer
WTP-PWC-001	LV Indoor Power Center	1	Each	600 V; 3ph; Bus 2500A; 42kA; 60Hz;1x Incoming Breaker 2500A; 2x Feeder Breaker 1250A; 2x Feeder Breaker 250A	2300x2740x500	1400	3786-TARG-E-OD-000-003	Dimensions and Weight obtained to ABB offer
WTP-PWC-002	LV Indoor Power Center	1	Each	600 V; 3ph; Bus 2500A; 42kA; 60Hz;1x Incoming Breaker 2500A; 1x Feeder Breaker 1250A; 3x Feeder Breaker 250A	2300x2140x500	1050	3786-TARG-E-OD-000-003	Dimensions and Weight obtained to ABB offer
WTP-MCC-001	LV MCC Make-Up Water	1	Each	600V; 3 ph; 60 Hz	TBD	TBD	3786-TARG-E-OD-000-003	TBD by VENDOR
WTP-MCC-002	LV MCC HYL Ind. Cool. Water#1	1	Each	600V; 3 ph; 60 Hz	TBD	TBD	3786-TARG-E-OD-000-003	TBD by VENDOR
WTP-MCC-003	LV MCC HYL Ind. Cool. Water#2	1	Each	600V; 3 ph; 60 Hz	TBD	TBD	3786-TARG-E-OD-000-003	TBD by VENDOR
WTP-MCC-004	LV MCC HYL Dir. Cool Water	1	Each	600V; 3 ph; 60 Hz	TBD	TBD	3786-TARG-E-OD-000-003	TBD by VENDOR
WTP-MCC-005	LV MCC EAF Non Contact Water	1	Each	600V; 3 ph; 60 Hz	TBD	TBD	3786-TARG-E-OD-000-003	TBD by VENDOR
WTP-MCC-006	LV MCC Lighting, sockets & HVAC	1	Each	600V; 3 ph; 60 Hz	TBD	TBD	3786-TARG-E-OD-000-003	TBD by VENDOR



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ELECTRICAL EQUIPMENT LIST

TECHINT N°:  
3786-TARG-E-EL-000-001

Rev: 0

CUSTOMER N°:

PIG IRON PRODUCTION PLANT - CLASS 2 FS

TAG TECHINT	DESCRIPTION	QUANTITY	UNIT	ELECTRICAL FEATURES	DIMENSIONS H x W x D (mm)	WEIGHT (Kg)	SINGLE LINE DIAGRAM N°	COMMENTS
<b>ELECTRICAL CABIN CE-BP BRIQUETTING PLANT</b>								
BP-ISW-001	MV Indoor Interrupter Switch	1	Each	4,16 Kv; 3PH; 600A; 40kA; 60Hz	2286x915x1524	547	3786-TARG-E-OD-000-003	<a href="#">Dimensions and Weight obtained to ABB offer</a>
BP-TR-001	Dry Type Transformer	1	Each	2500kVA; 4,16/0,6-0,346 kV; Dy11n; NEMA 1 (Indoor Ventilated)	2590x3200x1676	5875	3786-TARG-E-OD-000-003	<a href="#">Dimensions and Weight obtained to ABB offer</a>
BP-PWC-001	LV Indoor Power Center	1	Each	600 V; 3ph; Bus 2500A; 42kA; 60Hz; 1x Incoming Breaker 2500A; 1x Feeder Breaker 1250A; 1x Feeder Breaker 630A; 2x Feeder Breaker 250A	2300x2640x500	1400	3786-TARG-E-OD-000-003	<a href="#">Dimensions and Weight obtained to ABB offer</a>
BP-MCC-001	LV MCC Briquetting Plant	1	Each	600V; 3 ph; 60 Hz	TBD	TBD	3786-TARG-E-OD-000-003	TBD by VENDOR
BP-MCC-002	LV MCC RMH Briquetting Plant	1	Each	600V; 3 ph; 60 Hz	TBD	TBD	3786-TARG-E-OD-000-003	TBD by VENDOR
BP-MCC-003	LV MCC Lighting, sockets & HVAC	1	Each	600V; 3 ph; 60 Hz	TBD	TBD	3786-TARG-E-OD-000-003	TBD by VENDOR

### **10.2.3 Instrumentation Equipment List**

The following pages present the equipment list specifically prepared for instrumentation equipment.

INSTRUMENTATION, EQUIPMENT & SYSTEMS

Ar r S Fa	E m Nam	TAG	TAG	R	Ma r a D r	PFD 3 6-TARG-	UM	Q	I/O T	MATERIAL REQUISITION 3 6-TARG-	Pr (USD)	T a Pr (USD)	C mm	Gr I m
<b>GENERAL OF THE PLANT</b>														
015	FIRE FIGHTING SYSTEM		00000		Complete set of instrumentation and control equipment by Package Vendor					M-MR-000-003				
015					FIRE DETECTION SYSTEM	Part of Fire Fighting System	LT	---		Reference: 3786-TARG-I-BD-000-003				Las Salas Eléctricas son provistas con su propio sistema de detección Sistema único e integrado
015		FACP			Fire Alarm Panel	Dimensioning of system by bidder	ea	---		M-MR-000-003				
015		FGDV			Deluge Valves	Dimensioning of system by bidder	ea	---		M-MR-000-003				
015		FGHA			Beacon (Visual Alarm)	Dimensioning of system by bidder	ea	---		M-MR-000-003				
015		FGFD			Fire Detector	Dimensioning of system by bidder	ea	---		M-MR-000-003				
015		FGSD			Smoke Detector	Dimensioning of system by bidder	ea	---		M-MR-000-003				
015		FGMC			Manual Call Point	Dimensioning of system by bidder	ea	---		M-MR-000-003				
015		FGHS			Hand Switch / Pushbutton	Dimensioning of system by bidder	ea	---		M-MR-000-003				
015		FGBS			Horns (Audible Alarm)	Dimensioning of system by bidder	ea	---		M-MR-000-003				
<b>PIG IRON PRODUCTION PLANT</b>														
405	PORT		00000	B	By Others		X-FD-000-001	---	---	HOLD				DELETED
405	PIPE CONVEYOR	CV-105	00000	B	Complete set of instrumentation and control equipment by Package Vendor	TAKRAF	X-FD-000-001	---	---	Package PLC located in CE-4				DELETED
405	TRANSFER TOWER	TT-105	00000	B	Complete set of instrumentation and control equipment by Package Vendor	TAKRAF	X-FD-000-001	---	---					DELETED
405	CONVEYOR TT-DOME		00000	B	Complete set of instrumentation and control equipment by Package Vendor		X-FD-000-001	---	---					DELETED
210	DOME	SB-210-01	00000	B	Complete set of instrumentation and control equipment by Package Vendor		X-FD-000-001	---	---					
210	DOME	SB-210-02	00000	B	Complete set of instrumentation and control equipment by Package Vendor		X-FD-000-001	---	---					
210	GATE VALVES	GV-210-001/012	00000	B	Complete set of instrumentation and control equipment by Package Vendor	Pneumatic Actuation	X-FD-000-001	---	---	Controlled from PLC located in CE- HOLD				Acc. To dwg 3786-TARG-X-LY-200-003 Rev 0, valves are Knife Gates, tags KV-210-01 / 12
215	CONVEYOR TT-DOME	CV-215	00000	B	Complete set of instrumentation and control equipment by Package Vendor		X-FD-000-001	---	---					DELETED
310	SCREENING TOWER	ST-310-01	00000	B	Complete set of instrumentation and control equipment by Package Vendor		X-FD-000-001	---	---	Package PLC located in CE-05				Global I/O Count: 167 Iron Ore + Coating system EUROMECS scope
315	VIBRATING SCREENS	VS-315-01 / 02	00000	B	Complete set of instrumentation and control equipment by Package Vendor		X-FD-000-001	---	---	Package PLC located in CE-05				
320	RECLAIMER CONVEYOR	CV-320-01	00000	B	Complete set of instrumentation and control equipment by Package Vendor		X-FD-000-001	---	---	Package PLC located in CE-05				
325	REVERSIBLE BELT CONVEYOR	CV-325-01	00000	B	Complete set of instrumentation and control equipment by Package Vendor		X-FD-000-001	---	---	Package PLC located in CE-05				
326	FLEXOWELL	CV-326-01	00000	B	Complete set of instrumentation and control equipment by Package Vendor		X-FD-000-001	---	---	Package PLC located in CE-05				
327	FINES SILO	SL-327-01	00000	B	Complete set of instrumentation and control equipment by Package Vendor		X-FD-000-001	---	---	Package PLC located in CE-05				
	TRANSPORT SYSTEM TO FUTURE BRIQUETTING PLANT		00000	B	HOLD	HOLD	X-FD-000-001	---	---	Package PLC located in CE-5 FUTURE				REPLACED BY TRUCK
330	PNEUMATIC TRANSPORT LINE	BL-330-01	00000	B	Complete set of instrumentation and control equipment by Package Vendor	Truck unloading and silo loading are part of system to be supplied.	X-FD-300-001	---	---	Package PLC located in CE-05 Truck unloading: Local Control Panel HOLD				
330	SILO COATING SYSTEM	SL-330-01	00000	B	Complete set of instrumentation and control equipment by Package Vendor	Control of Lime addition to ore also by package vendor.	X-FD-000-001	---	---	Package PLC located in CE-05 Truck unloading: Local Control Panel				
330	BELT CONVEYOR	CV-330-01	00000	B	Complete set of instrumentation and control equipment by Package Vendor		X-FD-000-001	---	---	Package PLC located in CE-05				
335	BELT CONVEYOR	CV-335-01	00000	B	Complete set of instrumentation and control equipment by Package Vendor		X-FD-000-001	---	---	Package PLC located in CE-05				



INSTRUMENTATION, EQUIPMENT & SYSTEMS

Ar r S Fa	E m Nam	TAG	TAG	R	Ma r a D r	PFD 3 6-TARG-	UM	Q	I/O T	MATERIAL REQUISITION 3 6-TARG-	Pr (USD)	T a Pr (USD)	C mm	Gr	I m
340	REVERSIBLE BELT	CV-340-01	00000	B	Complete set of instrumentation and control equipment by Package Vendor	X-FD-000-001	---	---		Package PLC located in CE-05					
350	BELT CONVEYOR	CV-350-01	00000	B	Complete set of instrumentation and control equipment by Package Vendor	X-FD-000-001	---	---		Package PLC located in CE-05					
345	BELT CONVEYOR	WC-345-01 / 03	00000	B	Complete set of instrumentation and control equipment by Package Vendor	X-FD-000-001	---	---		Package PLC located in CE-05					
355	SURGE BINS	SB-355-01 / 03	00000	B	Complete set of instrumentation and control equipment by Package Vendor	X-FD-000-001	---	---		Package PLC located in CE-05					
360	FLEXOWELL	CV-360-01	00000	B	Complete set of instrumentation and control equipment by Package Vendor	X-FD-000-001	---	---		Package PLC located in CE-05					
365	BELT CONVEYOR	CV-365-01	00000	B	Complete set of instrumentation and control equipment by Package Vendor	X-FD-000-001	---	---		Package PLC located in CE-05					
400	BRIQUETTING PLANT		00000	B	Complete set of instrumentation and control equipment by Package Vendor	X-FD-000-001	---	---		Package PLC located in _____ HOLD					Global I/O Count: 436
500	DIRECT REDUCTION PLANT (DRI)		00000	B	Complete set of instrumentation and control equipment by Package Vendor	X-FD-000-001	---	---		Package PLC distributed between CE-DRB (CO2 Removal Area) and CE-05 rest of DR Plant areas.					Global I/O Count: 1930
610	FLEXOWELL	CV-610	00000	B	Complete set of instrumentation and control equipment by Package Vendor	X-FD-000-001	---	---		Package PLC located in CE-5					DELETED
600	ELECTRIC ARC FURNACE		00000	B	Complete set of instrumentation and control equipment by Package Vendor	X-FD-000-001	---	---		Package PLC's distributed between CE-10.EAF and CE-02					Global I/O Count: 420
371	LIME SILO	SL-371-01	00000	B	Complete set of instrumentation and control equipment by Package Vendor	---	---	---		Truck unloading and silo loading are part of system to be supplied. Control of Lime addition to process also by package vendor.					
371	DOLOMITIC LIME SILO	SL-371-02	00000	B	Complete set of instrumentation and control equipment by Package Vendor	---	---	---		Truck unloading and silo loading are part of system to be supplied. Control of Dolomite addition to process also by package vendor.					
371	BAUXITE SILO	SL-371-03	00000	B	Complete set of instrumentation and control equipment by Package Vendor	---	---	---		Truck unloading and silo loading are part of system to be supplied. Control of Bentonite addition to process also by package vendor.					
6..	HOT METAL LADLE HEATER		00000	B	Complete set of instrumentation and control equipment by Package Vendor	---	---	---		Includes Flame Safety System					
6..	LADLE DRYER STATION		00000	B	Complete set of instrumentation and control equipment by Package Vendor	---	---	---		Includes Flame Safety System					
715	PIG CASTING MACHINE	PC-715-01	00000	B	Complete set of instrumentation and control equipment by Package Vendor	X-FD-000-001	---	---		Package PLC located in CE-04					Global I/O Count: 424
715	LADLE TILTER	LT-715	00000	B		X-FD-000-001	---	---		Operating Workstations located in Main Control Room					
730	BELT CONVEYORS	CV-730	00000	B	Complete set of instrumentation and control equipment by Package Vendor	X-FD-000-001	---	---		Package PLC located in CE-4					DELETED
730	DIVERTER	DV-730	00000	B	Complete set of instrumentation and control equipment by Package Vendor	X-FD-000-001	---	---							DELETED
730	STORAGE BIN	SL-730	00000	B	Complete set of instrumentation and control equipment by Package Vendor	X-FD-000-001	---	---							DELETED
730	WEIGHING HOPPER	HO-730	00000	B	Complete set of instrumentation and control equipment by Package Vendor	X-FD-000-001	---	---							DELETED
730	VIBRATING FEEDER	VF-730	00000	B	Complete set of instrumentation and control equipment by Package Vendor	X-FD-000-001	---	---							DELETED
<b>AU ILIARY SERVICES &amp; FACILITIES</b>															
810	REDUCING GAS PLANT		00000	B	Complete set of instrumentation and control equipment by Package Vendor	R-BF-000-001	---	---	HOLD	Reducing Gas Plant by NG Transportist					HOLD - Reducing Gas Plant by NG Transportist Gaz Mtro
810				B	Metering Skid, ultrasonic flow transmitter x 2; PT; TT; flow computers	Not Shown	---	---		Reducing Gas Plant by NG Transportist					
810				B	Chromatograph HOLD pending NG transportist requirements	Not Shown	---	---		Reducing Gas Plant by NG Transportist					

INSTRUMENTATION, EQUIPMENT & SYSTEMS

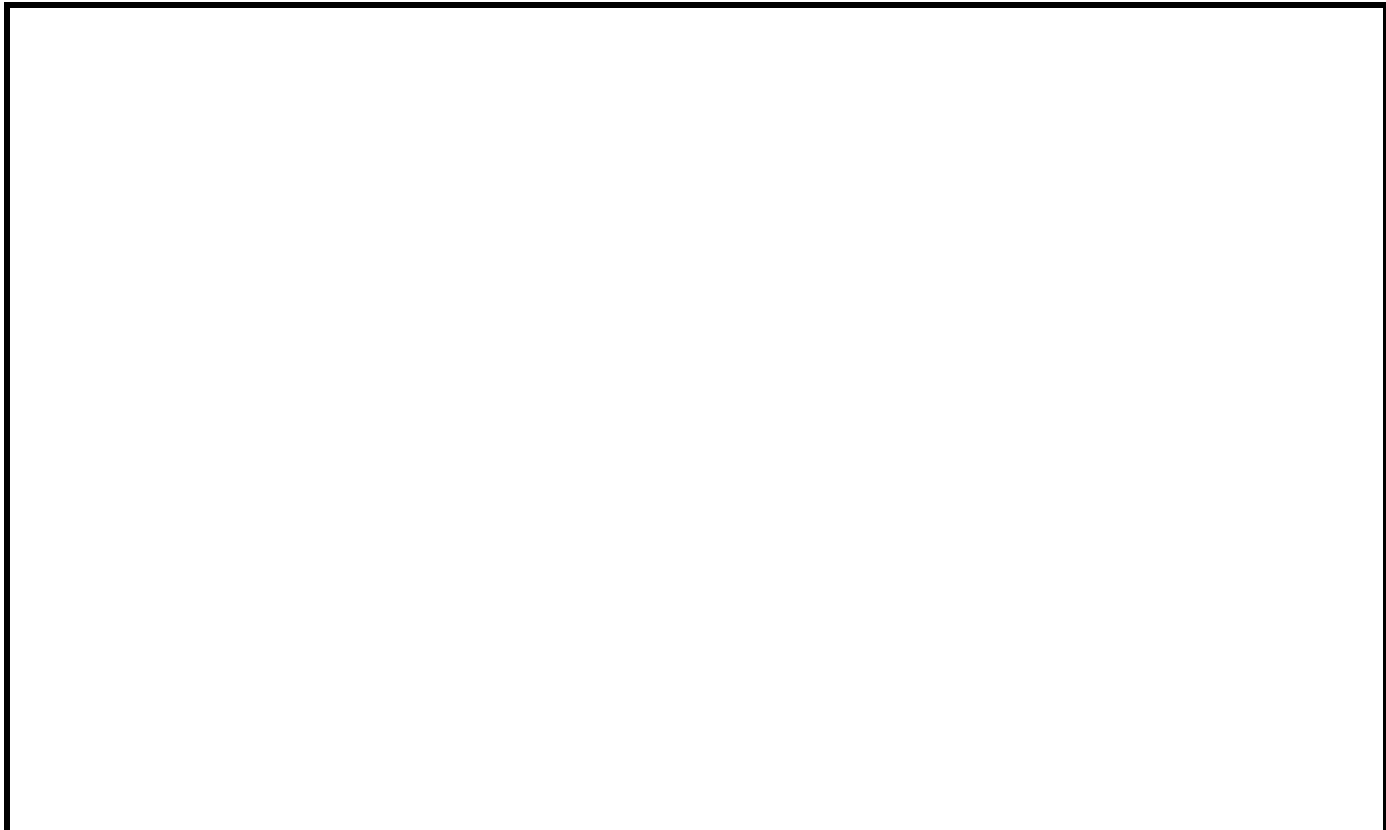
Ar r S Fa	E m Nam	TAG	TAG	R	Ma r a D r	PFD 3 6-TARG-	UM	Q	VO T	MATERIAL REQUISITION 3 6-TARG-	Pr (USD)	T a Pr (USD)	C mm	Gr	I m
810				B	Block valves 6" 300# (HOLD)		---	---		Reducing Gas Plant by NG Transportist					
810				B	Reducing Station HOLD - Industrial consumers		---	---		HOLD					
810				B	Reducing Station - Domestic consumers (4 pressure regulators, two PT)		---	---		HOLD					
810				B	Odorization system		---	---		HOLD					
815	NATURAL GAS DISTRIBUTION	XV	00000	B	On-Off Block valves 10" 150# CS Body Pneumatic Actuator (HOLD)	w/ SOLENOID VALVE and TWO LIMIT SWITCHES	Not Shown	ea	2	DO x 2 DI x 4	Location near consumers. Revised line sizes	I-MR-000-002	3786-TARG-I-SP-000001		RIO: by EPC Contractor
815	NATURAL GAS DISTRIBUTION	XV	00000	B	On-Off Block valves 3" 300# CS Body Pneumatic Actuator (HOLD)	w/ SOLENOID VALVE and TWO LIMIT SWITCHES	Not Shown	ea	3	DO x 3 DI x 6	Location near consumers Added NG to Air Heaters in process buildings Revised line sizes	I-MR-000-002	3786-TARG-I-SP-000001		RIO: by EPC Contractor
815	NATURAL GAS DISTRIBUTION	XV	00000	B	On-Off Block valves 2" 300# CS Body Pneumatic Actuator (HOLD)	w/ SOLENOID VALVE and TWO LIMIT SWITCHES	Not Shown	ea	16	DO x 16 DI x 32	Location near consumers Added NG to Air Heaters in process buildings Revised line sizes	I-MR-000-002	3786-TARG-I-SP-000001		RIO: by EPC Contractor
815	NATURAL GAS DISTRIBUTION	XV	00000	B	On-Off Block valves 1" 300# CS Body Pneumatic Actuator (HOLD)	w/ SOLENOID VALVE and TWO LIMIT SWITCHES	Not Shown	ea	9	DO x 9 DI x 18	Location near consumers Added NG to Air Heaters in process buildings Revised line sizes	I-MR-000-002	3786-TARG-I-SP-000001		RIO: by EPC Contractor
815	NATURAL GAS DISTRIBUTION	FE	00000	B	ORIFICE PLATES 8" w/ ORIFICE FLANGES 300#		Not Shown	ea	1	---	Location near consumers Added NG to Air Heaters in process buildings Revised line sizes	I-MR-000-002	3786-TARG-I-SP-000001		
815	NATURAL GAS DISTRIBUTION	FE	00000	B	ORIFICE PLATES 2" w/ ORIFICE FLANGES 300#		Not Shown	ea	8	---	Location near consumers Added NG to Air Heaters in process buildings Revised line sizes	I-MR-000-002	3786-TARG-I-SP-000001		
815	NATURAL GAS DISTRIBUTION	FE	00000	B	ORIFICE PLATES 3" w/ ORIFICE FLANGES 300#		Not Shown	ea	1	---	Location near consumers Added NG to Air Heaters in process buildings Revised line sizes	I-MR-000-002	3786-TARG-I-SP-000001		
815	NATURAL GAS DISTRIBUTION	FT	00000	B	DIFFERENTIAL PRESSURE TRANSMITTER		Not Shown	ea	10	AI x 10	Location near consumers Added NG to Air Heaters in process buildings Revised line sizes	I-MR-000-002	3786-TARG-I-SP-000001		RIO: by EPC Contractor
815	NATURAL GAS DISTRIBUTION	PT	00000	B	PRESSURE TRANSMITTER		Not Shown	ea	10	AI x 10	Location near consumers Added NG to Air Heaters in process buildings Revised line sizes	I-MR-000-002	3786-TARG-I-SP-000001		RIO: by EPC Contractor
815	NATURAL GAS DISTRIBUTION	PV	00000	B	CONTROL VALVE CS BODY 6" 300# PNEUMATIC ACTUATOR		Not Shown	ea	1	AO x 1	Location near consumers Added NG to Air Heaters in process buildings Revised line sizes	I-MR-000-002	3786-TARG-I-SP-000001		RIO: by EPC Contractor
815	NATURAL GAS DISTRIBUTION	PV	00000	B	CONTROL VALVE CS BODY 2" 300# PNEUMATIC ACTUATOR		Not Shown	ea	1	AO x 1	Location near consumers Added NG to Air Heaters in process buildings Revised line sizes	I-MR-000-002	3786-TARG-I-SP-000001		RIO: by EPC Contractor
815	NATURAL GAS DISTRIBUTION	PV	00000	B	CONTROL VALVE CS BODY 1" 300# PNEUMATIC ACTUATOR		Not Shown	ea	8	AO x 8	Location near consumers Added NG to Air Heaters in process buildings Revised line sizes	I-MR-000-002	3786-TARG-I-SP-000001		RIO: by EPC Contractor
825	WATER TREATMENT PLANT		00000	B	Complete set of instrumentation and control equipment by Package Vendor		R-BF-000-002 R-BF-840-001	---	---		Package PLC's located in CE-WTP	RAVAGNAN			Potable water Tank: By others
825	WATER TANK	LT			ULTRASONIC LEVEL TRANSMITTER, range 0 - 10m	w/ LOCAL LEVEL INDICATOR at operating level	Not Shown	ea	1	AI		I-MR-000-002	3786-TARG-I-SP-000001		
825		LSHH			HIGH LEVEL SWITCH OVERFILL PROTECTION		Not Shown	ea	1	DI		I-MR-000-002	3786-TARG-I-SP-000001		
825		PT			PRESSURE TRANSMITTER	LOW PROCESS WATER LEVEL	Not Shown	ea	1	AI		I-MR-000-002	3786-TARG-I-SP-000001		
825		---	---		ELECTRIC HEATER		Not Shown	ea	1	AI x 2 DI x 2		By others			
825	WATER INTAKE	FT		B	TURBINE METER (BADGER METER or similar) w/ strainer MESH 10, certified per CSA, fiscal metering purposes. 4" 150#	Normal flow: 95 m3/h Maximum flow: 120 m3/h	Not Shown	ea	1	AI		I-MR-000-002	3786-TARG-I-SP-000001		
825	WATER INTAKE	PT			PRESSURE TRANSMITTER		Not Shown	ea	1	AI		I-MR-000-002	3786-TARG-I-SP-000001		
825	WATER INTAKE	TT			TEMEPERATURE TRANSMITTER, RTD & THERMOWELL w/ U = 3" FLANGED 2" 150# verify per ASME 19.3	-50°C ~ 50°C	Not Shown	ea	1	AI		I-MR-000-002	3786-TARG-I-SP-000001		
825	WATER INTAKE	LV			CONTROL VALVE CS BODY 3" 150# PNEUMATIC ACTUATOR		Not Shown	ea	1	AO		I-MR-000-002	3786-TARG-I-SP-000001		
825	WATER DISTRIBUTION	PSV			THERMAL RELIEF VALVE CS BODY 3/4" NPT x 1" NPT		Not Shown	ea	12	---		I-MR-000-002	3786-TARG-I-SP-000001		
825	WATER DISTRIBUTION	PG			PRESSURE GAUGE		Not Shown	ea	8	---		I-MR-000-002	3786-TARG-I-SP-000001		
825		---	---		FIRE PUMPS SHELTER		R-BF-840-001	ea	1	DI x 3	Local control Panels inside Shelter (NFPA)	RAVAGNAN			Diesel Storage HOLD
825		PT			PRESSURE TRANSMITTER	Water Pumps discharge Pressure HOLD	Not Shown	ea	1	AI		I-MR-000-002	3786-TARG-I-SP-000001		
836	POTABLE WATER		00000	B	Complete set of instrumentation and control equipment by Package Vendor	PART OF 825 WATER TREATMENT PLANT: HOLD	R-BF-000-002	---	---		See 825 Package	---			Potable Water Plant: DELETED: Inlet from City Water Net
835	POTABLE WATER DISTRIBUTION		00000		By Others		Not Shown								
855	DOMESTIC EFFLUENT WATER SYSTEM		00000		Complete set of instrumentation and control equipment by Package Vendor Collection, treatment, storage / disposal	By others		---	---		Local Control Panel	---			
860	INDUSTRIAL EFFLUENT WATER SYSTEM		00000		Complete set of instrumentation and control equipment by Package Vendor Collection, treatment, storage / disposal	By others		---	---		Local Control Panel	---			
875	AIR COMPRESSORS PLANT		00000	B	Complete set of instrumentation and control equipment by Package Vendor	COMPRESSORS x 2 AIR DRYERS x 2 VOLUME TANK x 1	R-BF-000-001	---	---		Package PLC wired to CE-DRB	M-MR-000-001			
875	AIR HEADER	PT			PRESSURE TRANSMITTER			ea	3	AI		I-MR-000-002	3786-TARG-I-SP-000001		
875	AIR HEADER	PG		B	PRESSURE GAUGE			ea	2	---		I-MR-000-002	3786-TARG-I-SP-000001		
875	AIR HEADER	XV			ON-OFF BLOCK VALVE CS BODY 8" 150# PNEUMATIC ACTUATOR	w/ SOLENOID VALVE and TWO LIMIT SWITCHES		ea	1	DO x 1 DI x 2		I-MR-000-002	3786-TARG-I-SP-000001		

INSTRUMENTATION, EQUIPMENT & SYSTEMS

Ar r S Fa	E m Nam	TAG	TAG	R	Ma r a D r	PFD 3 6-TARG-	UM	Q	I/O T	MATERIAL REQUISITION 3 6-TARG-	Pr (USD)	T a Pr (USD)	C mm	Gr	I m
8..	AIR DISTRIBUTION	PG		B	PRESSURE GAUGE		ea	7	---	I-MR-000-002		3786-TARG-I-SP-000-001			
8..	AIR DISTRIBUTION	PT		B	PRESSURE TRANSMITTER		ea	7	AI	I-MR-000-002		3786-TARG-I-SP-000-001			
8..	AIR DISTRIBUTION	PCV		B	PRESSURE REGULATORS 4" 150# FLANGED CS BODY		ea	1	---	I-MR-000-002		3786-TARG-I-SP-000-001			
8..	AIR DISTRIBUTION	PCV		B	PRESSURE REGULATORS 3" 150# FLANGED CS BODY		ea	1	---	I-MR-000-002		3786-TARG-I-SP-000-001			
8..	AIR DISTRIBUTION	PCV		B	PRESSURE REGULATORS 1" 150# FLANGED CS BODY		ea	5	---	I-MR-000-002		3786-TARG-I-SP-000-001			
8..	OXIGEN			B	Complete set of instrumentation and control equipment by Package Vendor	Truck unloading, metering, storage, regulation.	R-BF-000-001	---	---			System Local control Panel Monitored from CE-02			
8..	O2 DISTRIBUTION	PT		B	PRESSURE TRANSMITTER	Ox g S r	Not Shown	ea	2	AI		I-MR-000-002	3786-TARG-I-SP-000-001		No pressure regulation foreseen
8..	NITROGEN			B	Complete set of instrumentation and control equipment by Package Vendor	Truck unloading, metering, storage, regulation.	R-BF-000-001	---	---			System Local control Panel Monitored from CE-02			
8..	N2 DISTRIBUTION	PT			PRESSURE TRANSMITTER		Not Shown	ea	2	AI		I-MR-000-002	3786-TARG-I-SP-000-001		
8..	N2 DISTRIBUTION	PG		B	PRESSURE GAUGE		Not Shown	ea	2	---		I-MR-000-002	3786-TARG-I-SP-000-001		
8..	N2 DISTRIBUTION	PCV			PRESSURE REGULATORS 2" 300# FLANGED CS BODY		Not Shown	ea	2	---		I-MR-000-002	3786-TARG-I-SP-000-001		
8..	ARGON		00000	B	Complete set of instrumentation and control equipment by Package Vendor	Truck unloading, metering, storage, regulation.	R-BF-000-001	---	---			System Local control Panel			DELETED
8..	Ar-DISTRIBUTION	PT		B	PRESSURE TRANSMITTER		Not Shown	ea	0	AI		I-MR-000-002			DELETED
880	MAIN SUBSTATION		00000	B	By Others		---	---	---			CE-01			Hydro Quebec
898	FUMES TREATMENT PLANT		00000	B	Complete set of instrumentation and control equipment by Package Vendor	Dust collection, fumes collection and cooling. Bag house.	---	---	---			Package PLC located in CE-05	TENOVA		Global I/O Count: 834
910	MAIN ADMINISTRATION BUILDING		00000	B	By Others		---	---	---			CE-06			
945	TRUCK CONTROL AREA		00000	B	By Others		---	---	---			CE-06			
950	ROAD SCALE		00000	B	By Others		---	---	---			CE-06			
955	RADIATION DETECTOR AT GATE		00000	B	By Others		---	---	---			CE-06			
960	FUEL / GAS STATION		00000	B	Complete set of instrumentation and control equipment by Package Vendor	Truck unloading, metering, storage, dispensing.	---	---	---			CE-05 (HOLD) System Local control Panel	M-MR-000-002		
970	SLAG PROCESSING PLANT		00000	B	Complete set of instrumentation and control equipment by Package Vendor	FUTURE	---	---	---			FUTURE			
975	PRIMARY SCRAP AREA		00000	B	NO INSTRUMENTATION FORESEEN	HOLD	---	---	---			HOLD			FUTURE? HOLD
980	LABORATORY		00000		By Others		---	---	---			Laboratory in Melting / Casting Building HOLD			


INSTRUMENTATION, EQUIPMENT & SYSTEMS

Ar r S Fa	E m Nam	TAG	TAG	R	Ma r a D r	PFD 3 6-TARG-	UM	Q	I/O T	MATERIAL REQUISITION 3 6-TARG-	Pr (USD)	T a Pr (USD)	C mm	Gr	I m
<b>CONTROL MONITORING &amp; TELECOMMUNICATIONS</b>															
				B	PROCESS CCTV SYSTEM	Cameras, Racks, Servers and Monitors				As a reference, 32 cameras estimated		I-MR-000-001			
				B	SURVEILLANCE CCTV SYSTEM	Cameras, Racks, Servers and Monitors				As a reference, 7 cameras estimated		I-MR-000-001			
				B	ACCESS CONTROL SYSTEM					Number of gates/doors to be defined by EPC Contractor		I-MR-000-001			
					IP PHONES	Phones, servers						I-MR-000-001			
	HOLD			B	PAGING SYSTEM		HOLD			As a reference, 18 speakers and 11 phone booths.		I-MR-000-001			
					TELECOMM	Racks, switches, patch panels, fiber optic converters, etc.				In.Progress		I-MR-000-001			
				B	CONTROL SYSTEM - PLC & SCADA SYSTEM					It was assumed to have three racks and a wall cabinet per each Electrical Room. Only supervision. This count doesn't include package PLCs		I-MR-000-003			
					INTEGRATION SERVICES					In.Progress		I-MR-000-003			



REV.	DESCRIPTION	DATE	PROJ.	EXEC.	CHECK.	APPR.
1	ISSUED	4/4/18	SAG	SAG	MES	MES
0	FOR INFORMATION	8/21/16	SAG	SAG	MES	MES
0	PRELIMINARY	6/9/16	SAG	SAG	KJS	MES

 Pure Fonte Ltée	<b>PURE FONTE LT E</b> <b>PIG IRON PRODUCTION PLANT FEASIBILITY STUDY</b> <b>CUSTOMER N 1 21</b>
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	TENOVA TECHINT ENGINEERING & CONSTRUCTION
	SECTION 10 – PLANT EQUIPMENT <b>CHAPTER 10 3</b> MAIN PROCESS EQUIPMENT

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	ESC.: N/A	JOB: CD-335	

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Chapter's references:

- [1] Dome Technology, "Cliffs Iron Mine – Iron Ore Bulk Storage – Canada," 21 August 2016. [Online]. Available: <https://www.dometechnology.com/projects/cliffs-iron-mine-iron-ore-bulk-storage-canada/>.

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## 10.3 Main Process Equipment

### 10.3.1 Dome storage

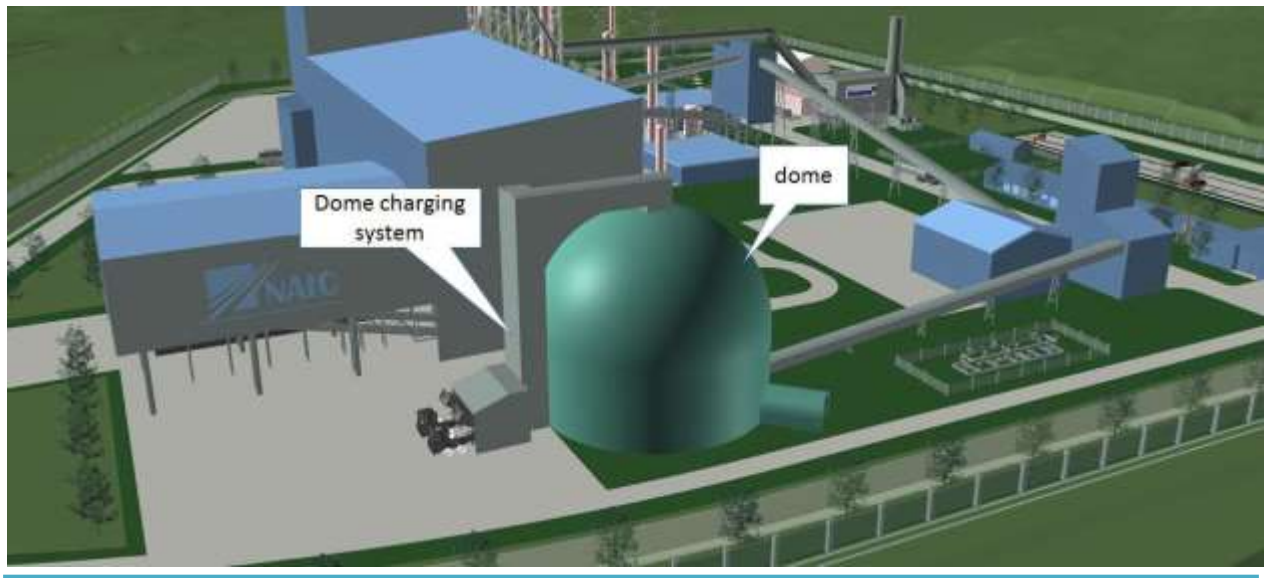


Figure 10.3-1.: position of the dome in the plant.



Figure 10.3-2.: IO bulk storage dome silos constructed by Dome Technology in Fermont, Québec [1]



Figure 10.3-3.: Primer applied in advance of polyurethane insulation [1]



Figure 10.3-4.: Shotcrete applied atop reinforcing steel forming the strong shell of the dome silo [1]

See attached the Dome Storage Technical Specification “DTP16 3790 Tenova QC Project Proposal – Iron Pellet Storage”.

# Dome Technology



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# PROJECT PROPOSAL

DTP16 3790 TENOVA QC PROJECT PROPOSAL - IRON PELLETT STORAGE

Prepared For:

Francesco Memoli / Tenova  
Cherrington Corporate Center 100 Corporate Center Drive  
Coraopolis, PA 15108, USA

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Proposal Date: April 20, 2016  
Proposal Number: DTP163790R1



# Table of Contents

Order	Description
1	Cover Letter
2	About Us
3	Project Overview
4	Scope of Work
5	Drawings
6	Schedule



We are pleased to provide Tenova with a proposal for one (1) 35m diameter x 30m tall, 46,000 metric ton iron pellets storage dome in Saguenay Canada.

As requested, we are providing a firm price for the following components:

- One (1) dome shell. (35m diameter x 30m tall)
- One (1) below grade tunnel. (3.05m width x 2.4m height x 117m length)
- One (1) dome entryway (6m width x 8m length x 4.75m height)
- Slated door to cover opening and resist product flow into entryway
- Apex curbs
- Hoppers & Gates

Sincerely,

A handwritten signature in black ink, appearing to read 'James Stoker', with a long horizontal flourish extending to the right.

**James Stoker**  
Business Development Manager

## About Us



### **Succeed with unmatched bulk-storage technology and design-build expertise**

Dome Technology designs and builds sophisticated dry-bulk storage structures, systems and complete projects for the world's industrial leaders storing various energy, cement, mining, and agricultural products. Over the past 35 years our team has successfully completed hundreds of projects at mines, ports, plants and elsewhere around the world.

#### **Who We Are**

Dome Technology was founded in 1975 by innovator Barry South and has since built over 550 domes around the world. Dome Technology aims to achieve its vision and mission to build a profitable, sustainable business recognized as the world leader in dome construction and bulk storage solutions. Dome Technology has assembled the most comprehensive experienced team of dome design, engineering, manufacturing and construction resources in the world. Dome Technology continues as the world leader in pioneering new advances, applications, and solutions for bulk storage applications, such as wood pellets, gypsum, fly ash, coal, grain, sugar, fertilizer, mining ores and other bulk products. Dome Technology provides its customers the best integrated design and quality-controlled, cost effective bulk storage systems on the planet.

#### **What We Do**

- Design-Build Project Delivery
- Value Engineering
- Front-End Engineering Design (FEED)
- Geotechnical Analysis & Engineering
- Structural, Mechanical, Electrical Engineering
- Procurement & Sub-Contract Management
- Construction Management & Quality Control
- Dome Construction
- Material Handling Systems Installation
- Tunnels Construction
- Maintenance



# Project Overview

Dome Technology gratefully submits this proposal with the objective to offer an innovative solution with minimal investment and provide the services set forth hereafter.

---

## Project Information

Project Name	DTP16 3790 Tenova QC
Location	Saguenay Canada
Contact	Francesco Memoli
Address	Cherrington Corporate Center 100 Corporate Center Drive Coraopolis, PA 15108, USA
Email	francesco.memoli@tenova.com
Telephone	412-262-2240

## Brief Project Summary

Tenova is looking to store Iron pellets that will be shipped in by a port and conveyed a few kilometers to the site. Dome Technology is proposing on the storage facility and the tunnel for reclaiming the material 117 meters from the dome.

---

## Handled Material Specification

Material Type	Iron Pellets
Material Volume Density	144
Material Structural Density	144
Dome Apex Load	250 kips
Storage Volume	metric
Angle of Repose	32
Filling Rate	3000 mtph
Reclaim Rate	100 mtph

# Scope of Work

This document identifies those items and activities that are required to perform this project and the responsible parties. This is based on the information shown in the Project Overview

## 1.00 Dome Technology Responsible For:

- 1.01 Excavation for dome and tunnel
- 1.02 Backfill for dome and tunnel
- 1.03 Concrete/shotcrete/rebar
- 1.04 Polyurethane insulation
- 1.05 Airform (White)
- 1.06 One (1) below grade tunnel. (3.05 width x 2.4m height x 117m length)
- 1.07 Ringbeam shallow footing
- 1.08 One (1) Dome Shell. (35m diameter x 30m height)
- 1.09 Apex curbs
- 1.10 Dome access opening (4.26m width x 4.9m height)
- 1.11 Slatted door
- 1.12 One (1) dome entryway (6m width x 8m length x 4.75m height)
- 1.13 Includes sales tax on Dome Technology material and equipment
- 1.14 Includes freight for Dome Technology material and equipment work scope
- 1.15 Includes contractor's license
- 1.16 Hoppers (AR 400)
- 1.17 Gates (AR 400)

## 2.00 Customer Responsible For:

- 2.01 Site surveying, survey points, benchmarks, baselines from which Dome Technology can layout the dome
- 2.02 Grading work
- 2.03 Builders risk insurance and deductible naming Dome Technology as an additional named insured
- 2.04 Prior to mobilization, all preliminary site preparations
- 2.05 Prior to mobilization, all required environmental and building permits
- 2.06 Temporary power panel with 208/220/240V 400 Amp 3 Phase power within 15.3m of dome entrance
- 2.07 Potable water within 15.3m of dome entrance to accommodate a 25.4mm hose at 40 psi
- 2.08 Removal and disposal of construction debris

## 3.00 Clarifications

- 3.01 Excludes deep foundations and soil improvements
- 3.02 Price is based on open shop (NON-UNION/NON-PREVAILING WAGES) construction
- 3.03 Design is based on current Canadian Building Code
- 3.04 Proposal valid for 60 days (Due to frequent changes in material pricing we require a requote after 60 days)






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### 10.3.2 Material Handling System for IO Pellets

The MHS for IO pellets consists of:

-  Transportation belts
-  Screening station (<3.2 mm) combined with the Coating station
-  Curing bin station

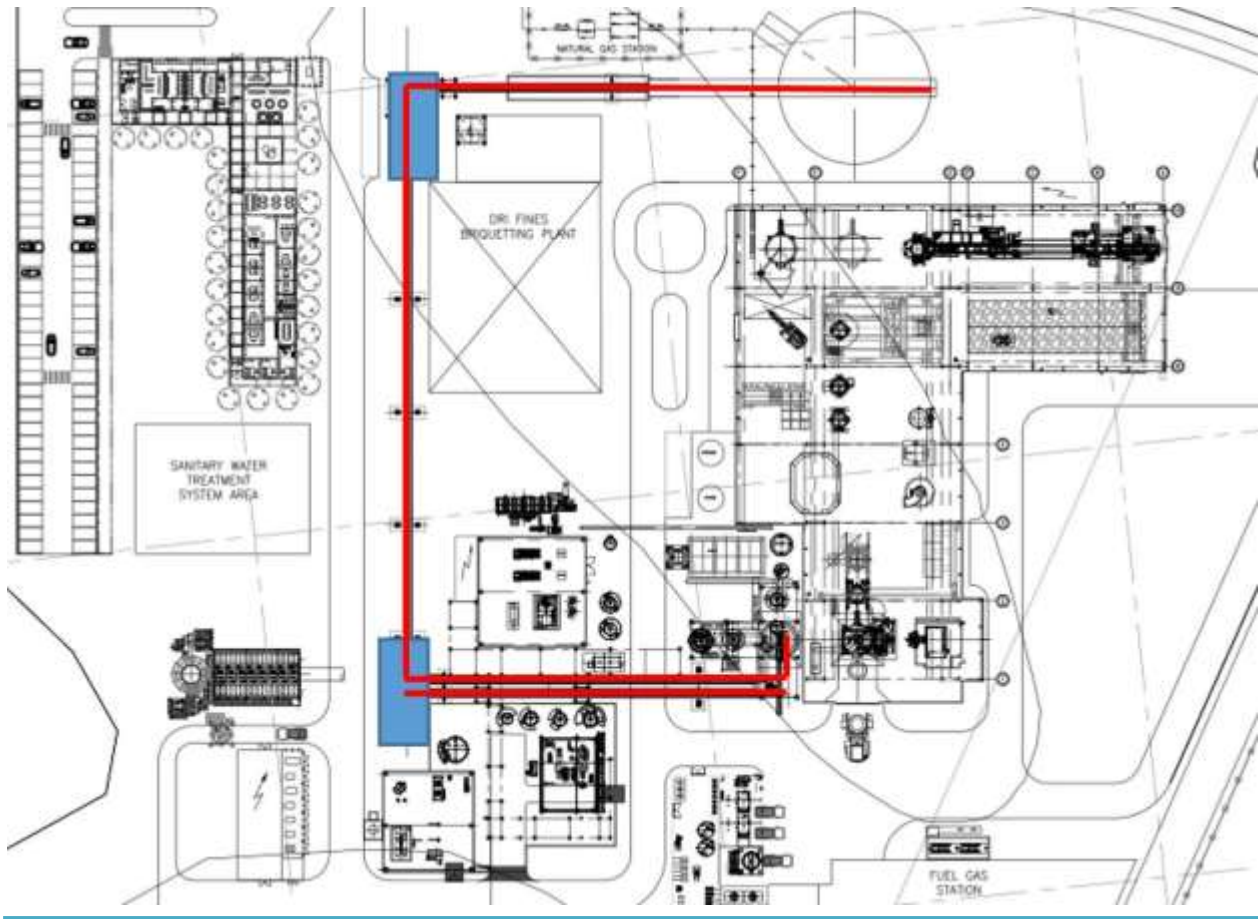


Figure 10.3-5.: Layout of the material handling system

### 10.3.2.1 General Characteristics of the MHS

Material: IO pellets

- Material sizes:- 6,3 mm. Max 3%, + 16 mm. Max 5%.
- Specific weight 2,05 t/m<sup>3</sup>
- Humidity Minus 5%
- Material out size Max 5%

System:

- Max operating time 24 hours
- Compressed air Min 6 bar – dry
- Electric motors 600V 60Hz – IP54 Class F Tropicalized
- Magnetic extractors 600V 60Hz – IP65
- Magnetic extractors control panel 600V 60Hz
- Limit switch - sensors 120 VAC 60Hz / 24 VDC-IP55
- Solenoid valve 24Vdc
- Installed power ca 255 KW
- Piping UNI

Fluids data, compressed air:

- Dew point -30°C
- Oil content Maximum 0,01 mg/m<sup>3</sup>
- Particle size Max 0,1 µm
- Particle Concentration Max 0,1 mg/m<sup>3</sup>
- Pressure 0,6 MPa
- Temperature Ambient.

### 10.3.2.2 Components Description Overview

Legend for engineering:

Stairs, walkways and platform shall be previewed to reach in safety conditions each inspection and maintenance area, **load capacity 400 kg/m<sup>2</sup>**.

Walkways (min. width 600mm) and steps in grating panels galvanized 25x76, plate 25x3;

Handrails designed as following: angular profile 50x50x5, upper pipe diameter 42x3 mm. intermediate pipe diameter 27x3 mm. foot plate guard height 150x3 mm.

Supporting structures under the belt conveyors frames will include protection to prevent material falling down (anti falling net 30x60mm.)


The electronic regulation cards for electromagnetic extractors will be supplied loose and will be installed inside the Customer electrical panel.

All equipment will be operated in safety conditions during operation (protection, covers, shield will be foreseen) overall the lateral side of the belt conveyor frames.

All the equipment will be able to start at full load; where necessary (motor power more than 20 kW) the hydraulic joint will be included.

Gear motors will be supplied without oil for transportation (oil at Customer charge).

Equipment will be supplied with risk assessment and safety lay-out.

 All machinery will be supplied as following:

- Belt conveyors:

- drive end completely assembled;
- idle end completely assembled;
- central bodies with length 6 meters without rollers and devices;
- box containing: rollers, pull rope switch and other devices to be installed on belt conveyor during erection;
- belt in open ring: junction to be done during erection;
- belt conveyors shorter than 11 ml. will be supplied fully assembled and tested;

 Weighing conveyor:

- completely assembled with closed belt;
- Belt elevator:
  - drive end completely assembled;
  - idle end completely assembled;
  - lower and upper curve completely assembled;
  - horizontal part assembled without rollers and devices;
  - vertical tubes to be assembled during erection;
  - box containing: rollers, pull rope switch and other devices to be installed on belt elevator during erection;
  - belt in open ring: junction to be done during erection;
- Electric diverter:
  - completely assembled;
- Vibrating feeders:
  - completely assembled;
- Vibrating screening:
  - completely assembled;
- Bins vibrating bottom:
  - completely assembled;
- Bin discharging system
  - completely assembled;
- Filter for S2 bin:
  - completely assembled;
- Slide gate valves:
  - completely assembled;
- Mixer tank for coating system:
  - completely assembled;
- Carpentry: completely loose, with commercial parts in wooden boxes

### 10.3.2.3 BC/1 Inclined Belt Conveyor

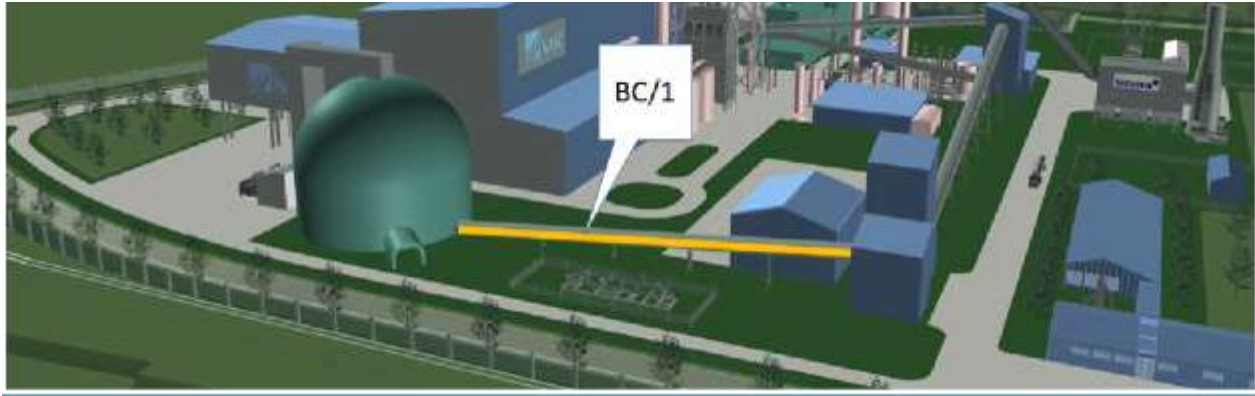


Figure 10.3-6.: location of belt BC/1 in the plant

Technical characteristics:

Material quality: normal conditions;

Nominal flow: 75 m<sup>3</sup>/h, 150 ton/h;

Belt type: HR (+80°) width 800 mm. EP 500.3 4+2 Transflex,

Belt speed: 1.1 m/s;

Belt supports: roller with bearings, triad 30°, roller diameter 108 mm.;

Charge / discharge distance axis: 117.000 mm., inclination 11°;

Installed power (for belt rotation): 30 Kw (electric TOP);

Impact belt supporting rollers distance in load area: 300 mm.;

Belt supporting rollers distance in upper part: 1.000 mm.;

Belt supporting rollers distance in lower part (idle branch): 3.000 mm.;

Drive drum diameter: 500 mm. machined.;

Idle drum diameter: 400 mm. machined;

Drive drum: with self centering coupling;

Idle drum: welded assembled;

Counterweight system support;

Counterweight system with two idle rollers (320 mm machined) and a counterweight roller (323 mm machined);

Counterweight system safety structure at + 7.300 level;

Drum coating: drive drum th.8 mm rhombus design;

- Structure: fully enclosed sheet (USA model) with proper legs, leaning against the below steel frame;
- Pull rope switch: nm. 04 (electric TOP);
- Tilt switches: nr.04 (electric TOP);
- Side plates with rubber stripes along 35,0 ml. at the charging points;
- Drive: orthogonal backstop gear directly coupled on the shaft, motor with hydraulic joint;
- Nm 04 Rotating detector switch (electric TOP);
- Belt scraper before the idle drum;
- Nm. 02 Belt scraper at drive drum;
- Belt scraper at the counterweight system before the drum;
- Discharge chute with bolted wear plates thickness 8 mm., HB400;
- Total cover of the belt.

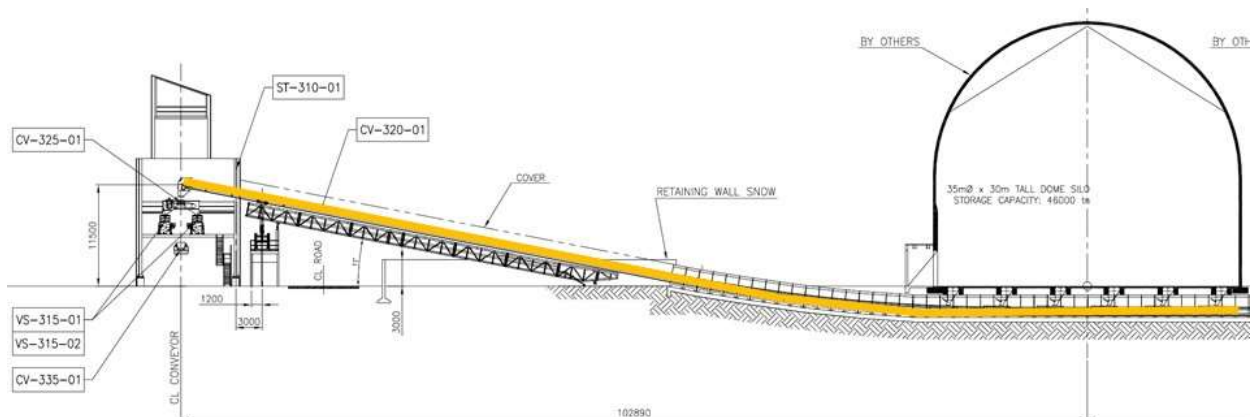


Figure 10.3-7.: cross section of BC/1

#### 10.3.2.3.1 Supporting frame for main belt conveyor BC/1 and tensioning counterweight system structure

Technical characteristics:

Carpentry structure in HE profile DIN;

From level +0,0 to + 13.000 mm.;

With access ladder;

Nm. 02 Walkways 800 mm. width. in grating panels galvanized 25x76, plate 25x3;

Handrails;

Supporting structures, columns

#### 10.3.2.3.2 Electric Diverter

At the end of BC/1 and electrical diverter is needed to direct material to one of the two vibrating screens (one in stand-by). The diverter is located inside the screening/coating station area/building.

Technical characteristics:

Material: normal conditions;

Nominal flow: 75 m<sup>3</sup>/h, 150 ton/h;

Size of bunker outlet: 500x400;

Drive: nm. 01 electric actuator;

Installed power: 0,25 Kw;

Bolted wear plates thickness 10 mm.;

Cabling: cable ways with galvanized pipe, joint with RTA sheath;

Junction Box (electric TOP);

Nm. 02 Position switches;

Charging and discharging chutes, with bolted wear plates thickness 10 mm.



### 10.3.2.4 Screening Station

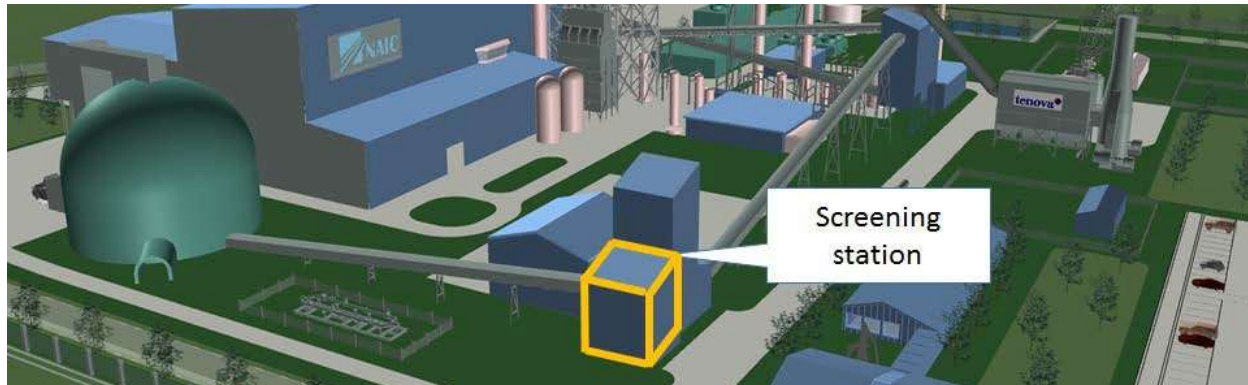


Figure 10.3-8.: location of the screening and coating station

#### 10.3.2.4.1 Electromechanical vibrating screen

Technical characteristics:

Screening of: IO pellets fines < 3.2mm

Material quality: normal conditions;

Entrance nominal flow: 75 m<sup>3</sup>/h 150 ton/h;

Final net selection passage: 5,0 mm., maximum 3% on the total;

Nm. 01 first stage selection net 15x15 useful passage for fines material;

Nm. 01 second stage selection net 5x5 useful passage for fines material;

Nets main sizes: width 1.300 mm., long 3.500 mm.;

Nm. 01 discharge chute for fines material, with supporting structure;

Nm. 01 discharge chute for big material, with supporting structure;

Drive: nm. 02 mechanical motors x 2,5+2,5 kw (to be verified)

Nm. 04 springs: steel;

Side closing with rubber stripes thickness 5/6 mm.;

DN200 Dedusting hood;

Nm. 01 supporting frame.

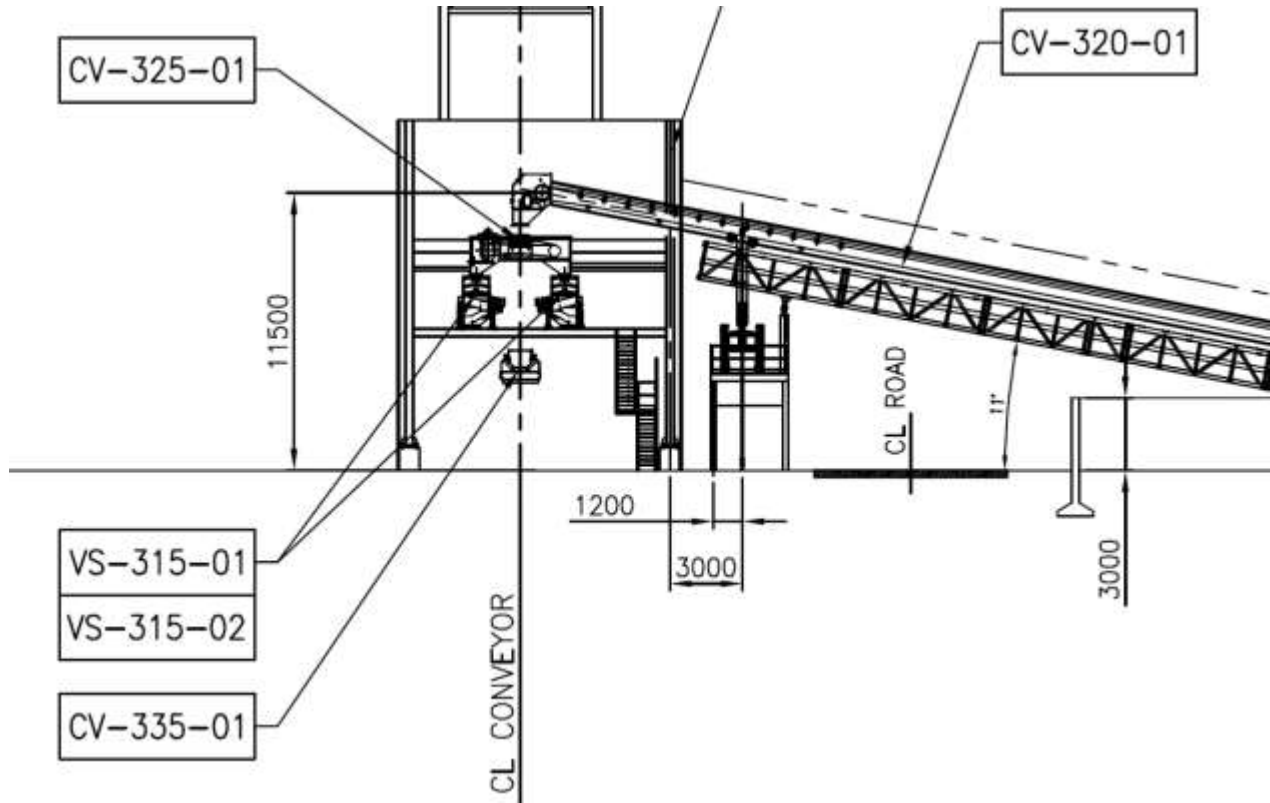


Figure 10.3-9.: cross section of the screening section with the two vibrating screens (VS-315-01/02)

### 10.3.2.4.2 Chain Conveyor type: TC-390x400-1C

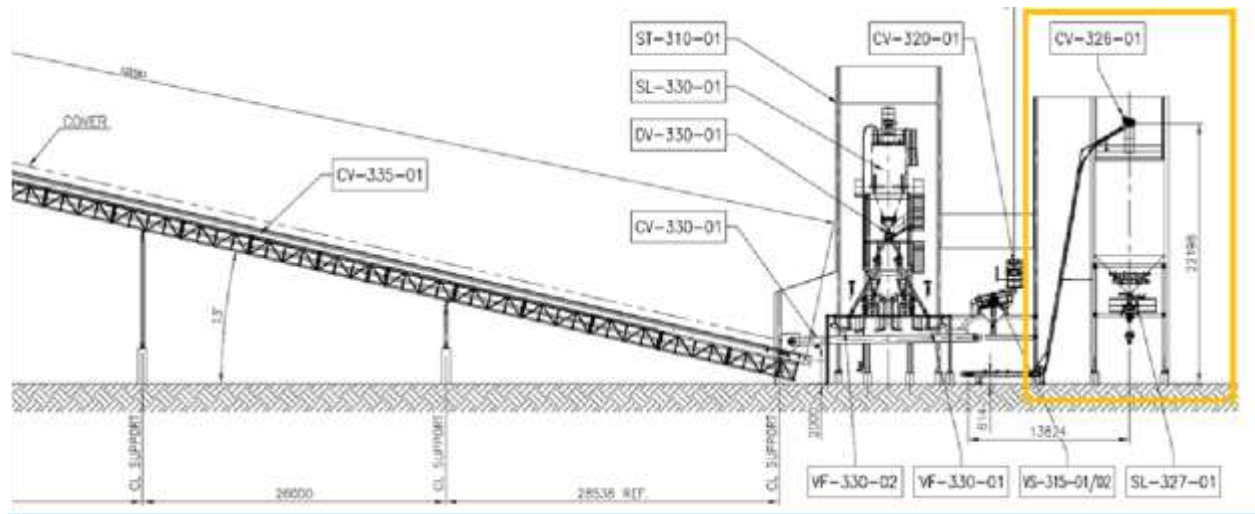


Figure 10.3-10.: elevation view of the IO fines silo

The fines below 3.2 mm are separated from the IO pellets and stored in a silo adjacent to the screening station. The system to store these fines is composed by:

1. a chain conveyor,
2. a storage bin
3. an extractor cone
4. a manual and pneumatic valve group
5. a telescopic discharger
6. supporting structure

Technical characteristics: of the chain conveyor

Nominal flow : 12 m<sup>3</sup>/h, 14,5 ton/h;

Chain speed: 0,10 m/s;

Inclination: horizontal + 100° vertical part + inclined final part;

Charge and discharge difference in level about 20 ml.;

Horizontal axis distance: 14,0 ml.;

Drive: geared motor, installed power: 7,5 kW;

Cabling: excluded, motor and sensor are T.O.P;

Junction Box: excluded;

- Rotating detector switch;
- Drive and idle shaft in 39 NiCrMo3;
- Completely closed structure made in S235JR;
- Manganese plate with central key seat for chain sliding;
- Drive drum diameter: 327 mm. machined;
- Idle drum diameter: 327 mm. machined;
- Chain axial pitch 142 mm., scrapers 80x10x380 in S275JR assembled all pitches;
- Nm. 04 greasing point;
- Nm. 01 charging point;
- Nm. 01 discharging hopper;
- Inspection door near charging point;
- Support legs to be adapted at installation;
- Dedusting hood at charging point.

#### 10.3.2.4.3 Fine Material Storage Bin

- Main characteristics:
- Nm. 01 storage bins capacity 210 m<sup>3</sup> (single discharge point);
- Inspection door: nm. 01 each storage bin and a ladder inside of bin for maintenance;
- Walking plan at storage bins roof discharge chutes coated with bolted wear plates th.
- Degusting system: dedusting hood near load area;
- Sheets thickness Fe: 6 mm.;
- Bolted wear plate Excluded.;
- Nm. 01 Continuous radar level sensor, 4/20 mA;
- Nm. 01 Maximum vibration level sensor switch, (800 mm. rope);
- Nm. 01 Minimum vibration level sensor switch, (9.000 mm. rope);

#### 10.3.2.4.4 Extractor Vibrating Cone

- Main size: diameter 2350/406 mm.,
- Flow capacity 100 m<sup>3</sup>/h;
- Drive: nm. 02 vibrators RPM 1500, 1,0 Kw each;

Suspensions: nm. 24 STD in rubber,  
Flange and counterflange;  
Anti-vibration joint bolted to carpentry;  
Deflector cone: tilting 45°;  
Included devices: set of bolts;  
Expansion joint in the outlet.

#### 10.3.2.4.5 Manual Valve Diameter 370mm

Main size: diameter mm. 370 height mm. H 125;  
Position: bolted to vibrating cone;  
Included devices: set of bolts, manual drive.

#### 10.3.2.4.6 Square Pneumatic Valve 370x370mm

Main size: mm. 370x370 height mm H 125;  
Position: bolted to hand valve;  
Included devices: set of bolts, pneumatic drive, solenoid valves, limit switches, flexible hoses, pipes, expansion joint, coupling with telescopic discharger with flanged tube.

#### 10.3.2.4.7 Telescopic Discharger

Inlet flange diameter: 300 mm.,  
Stroke: 1750mm;  
Flow capacity: 100 m<sup>3</sup>/h;  
Electric drive 0,55 kw 4 poles;  
Nm. 01 vibrator motor at outlet RPM 1500, 0,5 Kw;  
Carbon steel body;  
Double neoprene-hypalon bellow;  
Discharge cone coated with rubber material (sint);  
Dedusting pipe flange DN 150;

Junction box;  
Safety limit switch for rope;  
Two limit switch position;  
Pressure switch for high level;  
Coupling tube for AGV/1;  
Nm. 01 DN150 dedusting system pneumatic valve (to be connected to the suction pipe, at Customer charge);  
Main size: DN150;  
Installation: coupled to telescopic discharger;  
Included devices: set of bolts, pneumatic drive, solenoid valves, limit switches, flexible hoses, pipes.

#### 10.3.2.4.8 Technological Support Structure

Technical characteristics:  
Carpentry structure in HE profile DIN;  
Main dimension: see drawing study.  
Step ladder from level +0.00 to +26.686 mm.;  
Marinara ladder from level + 26.686 mm. to 27.661 mm.;  
Access from belt conveyor BC/1 walkways;  
Access to belt conveyor BC/2 and BC/3 walkways;  
Walkways) and steps in grating panels galvanized 25x76, plate 25x3;  
Cover roof and lateral side in corrugate steel 0,8 thickness;

### 10.3.2.5 BC/3 Inclined Belt Conveyor

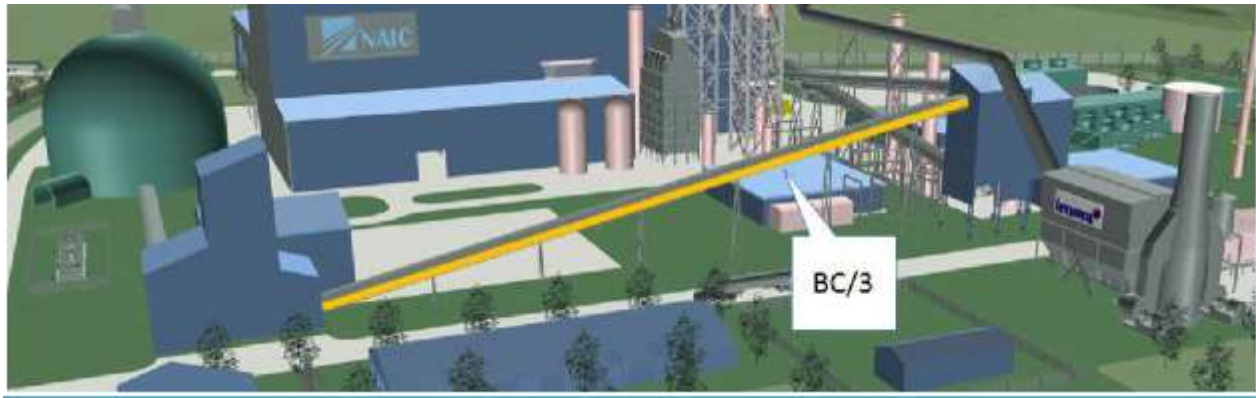


Figure 10.3-11.: position of BC/3 in the plant

BC/3 moves the IO pellets from the coating station to the curing bin station.

Technical characteristics:

Material quality: normal conditions;

Nominal flow: 75 m<sup>3</sup>/h, 150 ton/h;

Belt type: HR (+80°) width 800 mm. EP 500.3 4+2 Transflex,

Belt speed: 1.1 m/s;

Belt supports: roller with bearings, triad 30°, roller diameter 108 mm.;

Charge / discharge distance axis: 102.000 mm., inclination 13°;

Installed power (for belt rotation): 30 Kw (electric TOP);

Impact belt supporting rollers distance in load area: 300 mm.;

Belt supporting rollers distance in upper part: 1.000 mm.;

Belt supporting rollers distance in lower part (idle branch): 3.000 mm.;

Drive drum diameter: 500 mm. machined.;

Idle drum diameter: 400 mm. machined;

Drive drum: with self centering coupling;

Idle drum: welded assembled;

Counterweight system support;

Counterweight system with two idle rollers (320 mm machined) and a counterweight roller (323 mm machined);

Counterweight system safety structure at + 21.468 mm. level;



- Drum coating: drive drum th.8 mm rhombus design;
- Structure: fully enclosed sheet (USA model) with proper legs, leaning against the below steel frame;
- Pull rope switch: nm. 04 (electric TOP);
- Tilt switches: nr.04 (electric TOP);
- Side plates with rubber stripes along 35,0 ml. at the charging points;
- Drive: orthogonal backstop gear directly coupled on the shaft, motor with hydraulic joint;
- Nm 04 Rotating detector switch (electric TOP);
- Belt scraper before the idle drum;
- Nm. 02 Belt scraper at drive drum;
- Belt scraper at the counterweight system before the drum;
- Discharge chute with bolted wear plates thickness 8 mm., HB400;

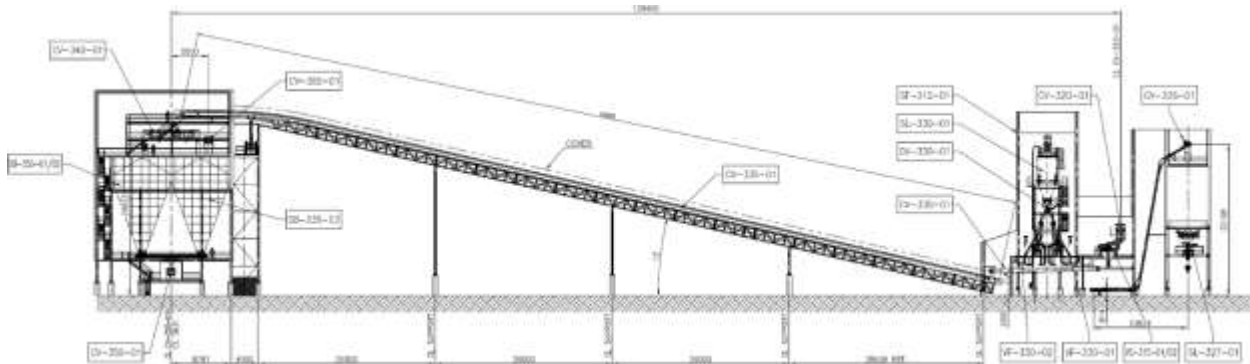


Figure 10.3-12.: elevation view of BC/3

#### 10.3.2.5.1 Supporting Frame for Main Belt Conveyor BC3 and Tensioning Counterweight System Fracture

- Technical characteristics:
- Carpentry structure in HE profile DIN;
- From level +0,0 to + 26.334 mm.;
- With access ladder;
- Nm. 02 Walkways 800 mm. width. in grating panels galvanized 25x76, plate 25x3;
- Handrails; Supporting structures, columns.



### 10.3.2.6 Curing bins station

#### 10.3.2.6.1 Reversible Belt Conveyor

Installed on top of the curing bins to direct the IO pellets in one of the three curing bins foreseen.

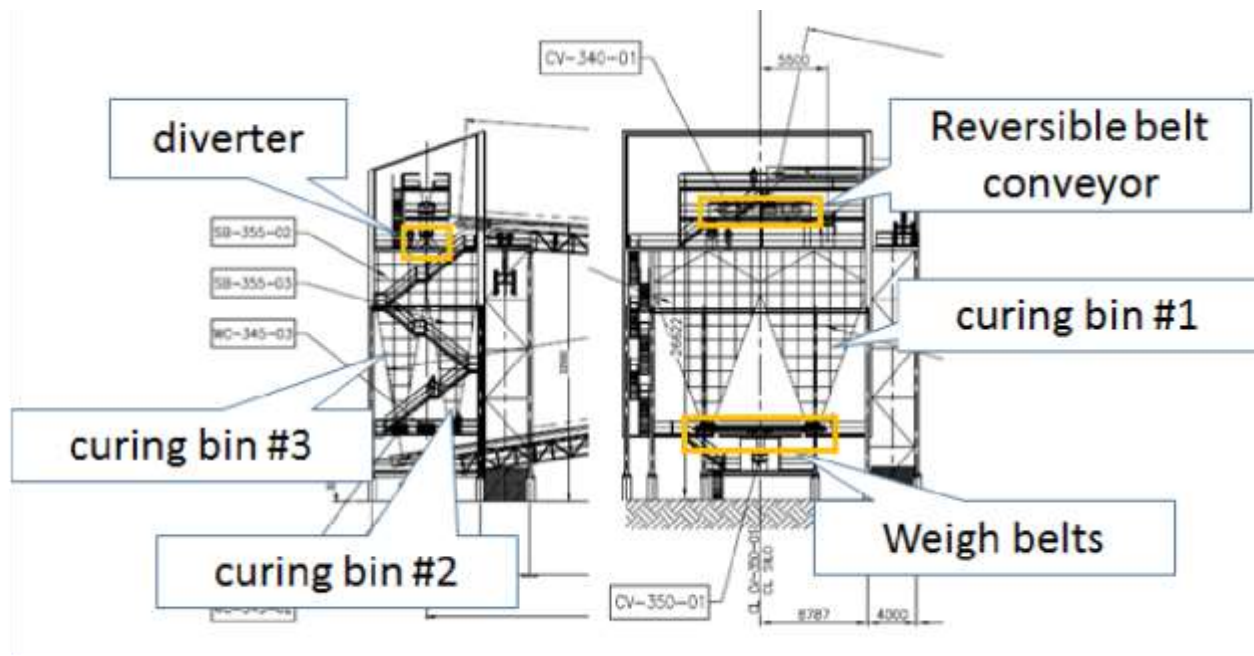


Figure 10.3-13.: components' position of the curing bin station

Technical characteristics:

Material quality: normal conditions;

Nominal flow: 75 m<sup>3</sup>/h, 150 ton/h;

Belt type: HR (+80°) width 800 mm., EP 400.3 4+2 Transflex,

Belt speed: 1.1 m/s;

Belt supports: roller with bearings, triad 30°, roller diameter 108 mm.;

Charge / discharge distance axis: 9.300 mm.;

Installed power (for belt rotation): 7,5 Kw (electric TOP);

Impact belt supporting rollers distance in load area: 300 mm.;

Belt supporting rollers distance in upper part: 1.000 mm.;

Belt supporting rollers distance in lower part (idle branch): 3.000 mm.;

Drive drum diameter: 400 mm. machined;

Idle drum diameter: 400 mm. machined;

Drive drum: with self-centering coupling;

Idle drum: welded assembled;

Screw tensioning system;

Drum coating: drive drum th.8 mm rhombus design;

Structure: fully enclosed sheet (USA model) with proper legs, leaning against the below steel frame;

Pull rope switch: nm. 02 (electric TOP);

Tilt switches: excluded;

Side plates with rubber stripes along all the belt;

Drive: orthogonal gear motor directly coupled on the shaft, without hydraulic joint;

Nm. 01 Rotating detector switch (electric TOP);

Belt scraper before the idle drum;

Nm. 02 Belt scraper at drive drum;

Discharge chutes with bolted wear plates thickness 8 mm., HB400;

Total cover of the belt.

#### 10.3.2.6.2 VD/5 Electric Diverter

Technical characteristics:

Material: normal conditions;

Nominal flow: 75 m<sup>3</sup>/h, 150 ton/h;

Size of bunker outlet: 500x400;

Drive: 1 electric actuator;

Installed power: 0,25 Kw;

Bolted wear plates thickness 10 mm.;

Cabling: cable ways with galvanized pipe, joint with RTA sheath;

Junction Box (electric TOP);

Nm. 02 Position switches;

Charging and discharging chutes, with bolted wear plates thickness 10 mm.

#### 10.3.2.6.3 Material Storage Bins

Main characteristics:

Nm. 01 storage bin capacity 420 m<sup>3</sup> (single discharge point);

Nm. 02 storage bins capacity 200 m<sup>3</sup> (single discharge point);

Inspection door: nm. 01 each storage bin and a ladder inside of bin for maintenance;

Walking plan at storage bins roof;

Discharge chutes coated with bolted wear plates th. 10 mm.;

Degusting system: dedusting hood near load area;

Sheets thickness Fe: 6 mm.;

Bolted wear plate excluded.;

Nm. 03 Continuous radar level sensor 4/20mA;

Nm. 03 Maximum vibration level sensor switch, (800 mm. rope);

Nm. 01 Minimum vibration level sensor switch, (10.000 mm. rope);

#### 10.3.2.6.4 Needle gate valves

Open section: 700x1.000 mm.

#### 10.3.2.6.5 Set bars for needle gate valves

Bars diameter 40 mm. (Nb. 01 sets);

#### 10.3.2.6.6 Technical Support Structure

Technical characteristics:

Carpentry structure in HE profile DIN;

Main dimension: see drawing study.

Step ladder from level +0.00 to +21.468 mm.;

Step ladder from level +21.468 to +23.901 mm.;

Step ladder from level +23.901 to 26.334 mm.;

Access from belt conveyor BC/3-4-5 walkways;

Cover roof and lateral side in corrugate steel 0,8 thickness;

#### 10.3.2.6.7 Weighing Belt Conveyor

Technical characteristics:

Material: normal conditions;

Nominal flow: from 20 m<sup>3</sup>/h to 75 m<sup>3</sup>/h;

Belt type: width 800 mm., EP 400.3 4+2 Transflex;

Speed: 0,25 m/sec, adjustable by inverter (inverter at Customer charge);

Belt supports: roller with bearings horizontal, roller diameter 89 mm.;

Charge / discharge distance axis: 5.000 mm.;

Installed power: 7,5 kW;

Belt supporting rollers distance in upper charging and weighing part: from 200 to 350 mm.;

Belt supporting rollers distance in upper part: from 350 to 500 mm.;

Belt supporting rollers distance in lower part (idle branch): 1.000 mm.;

Drive drum diameter: 323 mm machined.;

Idle drum diameter: 323 mm. machined;

Drums coating: drive drum th.8 mm rhombus design;

Structure: self-carrying structure;

Pull rope switches: nm. 02;

Misalignment switches: nm 02;

Side plates with rubber stripes along all belt;

Bolted sheet covers Th. 1,5mm;

Cabling: cable ways with galvanized pipe, joint with RTA sheath;

Junction Boxes;

Rotating detector switch;

Belt scraper before the idle drum;

Belt scraper before the drive drum;

Idle drum and drive drum: welded assembled;

Dedusting hood near load area and discharge area;

Supporting structures, handrails, ladder and service platform;

Charging and discharging chutes;

Weighing rollers with n° 2 load cells off center type, in stainless steel, with junction box;

Weighing system accuracy: +-1% of the max flow capacity allowable (150 t/h),

### 10.3.2.7 BC/4 Inclined Belt Conveyor

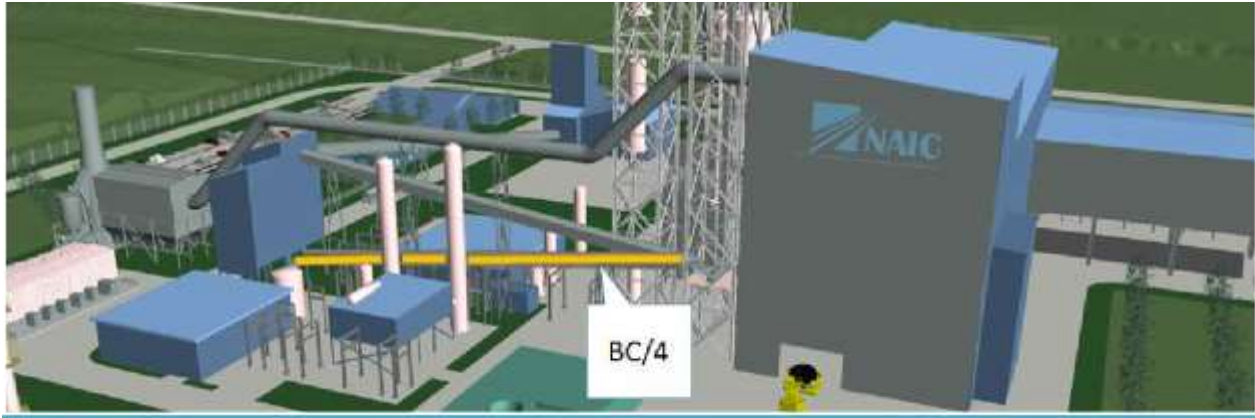


Figure 10.3-14.: Position of BC/4 and BC/5 in the plant

Technical characteristics:

Material quality: normal conditions;

Nominal flow: 75 m<sup>3</sup>/h, 150 ton/h;

Belt type: HR (+80°) width 800 mm., EP 500.3 4+2 Transflex,

Belt speed: 1.1 m/s;

Belt supports: roller with bearings, triad 30°, roller diameter 108 mm.;

Charge / discharge distance axis: 69.000 mm., inclination 10°;

Installed power (for belt rotation): 22 Kw (electric TOP);

Impact belt supporting rollers distance in load area: 300 mm.;

Belt supporting rollers distance in upper part: 1.000 mm.;

Belt supporting rollers distance in lower part (idle branch): 3.000 mm.;

Drive drum diameter: 500 mm. machined.;

Idle drum diameter: 400 mm. machined;

Drive drum: with self-centering coupling;

Idle drum: welded assembled;

Counterweight system support;

Counterweight system with two idle rollers (320 mm machined) and a counterweight roller (323 mm machined);

Counterweight system safety structure at + 9.046 mm. level;

Drum coating: drive drum th.8 mm rhombus design;

Structure: fully enclosed sheet (USA model) with proper legs, leaning against the below steel frame;  
Pull rope switch: nm. 04 (electric TOP);  
Tilt switches: nr.04 (electric TOP);  
Side plates with rubber stripes along 35,0 ml. at the charging points;  
Drive: orthogonal backstop gear directly coupled on the shaft, motor with hydraulic joint;  
Nm 04 Rotating detector switch (electric TOP);  
Belt scraper before the idle drum;  
Nm. 02 Belt scraper at drive drum;  
Belt scraper at the counterweight system before the drum;  
Discharge chute with bolted wear plates thickness 8 mm., HB400;  
Total cover of the belt.

#### 10.3.2.7.1 Supporting Frame for Main Belt Conveyor BC/4 and Tensioning Counterweight

Technical characteristics:  
Carpentry structure in HE profile DIN;  
From level +0,0 to + 15.700 mm.;  
With access ladder;  
Nm. 02 Walkways 800 mm. width. in grating panels galvanized 25x76, plate 25x3;  
Handrails;  
Supporting structures, columns

### 10.3.2.8 EL/1 Main Bucket Belt Conveyor

Flexowall Conveyor (with steel cord belt conveyor) transports the iron ore pellets to the Rotary Charger RE 250-F (filling the Reactor Iron Ore Loading Bin RE 251-F).

This conveyor is equipped with recovery devices at charge and discharge points of the conveyor in order to recover the spilled material.

Number		1
Material		Iron ore pellets and lump
Sizes Material		> 3.2 mm < 42 mm
Bulk density	t/m <sup>3</sup>	2.2
Conveying capacity	t/h	130
Motor Rating	kW	50

Table 10.3-1.: Elevating Conveyor RH 126-V required characteristics



Figure 10.3-15.: position of the elevating conveyor EL/1

*Technical characteristics:*

Nominal flow 75 m<sup>3</sup>/h – 150 tons/h;

Cups belt type: EP1600/5+2-5+3 belt width= 1.000 mm.;

Edge height: 240 mm.;

Cups height: 220 mm.;

Cups pitch: 260 mm.;

Speed: 1,15 m/s;

Vertical belt length: 96 ml. / slope 90°;

Horizontal belt length (lower part): 7,6 ml.

Horizontal belt length (upper part): 4,3 ml.

Installed power: 75 kW,

Drive drum diameter: 1.000 mm. machined;

Idle drum diameter: 1.000 mm.. machined;

Deflection wheel diameter: 1.200 mm.;

Cups belt supporting rollers diameter: 108 mm.;

Drums coating: drive drum th.8 mm rhombus design;

Belt supporting rollers distance in load area: 400 mm.;

Belt supporting rollers distance in horizontal parts: 1.000 mm.;

Tilt switch (security switch for belt position): nm. 04

Pull rope security switch: nm. 04,

Vertical tube: completely closed, with manhole near rollers;

Dedusting hood near load area;

Self-carrying structure;

Drive: orthogonal backstop gear directly coupled on the shaft, motor with hydraulic joint;

Cabling: Excluded;

Junction Boxes: Excluded;

Rotating detector switch,

Belt scraper before the idle drum;

Charging and discharging chute with wear plates thickness 8 mm.;

Drive end service platform: Excluded;

Supporting structures, handrails, ladder: Excluded



Drive drum: assembled with shaft by self-centring elements;  
Idle drum: assembled with shaft by self-centring elements;  
Anti-back stroke system.

#### 10.3.2.8.1 ST/6 Nm. 01 Supporting Frame for Main Belt Conveyor EL/1

Technical characteristics:

Carpentry structure in HE profile DIN;

From level +0,0 to + 15.000 mm.;

Without access ladder until +12.000 level;

With step access ladder from +12.000 to 15.000 level;

Nm. 01 set of service platform about +12.000 and +15.000 level;

Supporting structures, columns until + 15.000 level

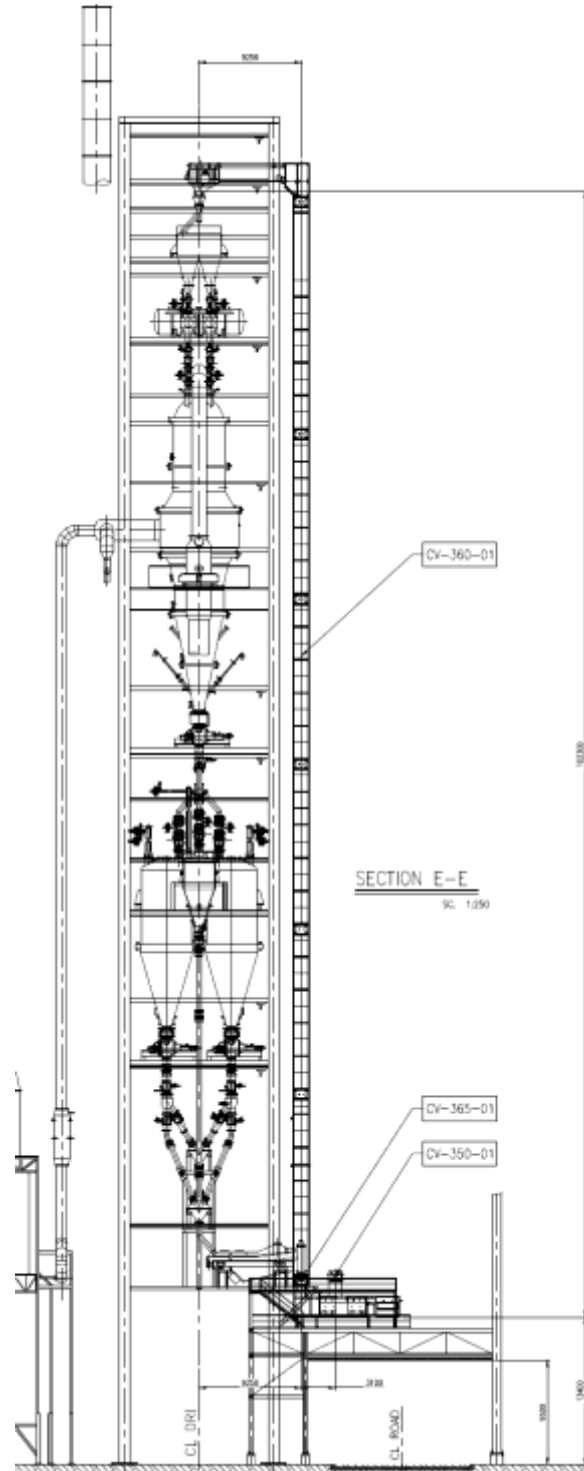


Figure 10.3-16.: elevation view of the elevating conveyor attached to the reactor tower

### 10.3.2.9 BC/5 Inclined Belt Conveyor

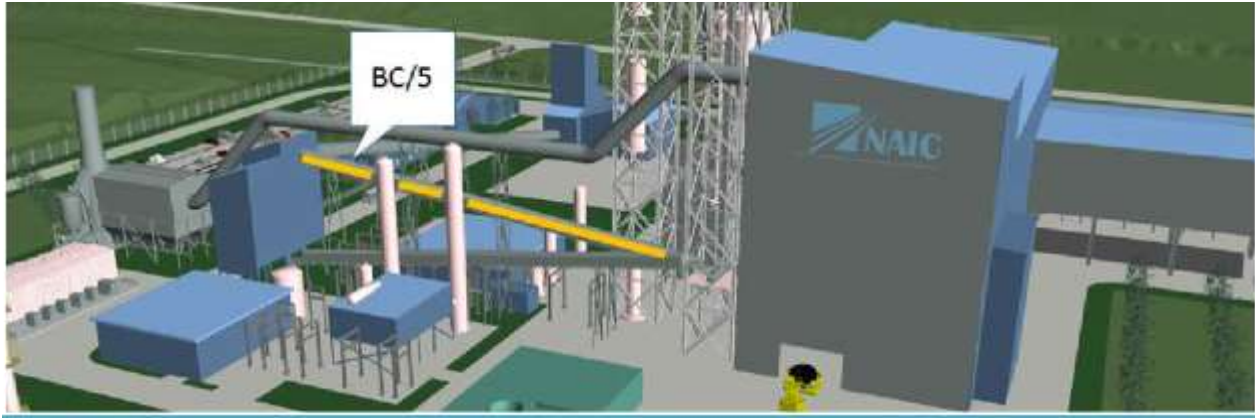


Figure 10.3-17.: position of BC/5 in the plant

As seen in the process section, the BC/5 is used during the first phases of the DRI reactor starting operation, to collect and transport the “remet” material back to the curing silo area.

Technical characteristics:

Material quality: normal conditions;

Nominal flow: 75 m<sup>3</sup>/h, 150 ton/h;

Belt type: HR (+80°) width 800 mm., EP 500.3 4+2 Transflex,

Belt speed: 1.1 m/s;

Belt supports: roller with bearings, triad 30°, roller diameter 108 mm.;

Charge / discharge distance axis: 70.000 mm., inclination 9°;

Installed power (for belt rotation): 22 Kw (electric TOP);

Impact belt supporting rollers distance in load area: 300 mm.;

Belt supporting rollers distance in upper part: 1.000 mm.;

Belt supporting rollers distance in lower part (idle branch): 3.000 mm.;

Drive drum diameter: 500 mm. machined.;

Idle drum diameter: 400 mm. machined;

Drive drum: with self-centering coupling;

Idle drum: welded assembled;

Counterweight system support;

Counterweight system with two idle rollers (320 mm machined) and a counterweight roller (323 mm machined);  
Counterweight system safety structure at + 21.468 mm. level;  
Drum coating: drive drum th.8 mm rhombus design;  
Structure: fully enclosed sheet (USA model) with proper legs, leaning against the below steel frame;  
Pull rope switch: nm. 04 (electric TOP);  
Tilt switches: nr.04 (electric TOP);  
Side plates with rubber stripes along 35,0 ml. at the charging points;  
Drive: orthogonal backstop gear directly coupled on the shaft, motor with hydraulic joint;  
Nm 04 Rotating detector switch (electric TOP);  
Belt scraper before the idle drum;  
Nm. 02 Belt scraper at drive drum;  
Belt scraper at the counterweight system before the drum;  
Discharge chute with bolted wear plates thickness 8 mm., HB400;  
Total cover of the belt.

#### 10.3.2.9.1 Supporting Frame for Main Belt Conveyor BC/5 and Tensioning Counterweight

##### System Structure

Technical characteristics:

Carpentry structure in HE profile DIN;

From level +15.000 to + 24.000 mm.;

With access ladder;

Nm. 02 Walkways 800 mm. width. in grating panels galvanized 25x76, plate 25x3;

Handrails;

Supporting structures, columns

### 10.3.2.10 Coating Station

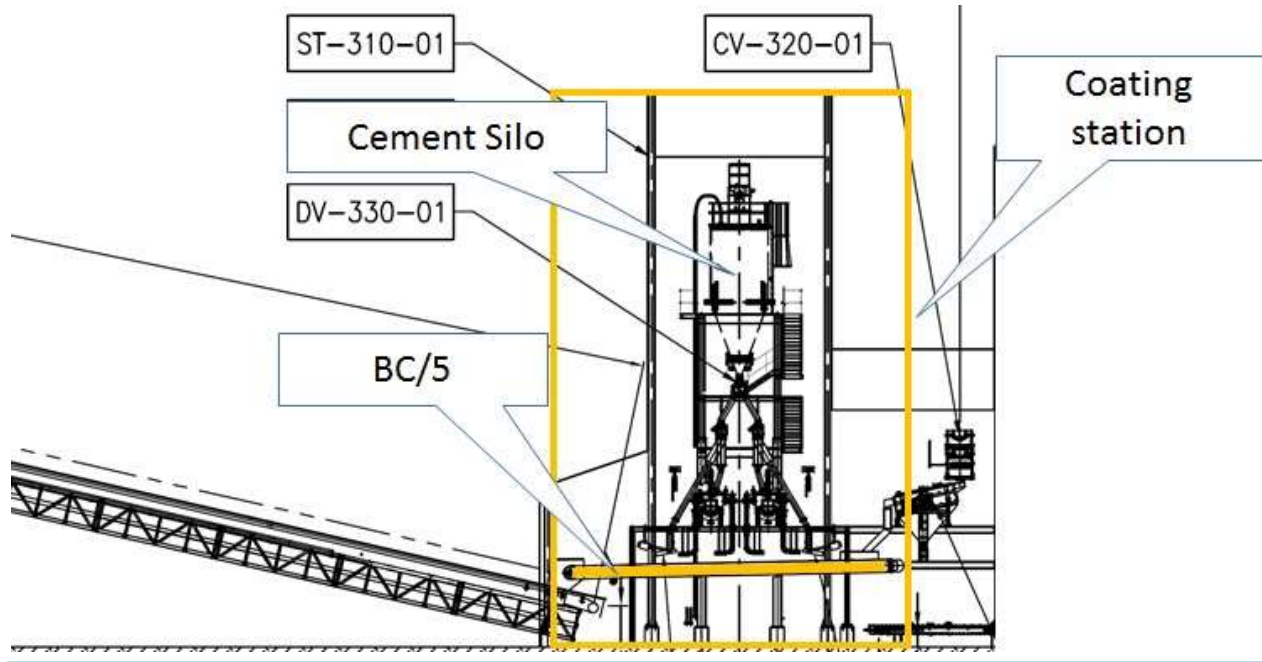


Figure 10.3-18.: elevation view of the IO pellets Coating station

#### 10.3.2.10.1 Cement Material Weighing Storage Bin

Main characteristics:

Nm. 01 storage bins capacity 40 m<sup>3</sup> (single discharge point);

Inspection door: nm. 01 each storage bin and a ladder inside of bin for maintenance;

Walking plan at storage bins roof;

Degusting system: Dedusting filter near load area;

Sheets thickness Fe: 6 mm.;

Bolted wear plate Excluded.;

Charging pipe DN100, thickness 5,0 mm., with pneumatic safety valve;

Pressure control valve D.273 mm.;

Nm. 01 Weighing system: with nm. 04 shear load cells, weighing transmitter, accuracy 0,5 %, combined error 0,5 %, output Profibus;

Load cell capacity: 20.000 kg. (each cell);

Nm. 01 Maximum vibration level sensor switch, (800 mm. rope);

Nm. 01 Minimum vibration level sensor switch, (9.000 mm. rope);

#### 10.3.2.10.2 Extractor Vibrating Cone

Main size: diameter 1800/300 mm.,

Flow capacity 30 m<sup>3</sup>/h;

Drive: nm. 02 vibrators RPM 1500, 0,55 Kw each;

Suspensions: nm. 24 STD in rubber,

Flange and counter flange;

Anti-vibration joint bolted to carpentry;

Deflector cone: tilting 45°;

Included devices: set of bolts;

Expansion joint in the outlet.

#### 10.3.2.10.3 Manual Valve Diameter 250mm

Main size: diameter mm. 250 height mm. H 125;

Position: bolted to vibrating cone;

Included devices: set of bolts, manual drive.

#### 10.3.2.10.4 Square Pneumatic Valve 250x250mm

Main size: mm. 250x250 height mm H 125;

Position: bolted to hand valve;

Included devices: set of bolts, pneumatic drive, solenoid valves, limit switches, flexible hoses, pipes, expansion joint, coupling with telescopic discharger with flanged tube.

#### 10.3.2.10.5 Filter

Main size: mm. 800x1500 height mm H 1800

Position: bolted to S/2 bin roof;

Installed power: 7,5 Kw;

Filtration area: 54 m<sup>2</sup>;

Filtration sleeves system: comprised air;

Sleeves material: antistatic, hydro-oleo phobic;  
Timer sleeves cleaning;  
Filter body: AISI 304;  
Supporting plate: Fe360;  
Included devices: set of bolts, flexible hoses.

#### 10.3.2.10.6 Technological Support Structure

Technical characteristics:  
Carpentry structure in HE profile DIN;  
Main dimension: see drawing study.  
Cover roof and lateral side in corrugate steel 0,8 thickness;

#### 10.3.2.10.7 Manual Diverter

Technical characteristics:  
Material: normal conditions;  
Nominal flow: 30 m<sup>3</sup>/h, 30 ton/h;  
Size of bunker outlet: 400x400;  
Drive: manual;  
Bolted wear plates thickness 6 mm.;  
Cabling: cable ways with galvanized pipe, joint with RTA sheath;  
Junction Box (electric TOP);  
Nm. 02 Position switches;  
Charging and discharging chutes, with bolted wear plates thickness 6 mm.

#### 10.3.2.10.8 Weighing Belt Conveyor

Technical characteristics:  
Material: normal conditions, cement 1 t/m<sup>3</sup>;  
Nominal flow: from 300 to 3.000 kg;  
Belt type: width 400 mm., EP 300.3 4+2;  
Speed: 0,25 m/sec, adjustable by inverter (inverter at Customer charge);  
Belt supports: AISI roller with bearings horizontal, roller diameter 89 mm.;  
Charge / discharge distance axis: 1.200 mm.;

Installed power: 0,55 kW, servo ventilated;  
Belt supporting rollers distance in upper charging and weighing part: from 200 to 350 mm.;  
Belt supporting rollers distance in upper part: from 350 to 500 mm.;  
Belt supporting rollers distance in lower part: excluded.;  
Drive drum diameter, AISI material: to be verified.;  
Idle drum diameter, AISI material: to be verified;  
Drums coating: drive drum th.8 mm rhombus design;  
Structure: self-carrying structure; in AISI 304  
Pull rope switches: nm. 02;  
Misalignment switches: nm 02;  
Side plates with rubber stripes along all belt;  
Bolted sheet covers Th. 1,5mm, in AISI 304;  
Cabling: cable ways with galvanized pipe, joint with RTA sheath;  
Junction Boxes;  
Rotating detector switch;  
Belt scraper before the idle drum;  
Belt scraper before the drive drum;  
Idle drum and drive drum: welded assembled;  
Dedusting hood near load area and discharge area;  
Supporting structures in Fe360;  
Charging and discharging chutes in Fe 360;  
Weighing rollers with n° 2 load cells off center-type, in stainless steel, with junction box;  
Integrator & flow regulator Thermo-Scientific, 32-bit, flesh memory 2MB, 128K NVRam;

#### 10.3.2.10.9 Electric Diverter

Technical characteristics:  
Material: normal conditions, cement;  
Nominal flow: 3 m<sup>3</sup>/h, 3 ton/h;  
Size of bunker outlet: 400x400;  
Drive: nm. 01 electric actuator;  
Installed power: 0,25 Kw;  
Bolted wear plates thickness 6 mm.;



Cabling: cable ways with galvanized pipe, joint with RTA sheath;  
Junction Box (electric TOP);  
Nm. 02 Position switches;  
Charging and discharging chutes, with bolted wear plates thickness 6 mm.

#### 10.3.2.10.10 Electromagnetic Vibrating Feeders

Technical characteristics:

Material: normal conditions, cement;  
Nominal flow: 3 m<sup>3</sup>/h, 3 ton/h (adjustable flow capacity);  
Size of bunker outlet: 400x400;  
Drive: nm. 01 magnetic motor;  
Nm 01 electronic controller card;  
Main sizes: width 500x500 mm. / length 1.200 mm.;  
Springs: black rubber buffers;  
Wear plates: on the two sides and on the bottom of the chute;  
Wear plates thickness 6 mm.;  
Dedusting hood with joint flange;  
Side closing with rubber stripes thickness 6 mm. with fixing counter plates;  
Discharging chutes.

#### 10.3.2.10.11 Mixing Tanks

Technical characteristics:

Material: normal conditions, cement;  
Nominal flow: 3 m<sup>3</sup>/h, 3 ton/h (adjustable flow capacity);  
Capacity: 1.000 lt.;  
Drive: nm. 01 axial motor;  
Installed power: 1,5 kw;  
Material contact parts, body: AISI 304;  
Shaft and mixer: AISI 304;  
Supports and no contact with material parts: Fe 360;  
Nm. 01 Cabled Junction box (only);  
Main sizes: see drawings;

#### 10.3.2.10.12 BC2 Inclined Belt Conveyor

Technical characteristics:

Material quality: normal conditions;

Nominal flow: 75 m<sup>3</sup>/h, 150 ton/h;

Belt type: HR (+80°) width 800 mm. EP 400.3 4+2 Transflex,

Belt speed: 1.1 m/s;

Belt supports: roller with bearings, triad 30°, roller diameter 108 mm.;

Charge / discharge distance axis: 18.000 mm.;

Installed power (for belt rotation): 7, 5 Kw (electric TOP);

Impact belt supporting rollers distance in load area: 300 mm.;

Belt supporting rollers distance in upper part: 1.000 mm.;

Belt supporting rollers distance in lower part (idle branch): 3.000 mm.;

Drive drum diameter: 400 mm. machined;

Idle drum diameter: 400 mm. machined;

Drive drum: with self-centering coupling;

Idle drum: welded assembled;

Screw tensioning system;

Drum coating: drive drum th.8 mm rhombus design;

Structure: fully enclosed sheet (USA model) with proper legs, leaning against the below steel frame;

Pull rope switch: nm. 02 (electric TOP);

Tilt switches: excluded;

Side plates with rubber stripes along the entire belt;

Drive: orthogonal gear motor directly coupled on the shaft, no hydraulic joint;

Nm. 01 Rotating detector switch (electric TOP);

Belt scraper before the idle drum;

Nm. 02 Belt scraper at drive drum;

Discharge chutes with bolted wear plates thickness 8 mm., HB400;

Total cover of the belt.

### 10.3.2.10.13 Mixing Tanks, Spray System

Technical characteristics:

Material: normal conditions, cement;

Nominal flow: 3 m<sup>3</sup>/h, 3 ton/h (adjustable flow capacity);

Main sizes: see drawings;

Set of pumps, valves, pipes & others equipment required for regular operation;

Discharging pipes;

Set of below belt conveyor spreaders required for a regular operation

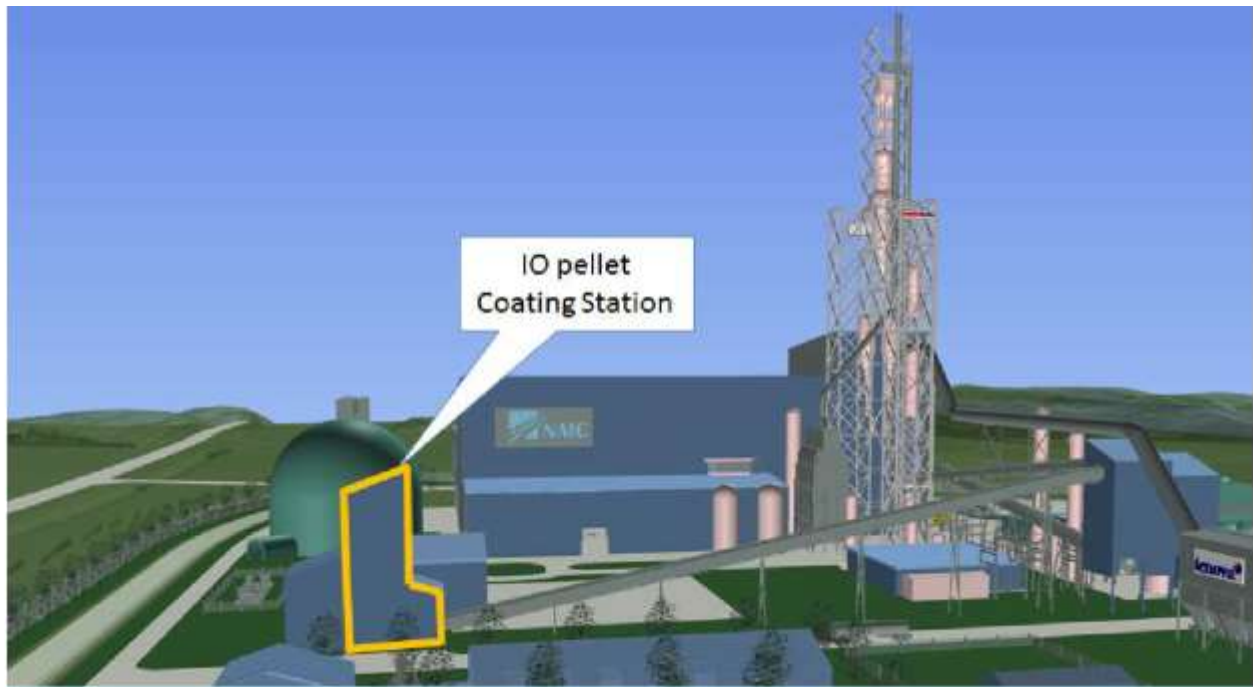


Figure 10.3-19.: position of the coating station adjacent to the screening station

### 10.3.3 Energiron ZR Direct Reduction Reactor Mini Module

#### 10.3.3.1 Reactor Charging System

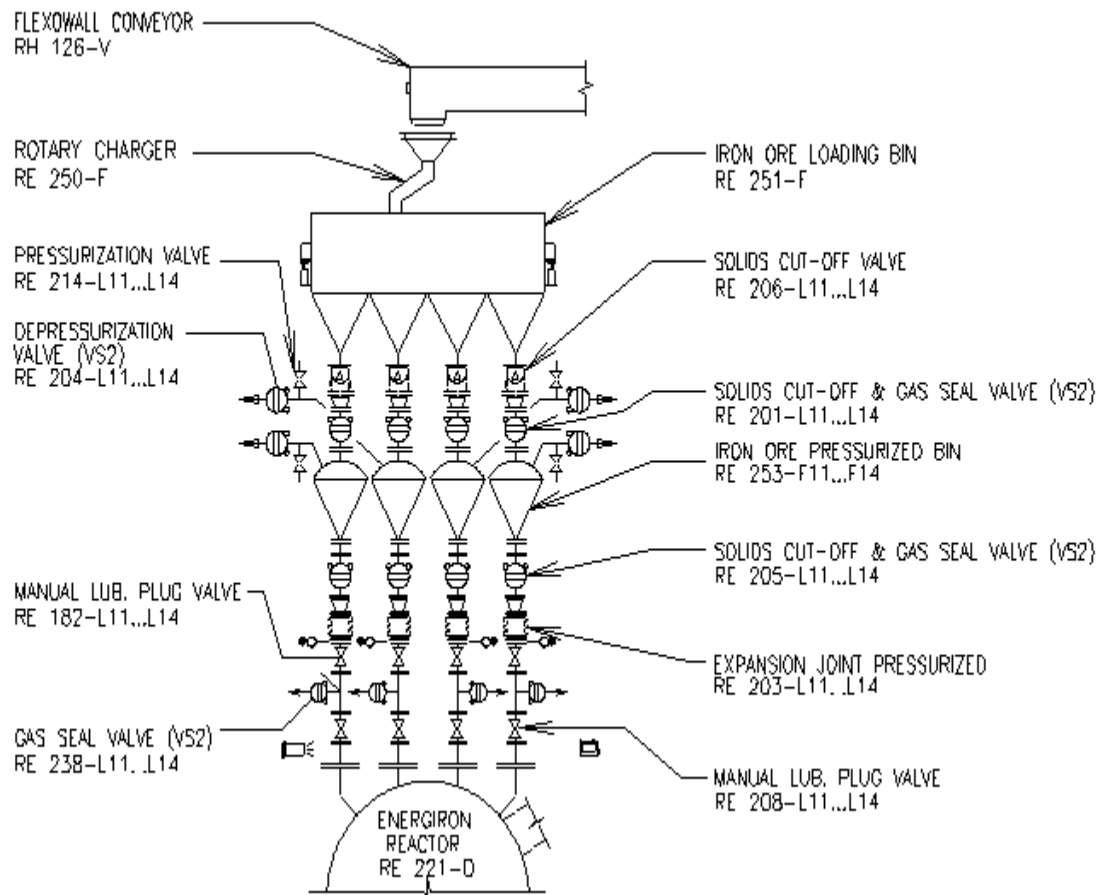






Figure 10.3-20.: Reactor Charging System schematics

The reactor charging system consists of the following main equipment:

-  Rotary Charger RE 250-F
-  Iron Ore Loading Bin RE 251-F
-  Solids Cut-Off Valve RE 206-L11/L14
-  Solids Cut-Off & Gas Seal Valve VS2 RE 201-L11÷L14

- Pressurization Valve RE 214-L11/L14
- Depressurization Valve VS2 RE 204-L11/L14
- Iron Ore Pressurized Bin RE 253-F11/F14
- Solids Cut-Off & Gas Seal Valve RE 205-L11/L14
- Expansion Joint Pressurized RE 203-L11/L14
- Manual Plug Valve RE 182-L11/L14
- Vent Gas Valve VS2 RE 238-L11/L14
- Manual Plug Valve RE 208-L11/L14
- Fittings and spool pieces

#### 10.3.3.1.1 Rotary Charger 250-F

This device is used to distribute in a gentle and even manner the iron ore pellets and lump coming from the Flexowell Conveyor RH 126-V onto the Iron Ore Loading Bin RE 251-F.

Number		1
Operating Temperature	°C	ambient
Driver		Electric Motor – variable speed
Motor Rating	kW	1.5

Table 10.3-2.: characteristics of the Rotary charger

### 10.3.3.1.2 Iron Ore Loading Bin RE 251-F

This bin is used as a surge bin to feed the Iron Ore Pressurized Bin RE 253-F11/F14. It has a square shape with four cones in the bottom, each one feeding a bin.

Number		1
Type		Mass Flow
Volume	m <sup>3</sup>	46
Operating Pressure	Kg/cm <sup>2</sup> A	ambient
Operating Temperature	°C	ambient
Level Detection		Load Cells
Material		Carbon Steel

Table 10.3-3.: Characteristics of the IO pellets loading bin

### 10.3.3.1.3 Solids Cut-Off Valve RE 206-L11/14

This valve is used to isolate the Iron Ore Loading bin RE 251-F with each of the Iron Ore Pressurized Bins RE 253-F11÷F14.

Number		4
Inlet Diameter	"	12
Operation		Hydraulic
Material		Carbon Steel + anti wear lining

Table 10.3-4.: Characteristics of the solids cut off valve

#### 10.3.3.1.4 Solids Cut-Off & Gas Seal Valve VS2 RE 201-L11/L14

This valve is used for cutting-off the solids flow and for sealing the gas pressure between the Pressurized Bin RE 253-F11÷F14 and Iron Ore Loading Bin RE 251-F.

Number		4
Inlet Diameter	“	12
Operation		Hydraulic
Seal		Inflatable Seal
Material		Carbon Steel + anti wear lining

Table 10.3-5.: Solids Cut-Off & Gas Seal Valve

#### 10.3.3.1.5 Pressurization valve RE 214-L11/L14

This valve is used to pressurize the Bins RE 253-F11/F14 to the same pressure as the Reactor by means of Nitrogen injection. Four valves are provided.

Once bin pressure is equalized to Reactor pressure, the lower valves are prepared to be open. It is a standard 2” gas shut-off valve. Once bin pressure is equalized to reactor pressure, the lower valves are prepared to be open.

#### 10.3.3.1.6 Depressurization Valve VS2 RE 204-L11/L14

This valve is used to depressurize the Bins RE 253-F11/F14 to atmospheric pressure, relieving the Nitrogen hold by the Bin to the atmosphere.

Once the inner pressure of bin is equal to atmospheric pressure, upper charging valves are ready to be open

Number		4
Inlet Diameter	“	4
Operation		Hydraulic
Seal		Inflatable Seal
Material		Carbon Steel

Table 10.3-6.: Depressurization Valve

### 10.3.3.1.7 Iron Ore Pressurized Bin RE 253-F11/F14

These Bins are used to feed continuously iron ore pellets or lump to the Reactor by means of an operation sequence which permits that one Bin is at atmospheric pressure while the others are at the Reactor pressure.

Number		4
Type		Mass Flow
Volume	m <sup>3</sup>	2.1
Operating Pressure	Kg/cm <sup>2</sup> A	Cycling from ambient to 8.0
Operating Temperature	°C	ambient
Level Detection		Level Switch High Nuclear Level Sensor (Low, on feeding leg below bin)
Material		Carbon Steel

Table 10.3-7.: Iron Ore Pressurized Bin

The four bins are located below each cone of the Iron Ore Loading Bin and disposed in two lines of two.

Each bin operates at atmospheric pressure while is being charged with material and operates at Reactor pressure while discharging the iron oxide material inside the Reactor.

When a bin is being pressurized, nitrogen at high pressure is allowed to flow to the bin, increasing the pressure.

When the bin is being depressurized, Nitrogen pressure contained into the bin is vented to atmosphere using a venting valve (Depressurization Valve VS2 RE 204-L11/L14).

By hydraulic interlock, charging valves are not enabled to operate while the operation of lower valves is taking place. And vice versa, while operating upper valves, lower valves are not enabled to operate.

The interlock prevents safety risks, preventing the system to open the venting valves while pressure locks are open, thus venting Reactor's pressure.

The system is designed in order to let the Plant working at its maximum capacity with three bins running, in order to give time allowance for maintenance in one bin, or related valves, without decreasing the production rate.



#### 10.3.3.1.8 Solids cut-off & gas seal valve VS2 RE 205-L11/L14

This valve is used for cutting-off the solids flow and for sealing the gas pressure between the Pressurized Bin RE 253-F11÷F14 and the Reactor RE 221-D.

Number	4
Inlet Diameter	12"
Operation	Hydraulic
Seal	Inflatable Seal
Material	Carbon Steel with wear resistant internals

#### 10.3.3.1.9 Expansion Joint Pressurized RE 203-L11/L14

This device is used to absorb any expansion or contraction that the components of the equipment or its structure may suffer, mostly due to temperature or by application of static loads.

Number		4
Inlet Diameter	"	12
Face to Face High	mm	700
Material		Carbon steel with bellow in SS

Table 10.3-8.: Expansion Joint Pressurized

### 10.3.3.1.10 Manual Plug Valve RE 182-L11/L14

This valve is used to seal the gas pressure between the Bins RE 253-F11/F14 and the Reactor RE 221-D mainly for maintenance in case of failure of the Solids Cut-Off & Gas Seal Valves RE 205-L11/L14.

Main purpose of the valve is for safety of plant and personal.

During maintenance of any of the Solids cut-off & gas seal valve VS2 RE 205-L11/L14 valves, the corresponding reactor charging line is isolated from reactor by closing manual lubricated plug valves RE 182-L11/L14 and RE 208-L11/L14 and opening of the Gas seal valve RE 238 L11/L14, in this way, in case of a leak of valve RE 208-L11/L14 during the maintenance period, the gas will be vented to atmosphere trough the Vent Gas Valve RE 238-L11/L14 protecting the maintenance personnel.

Valves allow the corrective maintenance to reactor charging equipment, without the need of reducing production.

Number	4
Inlet Diameter	12
Operation	Hydraulic
Seal	Mechanical with Grease
Material	Carbon Steel (internal parts in cast iron plus anti wear)

Table 10.3-9.: Manual Plug Valve

### 10.3.3.1.11 Vent Gas Valve VS2 RE 238-L11/L14

Main purpose of the valve is for safety of personnel during maintenance of any of the Solids cut-off & gas seal valve VS2 RE 205-L11/L14.

During maintenance of any of the Solids cut-off & gas seal valve VS2 RE 205-L11÷L14 valves, the corresponding reactor charging line is isolated from reactor by closing manual lubricated plug valves RE 182-L11/L14 and RE 208-L11/L14 and opening of the Gas seal valve RE 238 L11/L14, in this way, in case of a leak of valve RE 208-L11/L14 during the maintenance period, the gas will be vented to atmosphere trough the Gas Seal Valve RE 238-L11/L14 protecting the maintenance personnel.

Number		4
Inlet Diameter	“	4
Operation		Hydraulic
Material		Carbon Steel

Table 10.3-10.: Vent Gas Valve

### 10.3.3.1.12 Fittings and Spool Pieces

Pieces, like spool pieces, reducers or elbows, blind flanges, connecting the valves and expansion joints previously mentioned when the latter have different dimension and/or need some space in between each other for maintenance purposes.

### 10.3.3.1.13 Plug Valve RE 208-L11/L14

This valve is used to seal the gas pressure between the Bins RE 253-F11÷F14 and the Reactor RE 221-D mainly in case of failure of the Solids Cut-Off & Gas Seal Valves RE 205-L11÷L14.

Main purpose of the valve is for safety of plant and personnel.

During maintenance of any of the Solids cut-off & gas seal valve VS2 RE 205-L11/L14 valves, the corresponding reactor charging line is isolated from reactor by closing manual lubricated plug valves RE 182-L11/L14 and RE 208-L11/L14 and opening of the Gas seal valve RE 238 L11/L14, in this way, in case of a leak of valve RE 208-L11/L14 during the maintenance period, the gas will be vented to atmosphere trough the Gas Seal Valve RE 238-L protecting the maintenance personnel.

Valves allow the corrective maintenance to reactor charging equipment, without the need of reducing production.

Number		4
Inlet Diameter	“	12
Operation		Hydraulic
Seal		Mechanical with Grease
Material		Carbon Steel (internal parts in cast iron plus anti wear)

Table 10.3-11.: Plug Valve

### 10.3.3.2 Reactor

The Reactor RE 221-D consists of the following equipment:

- Reactor RE 221-D
- Feeding legs
- Refractory retainers
- Refractory
- Cooling jacket
- Cluster breakers RE 209-L1/L2



Figure 10.3-21.: Energiron<sup>®</sup> DRI reactor

### 10.3.3.2.1 Reactor RE 221-D

The reactor is a pressure vessel, made of carbon steel plate, internally refractory lined in its upper cylindrical sections, having a cylindrical geometry in the upper part and a conical shaped bottom portion, which provides a generalized free mass solids flow towards the bottom opening.

The lower section of the reactor consists of a carbon steel conical section, which is neither refractory lined nor insulated, but is water-cooled.

The reactor cone has water jackets which function is to protect the carbon steel plate from high temperatures. The iron ore burden is fed to the reactor through four charging legs to allow a uniform feed distribution. The section from the reducing gas inlet tuyere up to the iron ore inlet (charging legs) is classified as the "reduction zone". This section is lined with refractory bricks and castable to withstand the high temperatures and erosion. In between the refractory lining and the carbon steel shell, low-density insulation castable is provided.

Inner diameter of cylindrical parts	mm	5,500
Inner diameter of discharge opening	mm	575
Total Height	mm	37,800
Nominal diameter of feeding legs I.D.	mm	470
Number of feeding legs		4
Reducing Gas Duct inlets number		1
Top Gas Duct I.D	mm	1900
Working Pressure	barg	8.0
Working Temperature	°C	1100/450
Shell Material		Carbon Steel

Table 10.3-12.: DRI reactor main data

#### 10.3.3.2.2 Feeding Legs

To distribute evenly the iron ore pellets and lump blend feed inside the reactor.

Four legs are provided.

#### 10.3.3.2.3 Refractory Supports

To support the refractory lining, they are located in the hotter sections of the reactor, except in the cone; besides the supports for the refractory, there are gas stoppers located in the inner shell wall.

#### 10.3.3.2.4 Refractory

The reactor inside is covered by insulating and refractory materials for the internal lining of the cylindrical parts; with the purpose of shell protection and to minimize heat losses.

#### 10.3.3.2.5 Cooling Jackets

The reactor has one cooling jacket set; it is installed to protect the steel plate of the reactor lower cone shell, by means of water cooling.

#### 10.3.3.2.6 Cluster Breakers RE 209-L1/L2

Two (2) Cluster breakers are provided as an operative resource in the event of sudden changes in the sticking tendency of raw materials; their use is to break any clusters which may eventually form at the reactor, they are located opposite each to the other at different level, and close to the reactor discharge opening.

They are hydraulically operated.

### 10.3.3.3 Reactor Discharging System

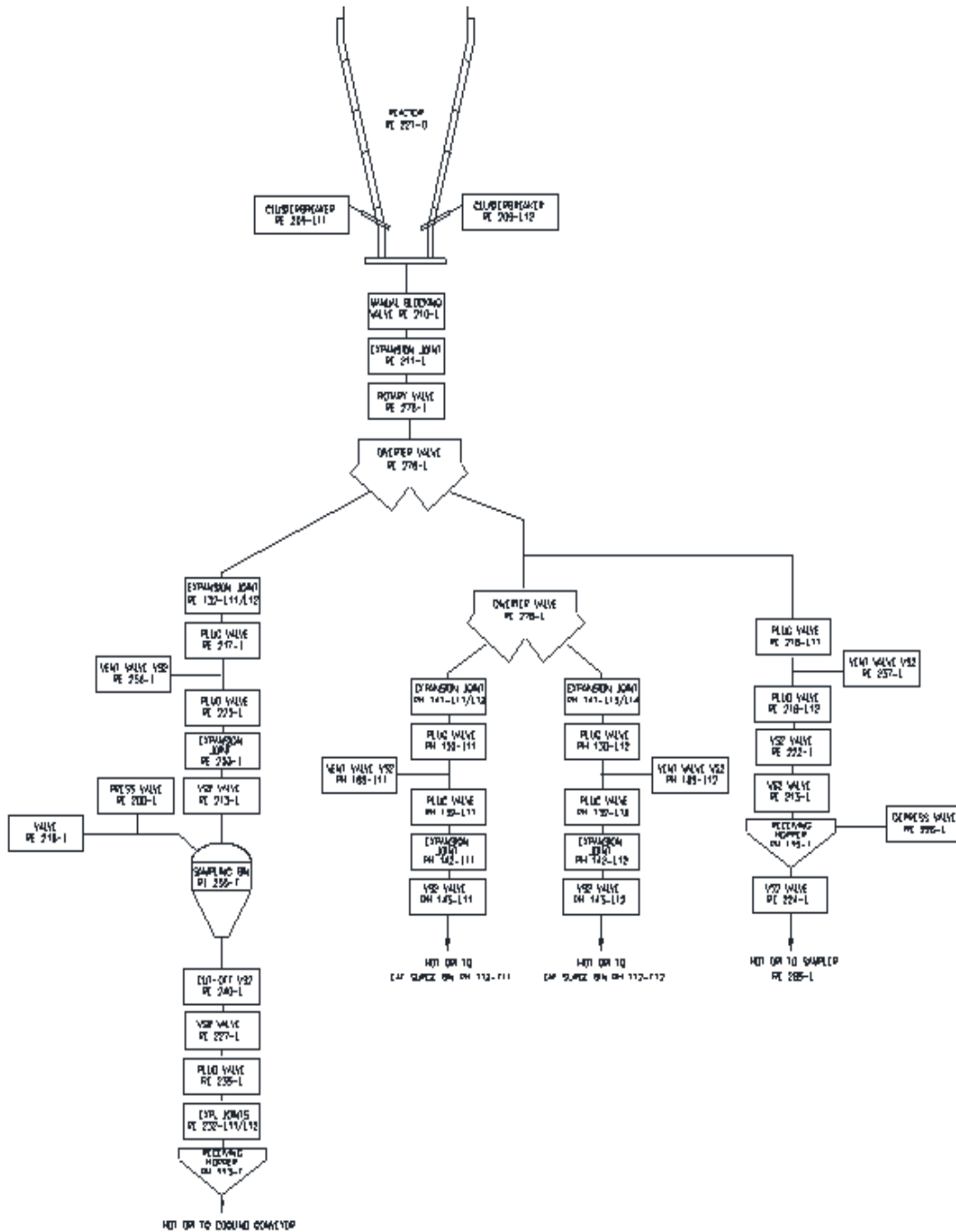









Figure 10.3-22.: Reactor Discharging System










The Reactor discharging system consists of the following main equipment

-  Manual Blocking Valve RE 210-L
-  Expansion Joint RE 211-L
-  Reactor Rotary Valve RE 276-L
-  Diverter Valve RE 278-L







Leg to Cooling Conveyor:

-  Expansion Joint RE 215-L11/L12
-  Plug Valve RE 217-L
-  Vent Gas Valve VS2 RE 236-L
-  Plug Valve RE 223-L
-  Expansion Joint RE 233-L
-  Solids Cut Off & Gas Seal Valve VS2 RE 213-L
-  Sampling Bin RE 255-F
-  Gas Seal Valve RE 216- L
-  Pressurization Valve RE 200-L
-  Solids Cut Off Valve RE 240-L
-  Solids Cut Off & Gas Seal Valve VS2 RE 227-L
-  Plug Valve RE 235-L
-  Expansion Joints RE 232-L11...L14
-  Receiving Hopper RE 113-F

Leg to Hot DRI sampler:

-  Plug Valve RE 218-L11/L12
-  Vent Gas Valve VS2 RE 237-L
-  Gas Seal Valve VS2 RE 222-L
-  Receiving Hopper RE 115-F
-  Gas Seal Valve RE 224- L
-  Depressurization Valve RE 226-L
-  Hot DRI sampler RE 285-L

Leg to EAF Charging System:

-  Diverter Valve PH 134-L
-  Expansion Joint PH 141-L11...L14
-  Manual Plug Valve PH 130- L11/L12
-  Vent Gas Valve VS2 PH 189- L11/L12
-  Manual Plug Valve PH 132- L11/L12
-  Expansion Joint PH 142-L11/L12
-  Solids Cut Off & Gas Seal Valve VS2 PH 143-L11/L12
-  Fitting and Spool pieces

#### 10.3.3.3.1 Manual Blocking Valve RE 210-L

Its function is to isolate the Reactor with the discharge system.

In the unlikely event of urgent corrective maintenance to rotary valve or diverter valve, this blocking device is set closed, then Reactor can be isolated without DRI material being discharged.

This device is equipped with water jackets which provide the cooling of the external shell and internal parts.

Number	1
Inlet Diameter	36
Face to Face High	125
Operation	Manual
Seal	Mechanical
Body Material	Carbon Steel
Gate Material	High manganese alloy steel

Table 10.3-13.: Manual Blocking Valve

### 10.3.3.3.2 Expansion Joint RE 211-L

The Expansion Joint is arranged between the Manual Blocking Valve and the Rotary Valve RE 276-L; it has the function to absorb the expansion and contractions of the Reactor during its operation. It has been designed for hot service. This device is equipped with water jackets which provide the cooling of the external shell and internal parts.

Number		1
Diameter	in	24
Face to Face High	mm	1200
Material		Carbon Steel plus SS Bellow

Table 10.3-14.: Expansion Joint

### 10.3.3.3.3 Refractory Rotary Valve RE 276-L

It is a variable speed motor driven Rotary Valve, it has the function to control the production rate of the Reactor.

This device is equipped with water jackets which provide the cooling of the external shell.

Number		1
Inlet Diameter		24
Face to Face High		1847
Motor Rating		22.35
Capacity		400
Rotary Valve Diverter		Variable Speed
Speed Range		0-20
Seal		Mechanical with Nitrogen
Material (shell)		Carbon Steel
Material (internal)		High alloy

Table 10.3-15.: Refractory Rotary Valve

#### 10.3.3.3.4 Diverter Valve RE 278-L

Is a hydraulically operated diverter valve, used to distribute the Hot DRI discharged from the Rotary Valve to the EAF Surge Bins PH 112-F11/12 or to the Sampling Bin RE 255-F. It has been designed for hot service. This device is equipped with water jackets which provide the cooling of the external shell and internal parts.

Number	1
Legs Angle	40 in
Operation	Hydraulic
Material	Carbon Steel with antiwear lining

Table 10.3-16.: Diverter Valve

#### 10.3.3.3.5 Expansion Joint RE 215-L11/L12

These hot service Expansion Joints are located between Diverter Valves RE 278-L and Plug Valve RE 217-L; their function is to absorb expansions and contractions in the duct between the mentioned valves.

Number	2
Material	Carbon Steel plus SS Bellow

Table 10.3-17.: Reactor's expansion joint's data

### 10.3.3.3.6 Manual Plug Valve RE 217-L

It is a seal gas valve, normally used to isolate any of the Sampling Bin RE 255-F from Reactor during maintenance to the equipment located below. Its normal condition is in open position. It is hydraulically operated.

Number	1
Inlet Diameter	12
Operation	Hydraulic
Material	Carbon Steel plus Anti-wear lining

Table 10.3-18.: Reactor’s manual plug valve characteristics

### 10.3.3.3.7 Vent Gas VS2 RE 236-L

Main purpose of the valve is for safety of personnel during maintenance of Solids cut-off & gas seal valve VS2 RE 213-L or other equipment (valves of bins) located below this valve.

During maintenance of any of the Solids cut-off & gas seal valve VS2 RE 213-L, the corresponding DRI discharging line is isolated from reactor by closing manual lubricated plug valves RE 217-L and RE 223-L and opening the Gas Seal Valve RE 236-L, in this way, in the event of a leak of valve RE 217-L during the maintenance period, the gas will be vented to atmosphere protecting the maintenance personnel.

Number	1
Inlet Diameter	4 in
Operation	Hydraulic
Material	Carbon Steel

Table 10.3-19.: Reactor’s vent gas valve characteristics

### 10.3.3.3.8 Manual Plug Valve RE 223-L

It is a seal gas valve, normally used to isolate any of the Sampling Bin RE 255-F from Reactor during maintenance to the equipment located below. Its normal condition is in open position. It is hydraulically operated.

Number		1
Inlet Diameter	“	12
Operation		Hydraulic
Material		Carbon Steel plus Anti-wear lining

Table 10.3-20.: Manual Plug Valve

### 10.3.3.3.9 Expansion Joint RE 223-L

This hot service Expansion Joint is located in the leg to the Sampling Bin RE 255-F; its function is to absorb expansions and contractions along the duct.

Number		1
Inlet Diameter	“	12
Material		Carbon Steel plus SS Bellow

Table 10.3-21.: Expansion Joint for the reactor’s discharging system

### 10.3.3.3.10 Solids Cut Off & Gas Valve VS2 RE 213-L

This hot service Solids Cut Off & Seal Valve is of the inflatable seal type. This valve has the function to make a gas tight seal, and at the same time to cut off the solids flow. This valve is located below the Expansion Joint RE 233-L, just at the inlet of the Sampling Bin RE 255-F. Valve is hydraulically operated.

Number		1
Inlet Diameter		12 in
Operation		Hydraulic
Material		Carbon Steel plus Anti-wear lining

Table 10.3-22.: Solids Cut Off & Gas Valve

### 10.3.3.3.11 Sample Bin RE 255-F

This bin receives the Hot DRI from the reactor and is directed to the cooling conveyor. The operation of the upper and bottom valves is very similar to the Iron Ore Pressurized Bins in the reactor feeding legs, but in opposite way, upper valves are open while charging the bin, internal pressure of bin is equalized to reactor's pressure. When discharging material, bin is at atmospheric pressure and lower valves open.

Another function of this bin is to help to the solids flow. By means of this bin, the DRI can be forced to flow downwards by a differential pressure being applied between bin and reactor whenever a non-proper solids flow is present. The bin when depressurized will force the material to being discharged into the bin, at the moment of opening the upper inlet valves; gas from reactor at high velocity is directed to flow to the bin, the gas by this mean carries over the DRI downwards.

By hydraulic interlock, it is not enabled the charging valves while operation of lower valves is taking place. And vice versa, while operating upper valves, lower valves are not enabled to operate

Number		1
Operating Pressure		Cycling from ambient to 8.0
Operating Temperature	°C	700-750
Capacity	m <sup>3</sup>	16
Material		Carbon Steel

Table 10.3-23.: discharge system pressure bin

### 10.3.3.3.12 Gas Seal Valve RE 216-L

Its function is to make a tight seal while the Sampling Bin is in charge stage, as well as to reduce the pressure of the bin before entering into the discharge.

This valve is equipped with water jackets which provide the cooling of the external shell.

Number	1
Face to face height	195
Inlet Diameter	4
Seal	Inflatable Seal
Operation	Hydraulic
Material	Carbon Steel

Table 10.3-24.:Reactor’s discharge system Gas Seal Valve data

### 10.3.3.3.13 Pressurization Valve RE 200-L

The function is to supply the required amount of nitrogen to pressurize the bin; pressurization stage finishes when the bin internal pressure reaches the Reactor internal pressure.

Number	1
Inlet Diameter	2"

Table 10.3-25.: reactor’s discharge system Pressurization Valve



#### 10.3.3.3.14 Solids Cut-Off Valve VS2 RE 240-L

Its function is to cut-off the solids at the end of the bin discharging phase. This device is equipped with water jackets which provide the cooling of the external shell.

Number	1
Inlet Diameter	16
Face to Face High	1060
Seal	Inflatable Seal
Operation	Hydraulic
Material	Carbon Steel plus anti-wear lining

Table 10.3-26.: reactor's discharge solids cut-off valve

#### 10.3.3.3.15 Solids Cut-Off and Gas Seal Valves VS2 RE 227-L

Their function is to seal the Sampling Bin when is in charging phase from the reactor. This device is equipped with water jackets which provide the cooling of the external shell.

Inlet Diameter	12
Face to Face High	480
Seal	Inflatable Seal
Operation	Hydraulic
Material	Carbon Steel plus anti-wear lining

Table 10.3-27.: reactor's discharge solids cut-off and gas seal valves

#### 10.3.3.3.16 Manual Plug Valve RE 235-L

This is a gas seal valve, normally used to isolate the upper or the lower equipment during maintenance operations. During normal operation they are in open position. They are hydraulically operated.

This device is equipped with water jackets which provide the cooling of the external shell.

Number	1
Nominal Diameter	12
Face to face Height	812
Seal	Mechanical with grease
Operation	Hydraulic
Material	C Steel (internal parts: cast iron + anti wear)

Table 10.3-28.: reactor's discharge system Manual plug valve

#### 10.3.3.3.17 Expansion Joint RE 232-L11...L14

These devices are used to absorb any expansion or contraction that the components of the equipment or its structure may suffer, mostly due to temperature or the application of static loads.

These devices are equipped with water jackets which provide the cooling of the external shell and internal parts.

Number	4
Inlet Diameter	16
Material	Carbon steel plus SS bellow

Table 10.3-29.: reactor's discharge system expansion joint

#### 10.3.3.3.18 Receiving Hopper RE 113-F

The Receiving Hopper basically is a small bin that receives the Hot DRI from the reactor and discharges it in the cooling conveyor.

### 10.3.3.3.19 Plug Valve RE 217-L11/L12

Just before the diverter valve PH 134-L, there is a spool piece which provides a deviation for the Hot DRI in order to take samples for laboratory analysis. The Hot DRI is taken here in batches and stored in a small container where it is cooled down by means of nitrogen before being discharged and transported to the laboratory. This is a gas seal valve is located in the sampling spool and its main purpose is to keep isolated the sampling pipe from the Reactor when the gas seal Valve RE 222-L is in maintenance.

Number	2
Inlet Diameter	4
Material	Carbon steel

Table 10.3-30.: reactor's discharge system plug valve

### 10.3.3.3.20 Vent Gas Valve VS2 RE 237-L

Main purpose of the valve is for safety of personnel during maintenance of any of the VS2 valve RE 222-L or any equipment (valves of bins) located below these valves.

In During maintenance of any of the Solids cut-off & gas seal VS2 RE 222-L valve, or valves located below the sampling hopper, the plug valves RE 218 L11÷L12 are closed and the Gas Seal Valve VS2 RE 237-L is open, in this way, in the event of a leak of valve RE 218-L11, the gas will be vented to atmosphere protecting the maintenance personnel.

Number	1
Inlet Diameter	4
Operation	Hydraulic
Material	Carbon Steel

Table 10.3-31.: reactor's discharge system vent gas valve

### 10.3.3.3.21 Gas Valve VS2 RE 222-L

Main purpose of the valve is to isolate the sampling Receiving Hopper RE 115-F from reactor. This valve will open only during sample taking.

Number	1
Inlet Diameter	4 in
Operation	Hydraulic
Material	Carbon Steel

Table 10.3-32.: reactor's discharge gas valve VS2

### 10.3.3.3.22 Receiving Hopper RE 115-F

This hopper will receive the hot DRI sample coming from the reactor discharge.

### 10.3.3.3.23 Gas Seal Valve VS2 RE 224-L

Main purpose of the valve is to isolate the sampling Receiving Hopper RE 115-F ambient pressure conditions.

During a discharge of a DRI sample, the Receiving Hopper RE 115-F is depressurized by means of valve RE 226-L. Once the bin is at atmospheric pressure, the Gas Seal Valve RE 224-L will open allowing the sample to be discharged into the sample container.

Number	1
Inlet Diameter	4 in
Operation	Hydraulic
Material	Carbon Steel

Table 10.3-33.: reactor's discharge Gas Seal Valve VS2

#### 10.3.3.3.24 Depressurization Valve RE 226-L

This valve is used to depressurize the Receiving Hopper RE 115-F to atmospheric pressure, relieving the Nitrogen gas hold by the Bin to the atmosphere.

Once the inner pressure of bin is equal to atmospheric pressure, lower discharging valve RE 224-L is ready to be open.

Number	1
Inlet Diameter	2 in
Operation	Hydraulic
Material	Carbon Steel

Table 10.3-34.: reactor's discharge depressurization valve

#### 10.3.3.3.25 Hot DRI Sampler 285-L

The Hot DRI is taken here in batches and stored in a small container where it is cooled down by means of nitrogen before being discharged and transported to the laboratory.

#### 10.3.3.3.26 Diverter Valve PH 134-L

Is a hydraulically operated diverter valve, used to distribute the Hot DRI discharged to each one of the EAF Surge Bins PH 112-F11/F12. It has been designed for hot service. This device is equipped with water jackets which provide the cooling of the external shell and internal parts.

Number	1
Legs Angle	40
Operation	Hydraulic
Material	Carbon Steel with antiwear lining

Table 10.3-35.: reactor's discharge diverter valve

### 10.3.3.3.27 Expansion Joints PH 141 L11/L14

These Expansion Joints are located between the Diverter valve and the Plug Valves; their function is to absorb expansions and contractions in each charging line to the EAF Surge Bins. This normally occurs when the bins are being charged or discharged.

These devices are equipped with water jackets which provide the cooling of the external shell.

Number	4
Nominal Diameter	12
Face to face Height	560
Material	Carbon Steel plus SS Bellow

Table 10.3-36.: reactor's discharge expansion joint PH 141

### 10.3.3.3.28 Plug Valve PH 130-L11/L12

It is a seal gas valve, normally used to isolate any of the EAF Surge Bins PH 112-F11/F12 from Reactor during maintenance to the equipment located below. Its normal condition is in open position. It is hydraulically operated.

Number	2
Inlet Diameter	12
Operation	Hydraulic
Material	Carbon Steel plus Antiwear lining

Table 10.3-37.: reactor's discharge Plug Valve PH 130-L11/L12

### 10.3.3.3.29 Vent Gas VS2 PH 189-L11/L12

Main purpose of the valve is for safety of personnel during maintenance of Solids cut-off & gas seal valve VS2 PH 143-L11/L12 or other equipment (valves of bins) located below this valve.

During maintenance of any of the Solids cut-off & gas seal valve VS2 PH 143-L11/L12, the corresponding DRI discharging line is isolated from reactor by closing manual lubricated plug valves PH 130-L11/L12 and PH 132-L11/L12 and opening the Vent Gas Valve PH 189-L11/L12, in this way, in the event of a leak of valve PH 130-L11/L12 during the maintenance period, the gas will be vented to atmosphere protecting the maintenance personnel.

Number	2
Inlet Diameter	4 in
Operation	Hydraulic
Material	Carbon Steel

Table 10.3-38.: reactor's discharge Vent Gas VS2 PH 189-L11/L12

### 10.3.3.3.30 Manual Plug Valve PH 132-L11/L12

It is a seal gas valve, normally used to isolate any of the EAF Surge Bins PH 112-F11/F12 from Reactor during maintenance to the equipment located below. Its normal condition is in open position. It is hydraulically operated.

Number	2
Inlet Diameter	12
Operation	Hydraulic
Material	Carbon Steel plus Antiwear lining

Table 10.3-39.: reactor's discharge Manual Plug Valve PH 132-L11/L12

### 10.3.3.3.31 Expansion Joints PH 142-L11/L12

These Expansion Joints are located between the Plug Valve and the VS2 valve; their function is to absorb expansions and contractions in each charging line to the EAF Surge Bins. This normally occurs when the bins are being charged or discharged.

These devices are equipped with water jackets which provide the cooling of the external shell.

Number	2
Nominal Diameter	12
Face to face Height	560

Table 10.3-40.: reactor's discharge Expansion Joints PH 142-L11/L12

### 10.3.3.3.32 Solids Cut-Off and Gas Seal Valves VS2 PH 143-L11/L12

Their function is to seal the EAF Surge Bins when is in discharging phase to the EAF. These devices are equipped with water jackets which provide the cooling of the external shell.

Number	2
Inlet Diameter	12
Face to Face High	480
Seal	Inflatable Seal
Operation	Hydraulic
Material	Carbon Steel plus antiwear lining

Table 10.3-41.: reactor's discharge solids Cut-Off and Gas Seal Valves VS2 PH 143-L11/L12

### 10.3.3.3.33 Fitting and Spool Pieces






Pieces, like spool pieces, reducers or elbows, blind flanges, connecting the valves and expansion joints previously mentioned when the latter have different dimension and/or need some space in between each other for maintenance purposes.



#### 10.3.3.4 EAF Charging System

The EAF Charging system receives by gravity the hot DRI from the reactor and feed it to the EAF.

The system for feeding the EAF with Hot DRI consists of the following main equipment (see 10.3-5):

-  EAF Surge Bins PH 112-F11/F12
-  Manual Blocking Valve PH 110-L11/L12
-  Expansion Joint PH 107-L11/L12
-  Rotary Valves PH 176-L11/L12
-  Solids Cut-Off & Gas Seal Valve VS2 PH 108-L11/L12
-  Manual Plug Valve PH 241-L11/L12
-  Diverter Valve PH 135-L11/L12
-  Solids Cut-Off & Gas Seal Valve VS2 PH 180-L11/L12
-  Expansion Joints PH 128-L11...L14
-  Loading Chute PH 147-L11/L12
-  Solids Cut-Off & Gas Seal Valve VS2 PH 145-L11/L12
-  Expansion Joints PH 109-L11/L12
-  Loading Chute PH 121-L11/L12
-  Receiving Hopper PH 114-F
-  Rotary Loading Chute PH 149-L
-  Expansion Joints PH 131-L11/L12
-  Fittings And Connecting Pieces
-  Depressurizing Scrubber System

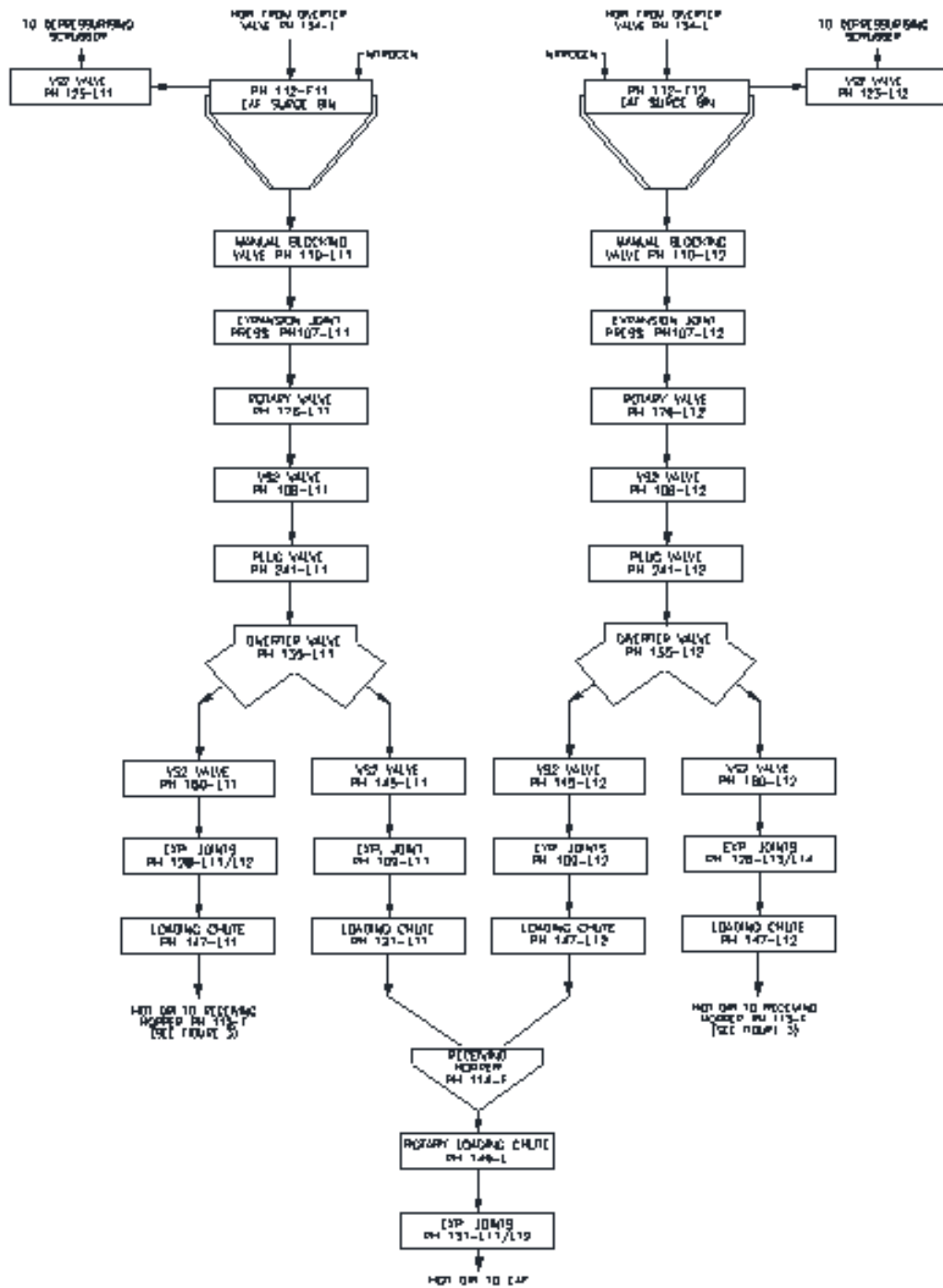


Figure 10.3-23.: EAF charging system flow diagram

#### 10.3.3.4.1 EAF Surge Bins PH 112-F11/F12

These bins are of welded construction; they receive alternately the hot DRI from the diverter valve PH 134-L and supply the material to the Receiving Hopper PH 114-F by means of a Rotary Valve. These bins work at almost atmospheric pressure all the time.

The shell is protected by refractory at the cylinder and dome; the cone is both protected by refractory and by a water jacket. They are installed over load cells to measure the quantity of DRI stored inside. They are kept in slight overpressure by means of Nitrogen blanketing. During filling, the gas trapped in the bin is displaced by the falling DRI and escapes from the bin through the valves PH 123-L11/L12 and goes to the Depressurizing Scrubber.

Number	2
Operating Pressure	atmospheric
Volume (each)	115
Number of Water Jackets	1
Level Detection	Load Cells
Material	Carbon Steel

Figure 10.3-24.: EAF charging system Surge Bins PH 112-F11/F12 data

#### 10.3.3.4.2 Manual Blocking Valves PH 110-L11/L12

Its function is to ensure a tight seal in order to avoid gas leakage from the EAF surge bin located above. It is normally set open. It is set closed when it is necessary to give maintenance to the equipment below.

Number	2
Inlet Diameter	24
Face to Face High	380
Operation	Manual
Material	Carbon Steel

Table 10.3-42.: EAF charging system Manual Blocking Valves PH 110-L11/L12

#### 10.3.3.4.3 Expansion Joint Non-Pressurized PH 107-L11/L12

These devices are used to absorb any expansion or contraction that the components of the equipment or its structure may suffer, mostly due to temperature or the application of static loads. Both are equipped with water jackets, which provide the cooling of the external shell.

Number	2
Inlet Diameter	24
Face to Face High	812
Material	Carbon steel plus SS bellow

Table 10.3-43.: EAF charging system Expansion Joint Non-Pressurized PH 107-L11/L12 data

#### 10.3.3.4.4 Rotary Valve PH 176-L11/L12

The Rotary Valve is designed for the control of the DRI flow from each EAF Surge Bin; adjusting the controlled speed of the Rotary Valve it discharges the desired flow rate of product. This device is equipped with water jackets which provide the cooling of the external shell. A variable speed electric motor controls the valve rotation.

Number	2
Inlet Diameter	24
Face to Face High	2847
Motor Rating	22.35
Rotary Valve Diverter	Variable Speed
Speed Range	0-20
Delivery Volume	0.350
Material	Carbon Steel plus internals in Special Alloy Internal

Table 10.3-44.: EAF charging System Rotary Valve PH 176-L11/L12 data

#### 10.3.3.4.5 Solids Cut-Off and Gas Seal VS2 PH 108-L11/L12

Its function is to seal the EAF Surge Bin that is in filling phase from the external atmosphere. It is set open when the above EAF Surge Bin is in discharging phase (therefore when the Rotary Valve is in operation and the VS2 valve above the bin is set closed).

It is set closed when the above EAF Surge Bin is in filling phase (therefore when the Rotary Valve isn't in operation and the VS2 valve above the bin is set open). This device is equipped with water jackets which provide the cooling of the external shell.

Number	2
Inlet Diameter	16
Face to Face High	620
Operation	Hydraulic
Material	Carbon Steel plus anti-wear lining

Table 10.3-45.: EAF charging System Solids Cut-Off and Gas Seal VS2 PH 108-L11/L12 data

#### 10.3.3.4.6 Manual Plug Valve PH 241-L11/L12

It is a seal gas valve, normally used to isolate any of the EAF Surge Bins PH 112-F11/F12 during maintenance to the equipment located below. Its normal condition is in open position. It is hydraulically operated.

Number	2
Inlet Diameter	12in
Operation	Hydraulic
Material	Carbon Steel plus Antiwear lining

Table 10.3-46.: EAF charging system Manual Plug Valve PH 241-L11/L12 data

#### 10.3.3.4.7 Diverter Valve PH 135-L11/L12

Is a hydraulically operated diverter valve, used to distribute the Hot DRI discharged from each one of the EAF Surge Bins PH 112-F11/F12 either to the EAF or to cooling conveyor. It has been designed for hot service. This device is equipped with water jackets which provide the cooling of the external shell and internal parts.

Number	2
Legs Angle	40
Operation	Hydraulic
Material	Carbon Steel with antiwear lining

Table 10.3-47.: EAF charging System Diverter Valve PH 135-L11/L12 data

#### 10.3.3.4.8 Solids Cut-Off and Gas Seal VS2 PH 180-L11/L12

This valve is used to discharge the material to the cooling conveyor.

This device is equipped with water jackets which provide the cooling of the external shell.

Number	2
Inlet Diameter	16
Face to Face High	620
Operation	Hydraulic
Material	Carbon Steel plus anti-wear lining

Table 10.3-48.: EAF charging System Diverter Valve PH 135-L11/L12 data

#### 10.3.3.4.9 Expansion Joint Non-Pressurized PH 128-L11...L14

These devices are used to absorb any expansion or contraction that the components of the equipment or its structure may suffer, mostly due to temperature or the application of static loads.

They are equipped with water jackets, which provide the cooling of the external shell.

Number	4
Inlet Diameter	16
Face to Face High	500
Material	Carbon steel plus SS bellow

Table 10.3-49.: EAF charging System Expansion Joint Non-Pressurized PH 128-L11...L14 data

#### 10.3.3.4.10 Loading Chute PH 147-L11/L12

The function of this chute is to feed Hot DRI to the Receiving Hopper PH 113-F and subsequently to the cooling conveyor.

It is made by high temperature and abrasion resistant steel, internally lined with anti-wearing materials.

Number	2
Inlet Diameter	16
Operation	Hydraulic

Table 10.3-50.: EAF charging System Loading Chute PH 147-L11/L12 data

#### 10.3.3.4.11 Solids Cut-Off and Gas Seal VS2 PH 145-L11/L12

This valve is used to discharge the material to the EAF.

This device is equipped with water jackets which provide the cooling of the external shell.

Number	2
Inlet Diameter	16
Face to Face High	620
Operation	Hydraulic
Material	Carbon Steel plus anti-wear lining

Table 10.3-51.: EAF charging system Solids Cut-Off and Gas Seal VS2 PH 145-L11/L12 data

#### 10.3.3.4.12 Expansion Joint Non-Pressurized PH 109-L11/L12

These devices are used to absorb any expansion or contraction that the components of the equipment or its structure may suffer, mostly due to temperature or the application of static loads.

They are equipped with water jackets, which provide the cooling of the external shell.

Number	2
Inlet Diameter	16
Face to Face High	500
Material	Carbon steel plus SS bellow

Table 10.3-52.: EAF charging system 10.3.3.4.12Expansion Joint Non-Pressurized PH 109-L11/L12 data



#### 10.3.3.4.13 Loading Chute PH 121-L11/L12

The function of this chute is to feed Hot DRI to the Receiving Hopper PH 114-F and subsequently to the EAF.

It is made by high temperature and abrasion resistant steel, internally lined with anti-wearing materials.

Number	2
Inlet Diameter	16
Operation	Hydraulic

Table 10.3-53.: EAF charging system Loading Chute PH 121-L11/L12 data

#### 10.3.3.4.14 Receiving Hopper PH 114-F

The Receiving Hopper basically is a small bin that receives the Hot DRI from each of the EAF Surge Bins PH 112-F11/F12 and discharge to the rotary loading chute.

#### 10.3.3.4.15 Rotary Loading Chute PH 149-L

The function of this chute is to feed DRI to the EAF. It can rotate, hydraulically operated, from the DRI charging position to the idling position aside the EAF in order to protect it during the EAF heat phase. It is made by high temperature and abrasion resistant steel, internally lined with anti-wearing materials.

Number	1
Inlet Diameter	16
Operation	Hydraulic

Table 10.3-54.: EAF charging system Rotary Loading Chute PH 149-L data

#### 10.3.3.4.16 Expansion Joint Non-Pressurized PH 131-L11/L12

These devices are used to absorb any expansion or contraction that the components of the equipment or its structure may suffer, mostly due to temperature or the application of static loads.

They are equipped with water jackets, which provide the cooling of the external shell.

Number	2
Inlet Diameter	16
Face to Face High	500
Material	Carbon steel plus SS bellow




Table 10.3-55.: EAF charging System Expansion Joint Non-Pressurized PH 131-L11/L12 data

#### 10.3.3.4.17 Fittings and Connecting Pieces

Pieces, like spool pieces, reducers or elbows, connecting the valves and expansion joints previously mentioned when the latter have different dimension and/or need some space in between each other for maintenance purposes. They are water cooled wherever required, through external cooling jackets.

#### 10.3.3.4.18 Depressurizing Scrubber

The Depressurizing Scrubber, not shown in 10.3-5, is composed by:

-  Gas Venturi PH 649-C
-  EAF Bins Depressurizing Stack PH 647-F
-  EAF Bins Scrubber PH 653-F



The depressurizing system provides the cleaning of the nitrogen coming from the depressurization of the EAF Surge Bins PH 112-F11/F12 when they are being filled, as well as the gas leaving the Sampling Bin RE 255-F. The water used to clean the gas is sent to WTP without using pumps, being this equipment located at enough height to allow gravity flow.

Venturi data	
Type	Fixed throat
Design Gas Flow	29,433
Max Pressure Drop	150
Material	Carbon Steel
Stack Operating Pressure	atmospheric
Operating Temperature	71
Outlet Gas Flow	43,825
Outlet Water Drain	93.8
Material	Carbon Steel
EAF Bins Scrubber data	
Type	Vertical K.O Drum with Chevron and demister pad
Outlet gas Flow	300
Operating pressure	atmospheric
Outlet PCW	1,0
Material	Carbon Steel

Table 10.3-56.: EAF charging System Depressurizing Scrubber data

### 10.3.3.5 Gas Treatment Circuits

The Reduction gas circuit consists of the following equipment:

-  Top Gas Heat Recuperator PG 221-C
-  Steam Drum PG 221-F
-  Process Gas Quench Orifice PG 211-C
-  Process Gas Venturi PG 312-G
-  Process Gas Separator PG 313-F
-  Process Gas Quench Tower PG 231-E
-  Humidifier Water Pumps PG 631-J11/J12
-  Process Gas KO Drum PG 416-F
-  Process Gas Filters PG 436-G11/G12
-  Process Gas Compressor PG 436-J
-  Process Gas Compressor Aftercooler PG 671-E
-  Process Gas Humidifier PG 622-E
-  Process Gas Heater KO Drum PG 623-F
-  Reactor by-pass Quench Orifice PG 650-C
-  Reactor by-pass KO Drum PG 651-F
-  Natural Gas K.O. Drum RG 611-F
-  Dispersant Addition Unit PG 212-U

### 10.3.3.5.1 Top Gas Heat Recuperator PG 221-C

The heat exchanger is located at the top gas outlet in the reactor reduction section. Its function is to take advantage of the sensible heat of the exhaust gas coming out from the reactor to generate the required steam in the CO<sub>2</sub> Absorption Plant.

Design Top Gas flow	Nm <sup>3</sup> /h	159,865
Top Gas inlet temperature	°C	461
Top gas pressure	barg	6.83
Top Gas outlet temperature	°C	195
Heat exchanger type		Shell and Tubes
Steam generated	ton/hr	29.3
Saturated steam pressure	barg	7.81

Table 10.3-57.: Top Gas Heat Recuperator PG 221-C data

The Heat Recuperator transfers partially the heat from the Top Gas stream flowing downwards into the tubes to boiler feed water contained in the shell side for steam generation. A Steam Drum maintains the water level in the Recuperator shell side. The water is fed by down comers to the bottom of the shell and the generated steam returns to the Steam Drum inside the risers. This design allows the use of conventional materials in the construction of the Recuperator, and there is no limitation on the Reactor top gas temperature.

### 10.3.3.5.2 Steam Drum PG 221-F

The Steam Drum PG 221-F is located over head the Top Gas Heat Recuperator, keeping the shell of the heat exchanger flooded with water, liquid is fed by the down comers' tubes. From the Recuperator steam returns to the steam drum inside the risers' tubes, steam gets separated from the water phase inside of the drum, leaving from the top of the drum passing through the mist eliminator. The boiler feed water is supplied to the Steam Drum (and to the Package Boiler CO 348-B, supplying the required extra steam as well) by the Boiler Feed Water Pumps CO 337-J1/J2.

Operating Pressure	barg	7.81
Operating Temperature	°C	174.5
Steam Generated	t/h	29.3
Material		Carbon Steel

Table 10.3-58.: Steam Drum PG 221-F data

### 10.3.3.5.3 Process Gas Quench Orifice PG 211-C

Is a direct contact gas cooler, located at the bottom of the Top Gas Heat Recuperator PG 221-C, it is used for cooling down the exhaust reducing gas stream with direct contact water. This equipment consists of two concentric tubes containing in between a water jacket. Process cooling water floods the jacket and due to its high pressure, the water is being sprayed into the gas stream through holes located on the inner pipe.

Operating Pressure	barg	6.78
Gas Inlet Temperature	°C	195
Gas Outlet Temperature	°C	117
Gas Design Flow rate	Nm <sup>3</sup> /h	165,857
Water Design Flow rate	m <sup>3</sup> /h	52.2
Material (External Tube/Internal Tube)		Carbon Steel/Stainless Steel

Table 10.3-59.: Process Gas Quench Orifice PG 211-C data

#### 10.3.3.5.4 Process Gas Venturi PG 312-G

It is located downstream the Quench Orifice PG211-C. The gas passes through the Venturi throat, where the gas and water streams velocity increases; this effect causes the water to be finely dispersed in small droplets and the water droplets catch dust particles as small as 10 microns. Thereafter the solid particles are kept entrained in the liquid stream. At the Venturi throat outlet the divergent nozzle allows the gas and water streams to decrease their velocity, in this way the pressure is then stabilized

Type		Fixed throat
Operating Pressure	barg	6.78
Operating Temperature	°C	117
Design Gas Flow	Nm <sup>3</sup> /h	165,857
Max Pressure Drop	mbar	150
Material		Stainless Steel with anti-erosion coating of Triten

Table 10.3-60.: Process Gas Venturi PG 312-G data

#### 10.3.3.5.5 Process Gas Separator PG 313-F

It is located downstream of the Process Gas Venturi PG 312-G, it has the function of separating the liquid and gas phases, being the liquid water bearing solids separated from the exhaust gas stream.

Type		Vertical Drum with demisting pad
Operating Pressure	barg	6.58
Operating Temperature	°C	117
Design Gas Flow	Nm <sup>3</sup> /h	165,857
Design Water Flow	m <sup>3</sup> /h	15.2
Design Water Drain	m <sup>3</sup> /h	62.9
Material		Carbon Steel with anti-abrasion coating

Table 10.3-61.: Process Gas Separator PG 313-F data

### 10.3.3.5.6 Process Gas Quench Tower PG 231-E

It is located downstream of the Process Gas Separator 313-F. It is a direct contact-packed tower, used for cooling down the clean exhaust gas stream with cold water. At the moment of cooling, the saturation water is condensed from the gas, producing an excess of clean water collected in the bottom of the vessel. The tower internals mainly include the pipes for cooling water, demisting pads, packing and supporting structure.

The hot water collected at the Quench Tower bottom is pumped to the Process Gas Humidifier, where water vapour is added to the fresh Process Gas for carbon control purposes in the DRI. The excess of water not needed by the Humidifier goes directly to the Cooling Towers in the Water Treatment Plant.

The amount of condensed water generated by the reduction of iron oxides and recovered in the Process gas quench tower minimizes the water requirements in the plant.

Type	Direct Contact Quencher with structural packed bed	
Operating Pressure	barg	6.48
Inlet Gas Temperature	°C	116
Outlet Gas Temp.	°C	38
Inlet Gas Flow	Nm <sup>3</sup> /h	165,450
Outlet Gas Flow	Nm <sup>3</sup> /h	127,786
Design Water Flow	m <sup>3</sup> /h	350.6
Design Water Drain	m <sup>3</sup> /h	380.9
Packing Bed Material	Stainless Steel	
Vessel Material	Carbon Steel with anti-abrasion coating	

Table 10.3-62.: Process Gas Quench Tower PG 231-E data



### 10.3.3.5.7 Humidifier Water Pumps PG 631-J11/J12

These pumps are located at the Process Gas Quench Tower bottom and their function is to increase the pressure of the hot water in order to allow injection in the Process Gas Humidifier.

Number		1+1
Type		Centrifugal
Design Flow	m <sup>3</sup> /h	380.9
Head	bar	7.0
Motor Rating	kW	186

Table 10.3-63.: Humidifier Water Pumps PG 631-J11/J12

### 10.3.3.5.8 Process Gas K.O. Drum PG 416-F

It is located downstream of the Process Gas Quench Tower PG 231-E. It has the function to remove any mist or any condensed water from the Process Gas stream before entering the Process Gas Compressor PG 436-J.

The vessel is a water separator tank with inlet nozzle located tangentially to the tank wall; at the top is a demisting pad which takes care of mist, collecting the liquid entrained in the gas stream by forming drops of liquid for its collection at the bottom of the vessel.

Type		Vertical Drum with demisting pad
Operating Pressure	barg	6.34
Operating Temperature	°C	38
Design Gas Flow	Nm <sup>3</sup> /h	127,786
Material		Carbon Steel

Table 10.3-64.: Process Gas K.O. Drum PG 416-F

#### 10.3.3.5.9 Process Gas Filters PG 435-G11/G12

Two (2) Process Gas Filters (one in operation and one in stand-by) are incorporated at the suction of the Process Gas Compressor PG 436-J. Their function is to remove any remaining particle in the process gas and prevent damage of the compressor. Each filter is designed to handle a flow of 132,086 Nm<sup>3</sup>/hr.

#### 10.3.3.5.10 Process Gas Compressor PG 436-J

The Process Gas Compressor has the function to compress the Reducing Gas. Compressor, gear box and drive will have a common base frame, and will include complete lube oil supply system for the compressor shaft bearings and seals.

Type		Centrifugal
Driver		Electric Motor
Design Capacity	Nm <sup>3</sup> /h	129,437
Head	bar	4.9
Motor Power	kW	3,730

Table 10.3-65.: Process Gas Compressor PG 436-J data

### 10.3.3.5.11 Process Gas Compressor Aftercooler PG 671-C

It is a quench tower packed vessel for the cooling of the process gas with direct contact quenching water. Its function is to lower the compressed gas temperature for an adequate absorption of the CO<sub>2</sub>. The CO<sub>2</sub> is generated in the reduction of the iron oxide by reaction of the oxygen present in the iron oxide feed with the CO contained in the Reducing Gas. The CO<sub>2</sub> in excess present in the gas is removed in the CO<sub>2</sub> Absorption plant.

Type	Direct Contact Quencher with structural packed bed	
Operating Pressure	barg	11.03
Inlet Gas Temperature	°C	99
Outlet Gas Temperature	°C	45
Inlet Gas Flow	Nm <sup>3</sup> /h	125,137
Outlet Gas Flow	Nm <sup>3</sup> /h	124,666
Design Water Flow	m <sup>3</sup> /h	248.6
Design Water Drain	m <sup>3</sup> /h	248.9
Packing Bed Material	Stainless Steel	
Vessel Material	Carbon Steel	

Table 10.3-66.: Process Gas Compressor Aftercooler PG 671-C data

### 10.3.3.5.12 Process Gas Humidifier PG 622-E

It is a packed bed vessel type used for the humidification of the Process Gas with direct contact hot quenching water. The Process Gas is received from the CO<sub>2</sub> Absorption plant. The hot water, taken from the bottom of the Process Gas Quench Tower PG 231-E, is delivered by the Humidifier Water Pumps PG 631-J11/J12. The function of the Humidifier is that of adjusting the moisture content in the reducing gas by heating it up; the required amount of water is added to the gas stream in order to increase its temperature and allow a higher percentage of steam inside the reducing gas.

After humidification, the Reducing Gas is sent to the Process Gas Heater PG 302-B.

The Carbon content in the DRI is here controlled by means of the controlled amount of water added to the reducing gas, together with the natural gas make-up to the process.

The water collected at the bottom of the Humidifier goes to the Water Treatment Plant.

Type	Direct Contact Quencher with structural packed bed	
Operating Pressure	barg	10.73
Inlet Gas Temperature	°C	45
Outlet Gas Temperature	°C	75
Inlet Gas Flow	Nm <sup>3</sup> /h	132,226
Outlet Gas Flow	Nm <sup>3</sup> /h	136,190
Design Water Flow	m <sup>3</sup> /h	380.9
Design Water Drain	m <sup>3</sup> /h	377.7
Packing Bed Material	Stainless Steel	
Vessel Material	Carbon Steel	

Table 10.3-67.: Process Gas Humidifier PG 622-E data

### 10.3.3.5.13 Process Gas Heater K.O. Drum PH 623-F

It is located downstream of the Process Gas Humidifier PG 622-E. It has the function to remove any mist or any condensed water from the Process Gas stream before entering the Process Gas Heater. The vessel is a water separator tank with inlet nozzle located tangentially to the tank wall; at the top is a demisting pad which takes care of mist, collecting the liquid entrained in the gas stream by forming drops of liquid for its collection at the bottom of the vessel.

Type	Vertical Drum with demisting pad	
Operating Pressure	barg	10.45
Operating Temperature	°C	75
Design Gas Flow	Nm <sup>3</sup> /h	136,190
Material	Carbon Steel	

Table 10.3-68.: Process Gas Heater K.O. Drum PH 623-F data

### 10.3.3.5.14 Reactor By-pass Quench Orifice PG 650-C

The Reactor By-pass Quench Orifice is located at the end of a refractory lined Reducing Gas pipeline, tied-up at before the Partial Combustion line and before the Reactor. The purpose of this equipment is providing a by-pass for the Reactor to be used during the start-up of the plant, in order to avoid sending gas to the Reactor until it has achieved enough reducing potential. At the bottom of this Quench Orifice is located the Start-up KO Drum PG 651-F.

Operating Pressure	barg	8.0
Max Inlet Gas Temperature	°C	1080
Outlet Gas Temperature	°C	140 normal – 175 max.
Gas Design Flow rate (max)	Nm <sup>3</sup> /h	75,000
Water Design Flow rate (max)	m <sup>3</sup> /h	130
Material (External Tube/Internal Tube)	Carbon Steel/Stainless Steel	

Table 10.3-69.: Reactor By-pass Quench Orifice PG 650-C data

### 10.3.3.5.15 Reactor By-pass K.O. Drum PG 651-F

The Reactor By-pass KO Drum is located at the bottom of the Reactor By-pass Quench Orifice PG 650-C1, its function is to collect the process cooling water previously added to the hot gas stream in the Quench Orifice. The water is collected at the bottom of the KO Drum and the gas leaves at the top.

The gas outlet pipeline is tied-up to the outlet pipeline of the Process Gas Separator PG 313-F. The regulation of the gas flows by-passing the Reactor is done by means of flow control valves. In normal operation the by-pass system is out of operation and all the Reducing Gas flows to the Reactor. The Process Cooling Water collected at the bottom flows to the Water Treatment Plant.

Type		Vertical Drum with demisting pad
Max Operating Pressure	barg	8.0
Operating Temperature	°C	140 normal – 175 max.
Design Gas Flow	Nm <sup>3</sup> /h	217,000
Design Water Drain (max)	m <sup>3</sup> /h	30
Material		Carbon Steel

Table 10.3-70.: Reactor By-pass K.O. Drum PG 651-F

### 10.3.3.5.16 Natural Gas K.O. Drum RG 611-F

Pressure steel vessel, used for removal of entrained liquids from the Natural Gas stream received from the Battery limits.




Type		Vertical Drum with demisting pad
Operating Pressure	barg	13.7
Operating Temperature	°C	Ambient
Design Gas Flow	Nm <sup>3</sup> /h	21,300
Material		Carbon Steel

Table 10.3-71.: Natural Gas K.O. Drum RG 611-F data

#### 10.3.3.5.17 Dispersant Addition Unit PG 212-U






This system consists of a dispersant addition unit which injects chemical compounds to the process cooling water stream going to the various users in order to protect the piping against incrustations.

One unit is foreseen, serving the PG Quench Orifice PG 211-C and the Reactor By-pass Quench Orifice PG 650-C. It is composed by the following equipment:

-  One Tank, 500-liter volume
-  One Mixer, 0.75 kW motor power
-  Two dosing Pumps, 3.75 kW motor power

### 10.3.3.6 Process Gas Heater & Partial Combustion System

The Process Gas Heater PG 302-B consists of the following sections and equipment: (for equipment layout, please refer to attached drawing PS-X-7002, equipment components are shown in 10.3-6):



-  Process gas heater FD fan PG 312-J
-  Process gas heater ID fan PG 322-J
-  Radiant Section
-  Convection Section
-  Sulphur addition system PG 303

The description of this equipment is preliminary; it will depend on the selected supplier and it might change during final design, provided that the unit performance will not change.

Downstream the PG Heater, the Partial Combustion System provides a further increase in the Reducing Gas temperature by means of a direct injection of Oxygen in the gas stream.

The system arrangement is properly designed to guarantee the perfect mixing of the oxygen with the main reducing gas stream, in order to burn hydrogen, carbon monoxide and natural gas (NG) to increase the stream temperature. This system is designed to achieve temperatures up to 1100°C.

The Partial Combustion System is composed by the following equipment:

-  Oxygen lances
-  Oxygen valve stands



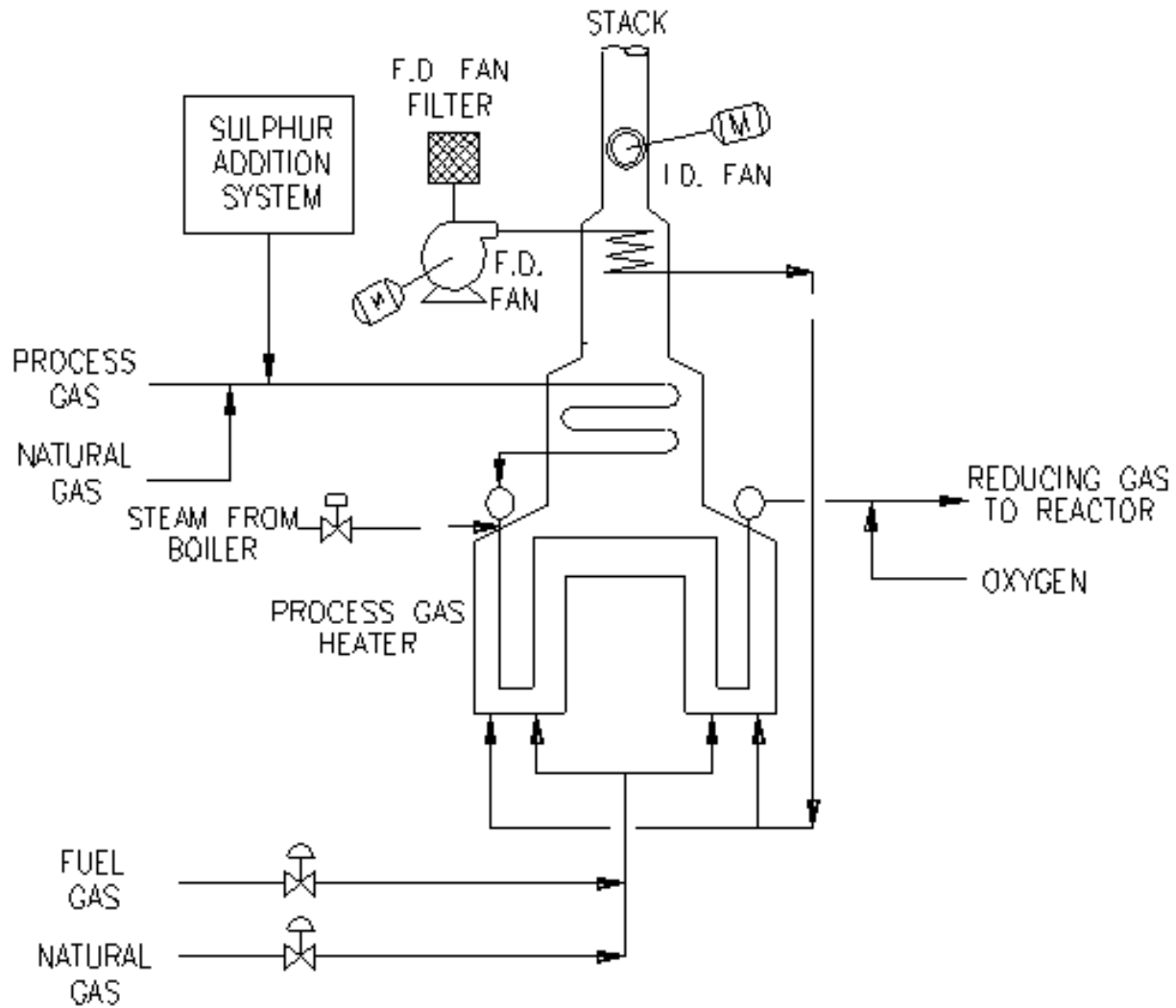


Figure 10.3-25.: Schematic Arrangement of PG Heater

#### 10.3.3.6.1 Process Gas Heater ID Fan PG 322-J

The Induced Draft Fan is used for the extraction of the combustion gases from the Process Gas Heater radiant section. The presence of this fan depends from the final design of the heater which can be designed without the presence of the Induced Draft Fan. The flue gases flow through the convection section for heat recovery and then are released through the stack.

Type		Centrifugal
Number		1
Design Gas Flow (normal/design)	Nm <sup>3</sup> /h	75,727 / 87,090
Suction Temperature	°C	Ambient
Driver		Electric Motor
Motor Power	kW	298

Table 10.3-72.: Process Gas Heater ID Fan PG 322-J data

#### 10.3.3.6.2 Process Gas Heater FD Fan PG 312-J

The Forced Draft Fan is equipped with an air filter and provides the supply of combustion air to the burners of the heater. The presence of this fan depends from the final design of the heater which can be designed without the presence of the Forced Draft Fan.

Type		Centrifugal with suction filter
Number		1
Design Gas Flow (normal/design)	Nm <sup>3</sup> /h	68,281 / 75,109
Suction Temperature	°C	Ambient
Driver		Electric Motor
Motor Power	kW	187

Table 10.3-73.: Process Gas Heater FD Fan PG 312-J data

#### 10.3.3.6.3 Convection Section

The Convection Section is the place where the process gas heater convective coils are located. The function of the convective coils is to take advantage of the sensible heat of the flue gases coming from the radiant zone by preheating the process gas before it enters to the radiant section coils of the process gas heater. Within the convection section are installed the following coils: Process Gas Convective Coil and Air Preheating Convective Coil.

##### Process Gas Convective Coil

Inlet temperature °C 75  
Inlet Pressure barg 10.4  
Design flow rate Nm<sup>3</sup>/h 136,190

##### Air Preheating Convective Coil

Inlet temperature °C ambient  
Outlet temperature °C 165  
Design flow rate (normal/design)Nm<sup>3</sup>/h68,281 / 75,109

#### 10.3.3.6.4 Radiant Section

The Radiant Section is the box where the radiant coils of the process gas heater and the burners are located. The process gas already preheated in the convective coils enters the radiant coils where it is heated up to the process requirements; the required heat is released by the process gas heater burners. The Radiant Section use natural gas and tail gas as fuel.

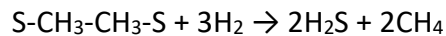
PGH outlet temperature °C 950  
Total process gas flow rate Nm<sup>3</sup>/h 136,190  
Process gas outlet pressure barg 8.4  
Heater Design Efficiency % 90

#### 10.3.3.6.5 Sulphur Addition System PG 303-L

The Sulphur addition system is common for both Process Gas Heaters

It has the function to supply the DMDS in order to control the required H<sub>2</sub>S concentration in the Process Gas that will pass through the Process Gas Heater (PG 302-B).




The sulphidric acid is produced by reaction between the Hydrogen contained in the process gas and the DMDS, as per following chemical formula:



DMDS is continuously fed to the Process Gas stream in order to control the H<sub>2</sub>S concentration in the Process Gas up to a maximum of 25 ppmv.

Sulphur has been successfully used in process gas heaters for diminishing the effects of metal dusting in high alloy tubes.

The system shall be composed by the following elements:

-  DMDS Storage Tank PG 355-F
-  DMDS Dosing Pumps PG 357-J11/J12
-  Catalytic Converter PG 361-F

#### 10.3.3.6.6 Oxygen Injection Lances

The oxygen injection lances are installed to inject oxygen in each reducing gas duct, in order to increase the reducing gas temperature.

Four (4) lances are symmetrically located on each refractory lined transfer line and they provide the injection of the Oxygen received from the Air Separation Plant.

#### 10.3.3.6.7 Oxygen Injection Valve Stands

A control valve stands regulate the Oxygen flow. The temperature reached by the gas after oxygen injection controls the valve in normal condition. In emergency condition the oxygen injection is stopped and a nitrogen injection is provided to purge the system from oxygen.

A valve stand is foreseen to control the Oxygen injection for each couple of lances, therefore in total two (2) valve stands are provided.

### 10.3.3.7 CO<sub>2</sub> Removal Unit

The CO<sub>2</sub> removal will be a wet system amine, consisting of the following equipment:

- CO<sub>2</sub> absorber Column CO 323-E
- De-carbonated gas washer CO 333-E
- Gas washing water pump CO 331-J11/J12
- Stripper Column CO 324-E
- Stripper Overhead condenser CO 315-C
- Stripper overhead Condenser KO drum CO 313-F
- Reflux pumps CO 325-J11/J12
- Sulphur Oxidizer CO 347-B
- Reboiler CO 316-C
- Reboiler condensate drum CO 335-F
- Reboiler condensate drum pumps CO 336-J11/J12
- Make up demineralized water CO 350-J11/J12
- Rich/lean solution heat exchanger CO 314-C
- Lean solution circulating pumps CO 322-J11/J12
- Lean solution heat exchanger CO 320-C
- Centrifuge filters CO 330-G11/G12
- Mechanical filter CO 327-G
- Activated carbon Filter CO 337-G
- Carbon traps CO 338-G
- Rich Solution Strainers CO 317-G11/G12
- Lean Solution Strainers CO 318-G11/G12
- Sewage Pump CO 342-J
- Solution Charging Pump CO 343-J
- Solution Storage tank CO 317-F
- Storage tank pump CO 328-J
- Solution Filter CO 340-G
- Solution preparation tank CO 341-F
- Solution sump pump CO 329-J
- Make up solution filter CO 339-G
- Antifoam metering system CO 346-L
- Hydro cyclone CO 321-G11/G12

### 10.3.3.7.1 CO<sub>2</sub> Absorber Column CO 323-E

It operates as a packed column to promote enough contact between the Process Gas and the selective absorbent, which flows counter-currently. The absorbing solution chemically removes the CO<sub>2</sub> from the gas stream for a final CO<sub>2</sub> concentration in the process gas of about 1.5% volume. The Absorption Column is located downstream of the Process Gas Compressor.

Type	Direct Contact Absorption Tower with structural packed bed
Operating Pressure	10.8 barg
Packing Bed Material	Stainless Steel
Vessel Material	Carbon steel

Table 10.3-74 CO<sub>2</sub> Absorber Column CO 323-E data

### 10.3.3.7.2 De-carbonated Gas Washer CO 333-E

It is located downstream of the Absorber Column. It has the function to wash out the Process Gas stream, as prevention of possible dragging of absorbing solution droplets; the recovered absorbent solution in this way is fed back to the CO<sub>2</sub> Absorption Plant. In this washer water is added as make-up of the overall Absorption System, due to water losses in the off gas stream at the outlet of the Regenerations columns.

Type	Direct Contact Washer with structural packed bed
Operating Pressure	10.7 barg
Packing Bed Material	Stainless Steel
Vessel Material	Carbon Steel

Table 10.3-75.: De-carbonated Gas Washer CO 333-E data

### 10.3.3.7.3 Gas Washing Water Pumps CO 331-J11/J12

They have the function to recycle enough amount of solution to the Decarbonated Gas washer in order to wash the Process Gas, retaining in the vessel the droplets of absorbent solution entrained in the Decarbonated Gas stream.

Number	1+1
Type	Centrifugal
Head	2.9 bar
Material (Casing/Impeller)	Stainless Steel/Stainless Steel

Table 10.3-76.: Gas Washing Water Pumps CO 331-J11/J12 data

### 10.3.3.7.4 Stripper Column CO 324-E

It has the function to regenerate the CO<sub>2</sub> rich solution (solution carrying CO<sub>2</sub> which has been removed from the process gas stream in the absorption column). Here the solution is heated up in the Reboiler; as a consequence the CO<sub>2</sub> and H<sub>2</sub>S are released from the solution by the addition of heat. The solution flows downwards, while the stripped CO<sub>2</sub> flows to the top of the column together with the formed vapours. The gaseous phase passes then to the overhead condenser CO 315-C.

Type	Direct Contact Stripping Tower with structural packed bed
Operating Pressure	0.5 bar
Operating Temperature	110 °C
Material	Carbon Steel/Stainless Steel (Shell/Internals)

Table 10.3-77.: Stripper Column CO 324-E data



#### 10.3.3.7.5 Stripper Overhead Condenser CO 315-C

Shell and tube heat exchanger located at the top outlet of the stripping column. It has the function to condense the water vapours coming along with the CO<sub>2</sub> stream. Equipment cooling water is used for this purpose.

#### 10.3.3.7.6 Reflux K.O. Drum CO 313-F

Vessel located downstream of the stripper overhead condenser, its function is to separate the condensate coming from the stripper overhead condenser CO 315-C in the CO<sub>2</sub> stream.

#### 10.3.3.7.7 Reflux Pumps CO 325- J11/J12

These pumps have the function to pump the condensate collected in the stripper overhead condenser KO drum CO 313-F and sending it to the stripping tower in order to maintain the solution concentration in the system.

Number		1+1
Type		Centrifugal
Design Flow	m <sup>3</sup> /h	13.7
Head	Bar	3.4
Motor Rating	kW	3.7

Table 10.3-78.: Reflux Pumps CO 325- J11/J12 data

#### 10.3.3.7.8 Reboiler Condensate Drum CO 335-F

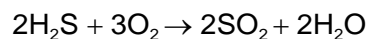
This vessel collects the steam condensate coming from the Reboiler. The condensed water flows then to the Deareator CO 367-F in order to be used as boiler feed water again.

#### 10.3.3.7.9 Reboiler CO 316-C

It is a kettle type heat exchanger. Its function is to provide the energy required for heating the absorbing solution. This energy is provided by low pressure saturated steam, which flows through the tubes. This steam flow heats up the solution flowing in the shell side, a weir is installed in order to maintain a solution level in the Reboiler shell high enough to ensure the tubes bundle is kept always flooded.

#### 10.3.3.7.10 Sulphur Oxidizer CO 347-B

It has the function to promote the oxidation reaction of the H<sub>2</sub>S, in order to comply with environmental regulations. The reaction is the following:



The gas coming from the incinerator is released to the atmosphere through the Process Gas Heater stack

#### 10.3.3.7.11 Reboiler Condensate Pumps CO 336-J11/J12

These pumps have the function to pump the condensate to the saturator in order to control de temperature of the steam entering to the Reboiler 336-C.

Number		1+1
Type		Centrifugal
Design Flow	t/h	0.4
Head	bar	6.4
Motor Rating	kW	1.4

Table 10.3-79.: Reboiler Condensate Pumps CO 336-J11/J12 data

#### 10.3.3.7.12 Make up Demin Water Pumps CO 350-J11/J12

These pumps have the function to pump demin water to Decarbonated Gas Washer CO 333-E in order to maintain the right concentration in the absorbent solution.

Number		1+1
Type		Centrifugal
Design Flow	t/h	1.0
Head	Bar	13.1
Motor Rating	kW	14.9

Table 10.3-80.: Make up Demin Water Pumps CO 350-J11/J12 data

#### 10.3.3.7.13 Rich/Lean Solution Heat Exchanger CO 314-C

Plates heat exchanger; into it heat is transferred from the hot lean solution (being cooled down before it returns to the absorption column) to the rich solution (being preheated for the stripping of CO<sub>2</sub>).

#### 10.3.3.7.14 Lean Solution Circulating Pumps CO 322-J11/J12

The lean solution coming from the Stripper Column CO 324-E and previously cooled down in the Rich/Lean Solution Heat Exchanger CO 314-C is suctioned by these stainless steel pumps. They have the function to deliver the required flow of lean solution to the Absorption Column CO 323-E.

Type		Centrifugal
Design Flow	t/h	156
Head	Bar	16.7
Motor Rating	kW	149

Table 10.3-81.: Lean Solution Circulating Pumps CO 322-J11/J12 data

#### 10.3.3.7.15 Lean Solution Heat Exchanger CO 320-C

Plates heat exchanger, where cooling down of the lean solution is accomplished over cooling water before it enters to the Absorption Tower CO 323-E in its upper part.

#### 10.3.3.7.16 Centrifuge Filters CO 330- G11/G12

They remove solids particles in the 1-10 micron size range from the lean solution. The flow feed to this equipment is supplied from the discharge of the Lean Solution Pumps CO 322-J11/J12; the lean solution already cleaned returns to the suction of the same pumps.

#### 10.3.3.7.17 Mechanical Filter CO 327-G

The filter is of the cartridge type, located at the inlet of the activated carbon filter; it receives the lean solution from the stream going to the absorption tower.

#### 10.3.3.7.18 Activated Carbon Filter CO 337-G

Equipment located in the downstream of Mechanical Filter CO 327-G. Its function is removing surface active contaminants from the lean solution, such as heavy hydrocarbons, solution degradation products, oils, etc.

#### 10.3.3.7.19 Carbon Traps CO 338-G

Mesh located downstream of the Activated Carbon Filter CO 337-G1. Its function preventing activated carbon particles being carried over in the solution stream.

#### 10.3.3.7.20 Rich Solution Strainers CO 317-G11/G12

A filter located before the rich/lean solution exchanger that prevents particles to reach the stripper column tower.

#### 10.3.3.7.21 Lean Solution Strainers CO 318-G11/G12

A filter located before the rich/lean solution exchanger that prevents particles to reach the stripper column tower.

Number of units 2

Material:Stainless Steel

#### 10.3.3.7.22 Sewage Pump CO 342-J

This pump is to clean the well area of the solution preparation tank in case of any spill.

Number of units 1

Material: Carbon Steel

#### 10.3.3.7.23 Solution Charging Pump CO 343-J

This pump supply solution to the solution preparation tank.

Number of units 1

Material: Carbon Steel

#### 10.3.3.7.24 Solution Storage Tank CO 317-F

Its function is storing the absorbent solution. It supplies the make-up needs by the CO<sub>2</sub> Removal unit; it also serves to store the solution whenever equipment of the system is under maintenance. Nitrogen flow to the storage tank is foreseen for blanketing purposes; oxidation of absorbent solutions is prevented by the use of the blanketing gas.

### 10.3.3.7.25 Storage Tank Pump CO 328-J

This pump supplies the absorbing solution make-up either directly to the system or to the solution preparation tank CO 341-F.

Number		1
Type		Centrifugal
Design Flow	t/h	38
Head	Bar	2.9
Motor Rating	kW	7.4

Table 10.3-82.: Storage Tank Pump CO 328-J data

### 10.3.3.7.26 Solution Filter CO 340-G

It filters the solution make-up entering to the CO<sub>2</sub> removal system or before the solution is being fed to the solution preparation tank.

### 10.3.3.7.27 Solution Preparation Tank CO 341-F

It is a tank used for the solution preparation; water is added to fresh new concentrated chemical agents as to comply with required concentration by the absorption process.

### 10.3.3.7.28 Make up Solution Filter CO 339-G

Its function is filtering the absorbing solution coming from the Solution Sump Pump, before being it fed feed into the Solution Storage Tank CO 317-F or to the CO<sub>2</sub> removal unit.

### 10.3.3.7.29 Solution Sump Pump CO 329-J

Its function is to feed the recovered solution either to the CO<sub>2</sub> removal system or to the make-up storage in the Solution Storage Tank CO 317-F (when the CO<sub>2</sub> removal system is going to be emptied).

Number		1
Type		Submersed Centrifugal
Design Flow	t/h	38
Head	Bar	2.9
Motor Rating	kW	7.4

Table 10.3-83.: Solution Sump Pump CO 329-J data

### 10.3.3.7.30 Antifoam Metering System CO 346-L

Its function is supplying and measuring the antifoam preparation to the absorbing solution stream. Foaming is prevented or controlled by the addition of an antifoaming agent.





### 10.3.3.7.31 Hydro cyclone CO 321 –G11/G12

A hydro cyclone is a device used to classify, separate or sort particles in a liquid suspension; in this case it is used to separate any impurities that can be present in the equipment cooling water flow used in the heat exchangers in the CO<sub>2</sub> removal area, in order to protect them from scaling or plugging.

### 10.3.3.8 Steam System

The Steam System is used to produce Medium Pressure Steam for the CO<sub>2</sub> removal unit

The following equipment composes the complete Steam System:

-  Deareator CO 337-F
-  Boiler Feed Water Pumps CO 334-J1/J2
-  Chemical Addition Units
-  Steam Generation System CO 348-B

#### 10.3.3.8.1 Deareator CO 337-F

This equipment receives the make-up of fresh Demineralised Water coming from Demin Plant and Reboiler Condensate Drum CO 335-F. The make-up is here degassed before entering in the Steam System Circuits. Below the Deareator, the Boiler Feed Water Pumps WS 337-J11/J12 are fed with water and send it to Boiler CO 348-B.

Water inlet:

- Make up	m <sup>3</sup> /h	2.1
- Recycled	m <sup>3</sup> /h	29.3
Operating Pressure	barg	0.95
Operating Temperature	°C	saturated




Table 10.3-84.: Deareator CO 337-F data

#### 10.3.3.8.2 Chemical Addition Units




Several addition of chemical agents in the Boiler Feed Water are foreseen in order to both eliminate oxygen eventually entrapped in the liquid and limit the corrosion potential of the water to be boiled.

Typically, the following Chemical Addition Units allow a proper treatment of the water (the final list of treatments could anyhow change during final design):



-  Oxygen Scavenger (CO 336-U), oxygen elimination inside the Deareator
-  Amines Addition System (CO 338-U) injected upstream the Boiler.
-  Phosphates Addition Systems (CO 337-U) injected upstream Boiler.

Each Chemical Addition Unit is equipped with:

-  500 lt Storage Tank
-  Dosing Pump, 1.5 kW (1+1) on each unit
-  Mixer, 0.75kW

#### 10.3.3.8.3 Boiler Feed Water Pumps CO 334- J11/J12

They extract the water from the Deareator CO 337-U and send it to the steam drum.

Number		1+1
Type		Centrifugal
Nominal Flow	m <sup>3</sup> /h	30.4
Head	bar	16.7
Motor Rating	kW	56

Table 10.3-85.: Boiler Feed Water Pumps CO 334- J11/J12 data

#### 10.3.3.8.4 Steam Generation System CO 348-B



This system provides the required steam for plant start-up and during operation for pressure control.

Type		Superheated Steam Fired Boiler
Fuel		Natural Gas
Design Steam Flow	t/h	5
Pressure	barg	12.70
Temperature	°C	225
Feed Water Temperature	°C	120

Table 10.3-86.: Steam Generation System CO 348-B data

### 10.3.3.9 Flare System PG 639-U

The main equipment of the flare system are the following:

-  Flare PG 639-F
-  Flare Seal Drum PG 640-F

#### 10.3.3.9.1 Flare PG 639-F

It is a stack, equipped with a set of pilot burners at the top. Its function is to burn all the combustible gases vented from the plant during normal operation complying with environmental pollution regulations.

The stack has a dynamic seal preventing air access to the stack.



Set of instruments and natural gas regulators are installed for the control of flare burners and pilots, equipped with safe electric ignition of gas.

#### 10.3.3.9.2 Flare Seal Drum PG 640-F

It is a drum located upstream the flare stack. Its function is to maintain always a water seal in order to avoid backflow to the plant circuits; air entrance is prevented by this seal.

### 10.3.3.10 Nitrogen & Instrument Air Systems

Nitrogen with the required pressure and purity is supplied from the battery limits. The Nitrogen system inside the DRP core area consists of the following main equipment:

-  Nitrogen Storage Tank UT 429-F
-  Seal Gas Storage Tanks UT 430-F11/F12/F13

The Instrument Air is received from Battery Limits and it will be used also for general services. The air entering to the DR plant is stored in a buffer storage tank before being distributed through the DR Plant.

The compressed air system is composed by the following items:

-  Instrument Air Storage Tank UT 454-F

#### 10.3.3.10.1 Nitrogen Storage Tank UT 429-F

Main use of the Nitrogen storage tank is for receiving Nitrogen from Battery Limits. From this tank, the Nitrogen is distributed to the users in the plant.

This tank ensures a buffer sufficient to handle emergency operations in case the Nitrogen delivery is out of service (not lower than 30 minutes).

Operating Pressure	barg	17.0
Operating Temperature	°C	Ambient
Nominal Flow	Nm <sup>3</sup> /hr	2,200
Material		Carbon Steel

Table 10.3-87.: Nitrogen Storage Tank UT 429-F data

### 10.3.3.10.2 Seal Gas Storage Tanks UT 430-F11/F12/F13

They are the surge tanks for maintaining a constant pressure for the Nitrogen required in the seals of VS2 valves, rotary valves and diverter valves located in the Reactor tower.

Number		3
Operating Pressure	barg	17.0
Operating Temperature	°C	ambient
Capacity	m <sup>3</sup>	0.45
Material		Carbon Steel

Table 10.3-88.: Nitrogen Storage Tank UT 429-F data

### 10.3.3.10.3 Instrument Air Storage Tank UT 454-F1








It is a surge tank for Instrument Air. This storage tank has a capacity of about 10 minutes of operation, allowing in this way enough time to let the emergency power system starting up and restoring the supply of Instrument Air and for safe shut down of the plant if necessary.

Operating Pressure	barg	6.0
Operating Temperature	°C	ambient
Inlet Gas flow	Nm <sup>3</sup> /hr	750
Material		Carbon Steel

Table 10.3-89.: Instrument Air Storage Tank UT 454-F1

### 10.3.3.11 Direct Reduction Plant: balance of equipment

This section describes the equipment and components of the plant that serve different technological areas. These are listed hereafter:

-  Steel Structures
-  Piping, Ducts and Instrumentation
-  Refractory
-  Lifting Devices
-  Hydraulic System
-  Lubrication System
-  Hoists

#### 10.3.3.11.1 Steel Structures

The steel structures are composed by several steel beams of proper shape and section, selected to withstand the different loads acting due to dead weight, live loads, wind forces, etc. The structures are also designed to withstand to seismic actions in accordance to site requirements. The structures are completed with stairs, grating covers, gangways and handrails. The following structures can be defined:

##### Reduction Tower Steel Structures

The Reduction Tower Steel Structure holds the Reactor, Iron Oxide Charging and Hot DRI discharging equipment, including EAF Surge Bins.

Protection for stairs and walkways in the reactor tower is foreseen.

##### Technological Pipe Rack

The Technological pipe rack holds up pipes/ducts from the Reduction Tower to the equipment deployed at ground level.

Steel structures for the DRI are described with the other steel structures in the relevant section of this FS.

#### 10.3.3.11.2 Piping, Ducts & Instrumentation

The terms “Piping, Ducts & Instrumentation” indicate the complex composed with the here listed items described in the following section.

##### Process Piping

All piping distribution networks are in carbon steel, unless otherwise specified.

Pipes are supplied in commercial length bars not painted as well as piping supports and racks.

Fabrication, assembly and painting of piping systems will be carried out at site during erection.

Process piping includes all necessary pipes, fittings, valves and supports, for the connection between items described in present documentation.

Utilities piping includes all necessary pipes, fittings, valves and supports, for the connection between items described in present documentation.

##### Process Ducts

The plant Ducts can be distinguished in:

- Refractory lined Ducts:
  - Transfer line
  - Reactor top gas duct

The refractory lined ducts handle hot process gasses and need the refractory layer to reduce the gas thermal losses and to protect the steel shell. Cold ducts are all the other ducts in the plant. Ducts shall be considered completed with relevant supports and expansion joints wherever necessary.

##### Insulating Material

One (1) insulating material set according to SELLER Standards.

### Measuring Instrumentation for Process

One (1) instrumentation set according to SELLER Standards.

One (1) Mass Spectrometer for online analysis of 9 channels. Various different streams will be permanently connected to the spectrometer, as specified below. Two channels are kept unconnected and can be used for spot analysis. A last channel will be left unconnected in order to give room to offline analysis of any given stream (by bottles). Analyzed gases will be N<sub>2</sub>, H<sub>2</sub>, CO, CO<sub>2</sub>, CH<sub>4</sub>, C<sub>2</sub>H<sub>6</sub>, C<sub>3</sub>H<sub>8</sub>, C<sub>4</sub>H<sub>10</sub>, C<sub>5</sub>H<sub>12</sub>, C<sub>6</sub>H<sub>14</sub> and H<sub>2</sub>S (H<sub>2</sub>S detected at levels above 1 ppm).






Online analysis feature will be used also for specific gravity compensation of main streams.

### 10.3.3.11.3 Refractory






#### Plant Refractory

The terms “Refractory” indicates the complex composed with the here listed items described in the following section.

The refractory material is installed in several plant components, such as:

-  DR Reactor refractory
-  Top Gas outlet duct refractory
-  Reducing Gas inlet ducts refractory
-  Sampling Bin (RE 255-F)
-  EAF Surge Bins PH 112-F11/F12

Refractory material has been properly selected considering the conditions in the installation environmental. In particular:

-  Maximum working temperature.
-  Maximum allowed temperature on the external surface.
-  Reducing atmosphere.
-  Mechanical loads and gas pressures.
-  Abrasion.

Refractory material shall be considered installed, completed with relevant supports, stainless steel anchors, expansion joints and auxiliaries wherever necessary.



#### 10.3.3.11.4 Lifting Devices

##### Reducing Tower Elevator

The Elevator permits the transportation of plant operating personnel to several reduction tower floors.

One (1) Elevator, including:

- One (1) cabin, completed with lighting system, command keyboard and hand driven doors;
- One (1) Electrical driving unit;
- One (1) Elevator control system.

Maximum Lifting Capacity: 2,000 kg

Highest level: platform above ground (top of Iron Ore Loading Bin RE 251-F1).

##### Hoists

The following maintenance hoists are foreseen for the described areas / functions:

Direct reduction tower

- Top area
- Iron ore loading bin
- Pressurized bins
- Reactor Man Hole
- Cluster breakers
- Interconnecting

Rotary valves

- EAF Surge Bins
- Rotary Valve
- EAF Feeding System

#### 10.3.3.11.5 Hydraulic System

##### Reduction Tower Hydraulic Circuit

One (1) complete Hydraulic unit for all Reduction tower requirements is foreseen, including interconnecting piping with the users.

#### 10.3.3.11.6 Lubrication System

##### Reduction Tower Lubrication System

One (1) complete Lubrication unit (RE 510-U) for all Reduction tower requirements is foreseen, including interconnecting piping with the users.

### 10.3.3.12 Electrical Equipment

#### 10.3.3.12.1 LV Motor Control Centers (480 V MCC'S)

The LV MCC's contains all necessary electrical devices to feed, protect and control AC induction motors (1/2 to 300 hp) and to feed and protect small ancillary supplies, are suitable for indoor installation.

The MCC switchboard is composed of normalized type panels, each drive being assembled in a segregated cubicle mounted on extractable drawers with protection against accidental contact with open doors.





The cubicles are front access, thus allowing cubicle installation with the back direct to wall, or back-to-back arrangement if required.

The motor starters will be of the "intelligent type" and completed where necessary with auxiliary relays and other auxiliary devices for signals, sequences and interlocks, if any. Sequence and interlock control is by relevant IAS.

All MCC's will be smart type with connection IAS via Profibus DP.

#### Functional blocks

The following typical functional blocks are provided.

-  Incoming line unit (size 800A for each MCC)
-  AC Motors Starters
-  Feeders and small power supplies
-  Heaters and control devices

#### Norms and Standards

MCCs are designed and built in accordance with IEEE, NEMA, and ANSI standards.

#### 10.3.3.12.2 MV Motor Control Centers (MCC'S)

The MV MCC's includes the equipment for feeding the MV motors (>300 hp); it is made up of modular columns mounted next to each other, suitable for indoor installation (electric room), and has a single bus-bar system, air insulated.

The switchboard consists mainly of the following units:

- Incoming feeder unit
- Outgoing motor feeder unit

Special care is taken into consideration to satisfy safety requirements; all operations are from the front of the switchboard, while access to cable terminations, bus bars etc. are from the back through bolted non-hinged panels.

The units are divided into several segregated compartments, as described below:

- Auxiliary and instruments compartment (closed off with a door) is located above the MV compartment and contains the low voltage apparatus.
- Contactor compartment (closed with a door) is arranged to contain the withdrawal contactor and includes all the necessary accessories for its function.
- Cables incoming/outgoing compartment (accessible from the back of the compartment and closed with a bolted panel with screws).
- Busbar compartment (contains the main bus bar system, including the relative shunting to the fixed contacts of the circuit breaker).
- Voltage transformer compartment.

MCCs are designed and built in accordance with IEEE, NEMA, and ANSI standards.

### 10.3.3.12.3 Switch Gear 4.16 KV Distribution Bus

The Switch gear 4.16 KV distribution bus includes the equipment to supply electrical energy to the MV motors; it is made up of modular columns mounted next to each other, suitable for indoor installation (electric room), and has a single bus-bar system, air insulated.

The switchgear consists mainly of the following units:

- Incoming feeder unit
- Outgoing motor feeder unit

Special care is taken into consideration to satisfy safety requirements; all operations are from the front of the switchboard, while access to cable terminations, bus bars etc. are from the back through bolted non-hinged panels.

The units are divided into several segregated compartments, as described below:

- Auxiliary and instruments compartment (closed off with a door) is located above the MV compartment and contains the low voltage apparatus.
- Contactor compartment (closed with a door) is arranged to contain the withdraw able contactor and includes all the necessary accessories for its function.
- Cables incoming/outgoing compartment (accessible from the back of the compartment and closed with a bolted panel with screws).
- Busbar compartment (contains the main bus bar system, including the relative shunting to the fixed contacts of the circuit breaker).
- Voltage transformer compartment.

MCCs are designed and built in accordance with IEEE, NEMA, and ANSI standards.

#### 10.3.3.12.4 AC Induction Motors

All motors to be totally enclosed three-phase squirrel cage high efficiency induction motors, and are designed for the duties in severe drive applications, consequently they are both electrically and mechanically designed to withstand heavy duty operations.







Temperature and vibration of motor bearings monitoring systems are installed on critical line process motors.

Motors with a rated power  $\geq 1500$  KW are equipped with RTD's (Resistance Thermal Devices) embedded within stator windings and one RTD located in the bearing housing.

Inverters are foreseen when the speed regulation is required. All motors will be DOL (Direct on line) started.

PTC sensors are considered for ambient temperature higher than 40°C.

##### Technical features

-  Insulation Class:F
-  Temperature rise:Class B
-  Duty class:According to the line process needs
-  Protection degree:IP55
-  Construction form:According to Motor List
-  Cooling systemAccording to the motor

#### 10.3.3.12.5 Low Voltage Switchgear (480 V)

Low Voltage metal-enclosed power circuit breaker switchgear is heavy duty equipment built to ANSI Standards, with installed devices to feed, protect and control AC induction motors.

All to meet requirements of NFPA 70E, no personal protection required greater than L2

##### General Information

Circuit breakers are draw-out type with electronic trip units.



Circuit breakers have interrupting ratings and withstand capabilities according to the system application.

Bussing are designed to carry full ampacity, all bus bars are made of plated copper.




Circuit breaker trip systems have integrated solid state trip actuators and current sensors; the solid state trip units include all protective functions (LSIG protections).

##### Norms and Standards

**A.** - Switchgear are designed, manufactured and tested in accordance with the following:

-  ANSI C37.20.1 – Metal enclosed Low Voltage power circuit breaker switchgear.
-  ANSI C37.51 – Testing of Metal enclosed Low Voltage AC power circuit breaker switchgear.

**B.** - Main circuit breakers are designed, manufactured and tested in accordance with the following:

-  ANSI C37.13 – Low Voltage AC power circuit breakers used in switchgear.
-  ANSI C37.17 – Preferred rating, related requirements and application recommendations for Low Voltage power circuit breakers and AC Power circuit protectors.
-  ANSI C37.50 – Testing of Low Voltage AC power circuit breakers.

#### 10.3.3.12.6 Emergency Power Supply

Electrical emergency power supply will be provided by a Diesel emergency power generator (to be supplied by others).






The required capacity will be defined during engineering phase.

#### 10.3.3.12.7 Local Panels



Field operations for motors will be done remotely from control room in coordination with local operator using radio communications. An alternative will be operation via wireless tablet device having also coordination with control room operation.

Devices for personnel safety such as but not limited to pull cords and emergency pushbuttons will be implemented as required by regulations hence this will not rely on remote or tablet operation.

Local panels will be only installed for the following equipment:

-  Reducing gas compressor
-  Process gas heater I.D. fan and F.D. fan
-  Pumps
-  Elevating conveyor
-  Coating Station

These field panels will be defined by the equipment supplier, but in general will comply with the following:

-  Local motor control consists of a local start/stop and local/remote button station.
-  These stations are wired so that the hardwired control uses the momentary normally open start pushbutton to seal in motor starter contactor, and the momentary normally closed stop pushbutton to break the seal circuit dropping out the motor starter contactor.

All local control stations must be located in the best location for operation, safety and out of any containment areas.



### 10.3.4 Electric Arc Furnace

#### 10.3.4.1 EAF general characteristics

EAF brand	
Current	Tri-phase AC
Charging method	Continuous DRI feeding through the roof
Tapping system	Spout

Table 10.3-90.: EAF type



Figure 10.3-26.: 3D view of the EAF position in the plant

Nominal tapping capacity	130 [short tons]	120 [metric tons]
Hot-heel	Up to 55 [short tons]	Up to 50 [metric tons]
Total furnace capacity	185 [short tons]	170 [metric tons]
Shell diameter (inside plates)	20.0 [ft]	6200 [mm]
Weight of shell with refractory	~280 [short tons]	~250 [metric tons]
Nominal electrode diameter (*)	24 [in]	600 [mm]
Electrode pitch diameter (*)	48 [in]	1200 [mm]
Transformer power rating		55 MVA
Primary voltage		34.5 kV

Table 10.3-91.: EAF general characteristics



Figure 10.3-27.: top view of the 3D layout with the EAF at the south end of the main building bay



### 10.3.4.2 EAF Main Technical Data

The EAF proposed represents over 50 years of experience and expertise developed from the long history of EAF design and development of Lectromelt, Tagliaferri and Tenova.



Figure 10.3-28.: a typical Tenova EAF

#### Shell and Roof

-  Side wall lining::refractory (by Others)
-  Type of roof:refractory, monolithic type (refractory by Others)

### Furnace movements

- Furnace movements:by hydraulic cylinders
- Operating pressure:2030 psi (140 bar)
- Roof lifting:by one double-acting hydraulic cylinder
- Roof lifting stroke:18.7 in (500 mm)
  
- Roof rotation:by one double-acting hydraulic cylinder
- Roof rotation angle:60°
- Furnace tilting:by two single-acting hydraulic cylinders
- Tilting angles:+40° tapping side approx. (to empty the furnace), 10° slagging side
- Electrode movement:by three single-acting hydraulic cylinders
- Electrode clamping:by disk springs
  
- Electrode unclamping:by single-acting hydraulic cylinder
- Electrode lifting stroke:to be defined during design stage
- Door movement:by hydraulic cylinder

### Speed of movements

- Tilting (forward/backward):adjustable up to 2 degrees/sec.
- Fast return:up to 4 degrees/sec.

### Electrode-holder arms and columns

- Type of arms:power conductive/ water cooled/ copper-clad, steel plate
- Arm layout :triangulated
- Insulation:on the connection head of the mast (water cooled)
- Type of clamps:forged copper - water cooled; water cooled steel clamping band (pull action)
- Clamping/unclamping:spring/hydraulic
- Electrode cooling:water spray
- Electrode-holder columns:with hydraulic cylinder incorporated
- Guide rollers:8+8 top and bottom on the four surfaces of the mast
- Guide roller adjustment:by eccentrics (+/-0.2 in( 5 mm))

### Secondary circuit and flexible cables

- Delta closure:outside transformer
- Delta closure bus bars:copper tubes - water cooled
- Terminal heads:copper plates welded to bus tubes
- Number of flexible cables:4 per phase
- Flexible cable section:size 6.5 in2 ( 4,200 mm<sup>2</sup>) per cable
- Type of flexible cables:copper - water cooled

### Electrode automatic regulation system

- Type:TENOVA TDR-H electronic type with hot back-up
- Servo valves:electro-hydraulic TENOVA HRR2
- Electrode movement:by single-acting hydraulic cylinders
- Non-conductor detection::yes



### 10.3.4.3 EAF Mechanical Equipment

#### 10.3.4.3.1 EAF Tilting Platform and Mechanism

##### Shell Tilting Platform

Furnace tilting system	back heavy shell platform actuated by two (2) hydraulic cylinders
Furnace return	by gravity
Furnace fast return	by gravity
Superstructure locking	by locking pins driven by hydraulic cylinders located on each column

Table 10.3-92.: Shell Tilting Platform Data

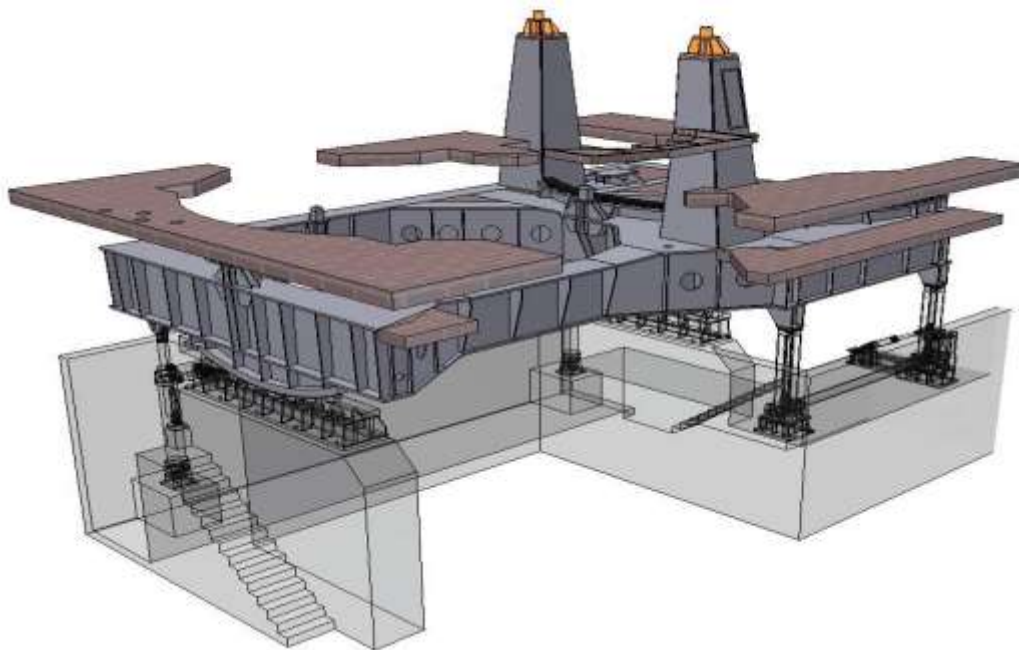


Figure 10.3-29.: Tenova EAF tilting platform







### Description

Purpose of the tilting platform is to support the shell and the superstructure and to tilt the furnace in order to pour molten steel and slag when needed during EAF operation.

The tilting platform is designed in order to allow shell thermal expansion without deformation.

The EAF concrete foundations consist only of the steel pedestals for the platform rockers, the tilting cylinders and the front and rear bumpers (platform stabilizers).

The platform is a sturdy steel structure composed of:

-  Main beams supporting furnace shell, roof, swinging and lifting system, electrode masts and arms
-  Secondary connection beams
-  Steel pedestals anchored to foundations
-  Rockers
-  Superstructure locking device
-  Maintenance service platform around the shell

The tilting platform is designed so that the center of gravity of the complete system remains always towards the slag door side even at maximum tilt to the tap side. This allows the furnace to return to horizontal position naturally by gravity.

The tilting platform is equipped with rockers that roll on steel pedestals anchored to the concrete foundations. The rockers have male teeth and side guides to keep the furnace “centered” and aligned with the pedestals during tilting movements.

Heavy-duty steel pedestals are anchored to the furnace piers and have guide teeth racks that mesh with the rockers to maintain alignment.

The furnace gantry locking system is installed on the tilting platform. This system locks the superstructure to prevent rotation during furnace tilting.

The superstructure locking system consists of conical pins installed in the columns and driven by hydraulic cylinders: locking pins retract from their female sockets during roof swing movement.

The space between the main structure of the tilting platform and the operating floor edge consists of an auxiliary platform built with support steel sections and steel plate panels designed for refractory filling.

The auxiliary platform allows easy personnel around the furnace.

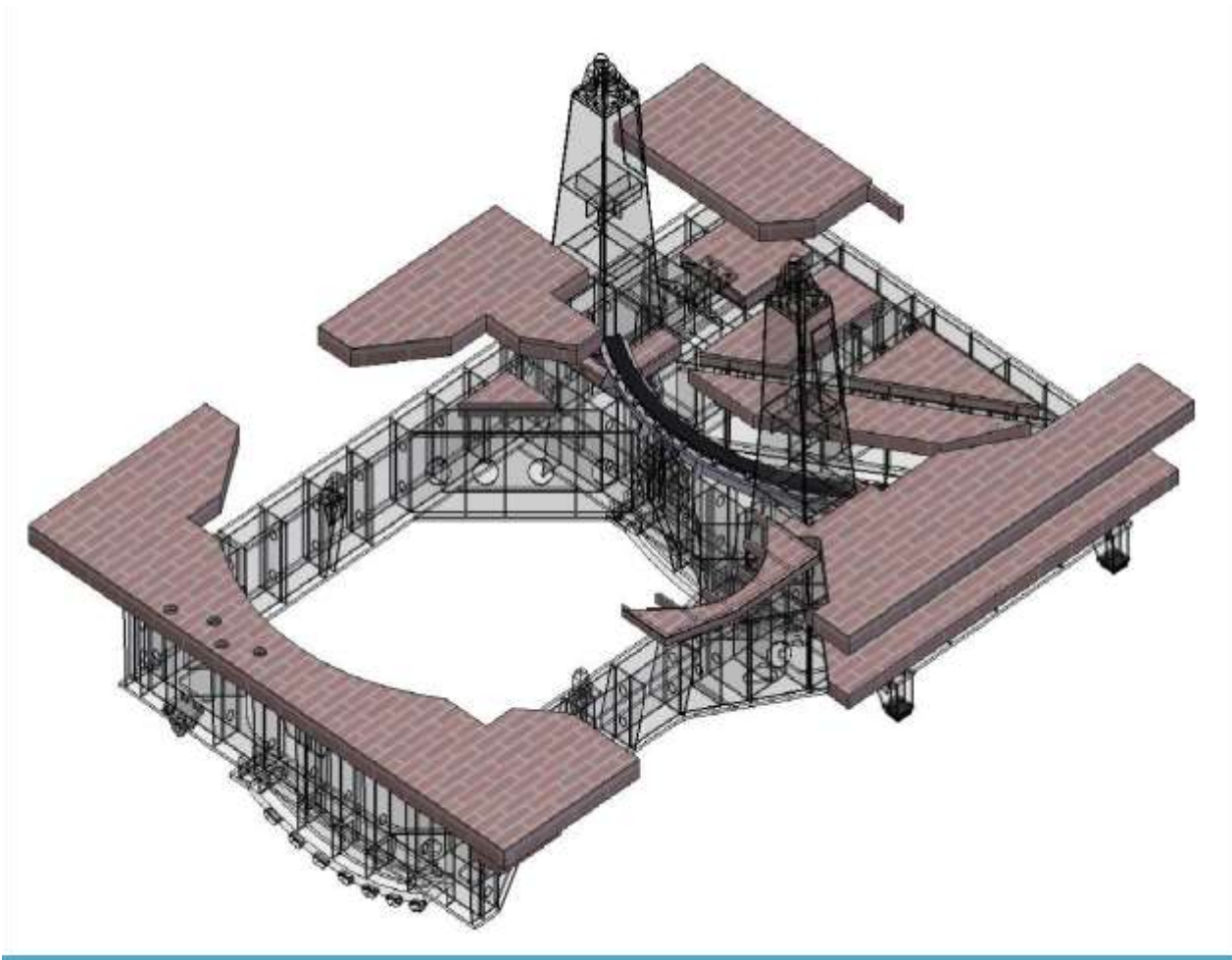


Figure 10.3-30.: Typical Auxiliary Platform



### Tilting Mechanism

Max tapping angle (*)	+40 degrees
Max deslagging angle	-10 degrees
Shell tilt locks (bumpers)	2 (two) bumpers on slag door side
Shell Safety Posts (bumpers)	2 (two) bumpers on pouring side
Number of hydraulic cylinders	2 single acting
Movement control	through proportional valve
Tilting speed	Up to 2°/sec
Backward speed with fast return	4°/sec

Table 10.3-93.: Tilting Mechanism Data

The furnace tilt is actuated by two (2) single acting cylinders controlled by a single proportional-type hydraulic valve. The tilting cylinder ends are equipped with spherical bearings to maintain force transmission along the cylinder axis. High pressure hose between the cylinder and the fixed piping allows the cylinders to pivot during furnace tilting.

Two (2) pilot-operated check valves are installed at the base of the cylinders to stop movement in case of a hose break.

The furnace tilting movements are controlled from either of two control stations, one located on the tapping desk at the pouring side and the other on the main control desk into the control pulpit.

Two (2) additional hydraulic valves (one at each desk) are installed, for tilting in case of emergency. Manual control does not provide fast back tilt.

The design of the furnace is such that the furnace center of gravity is always behind the furnace rocker centerline. This assures the return of the furnace from any forward tilting position by gravity.

The furnace tilt angle, detected by a low inertia angle transducer (clinometer) and the tapped steel weight are the basic signals used to control the steel tapping operation.

(\*) the EAF is completely tilted only when emptying the furnace

### Tilt Locks and Safety Posts (Bumpers)

Two sets of bumpers stabilize the furnace in the level (0°) position.

On the slag side, centered on the heavy side rocker and on the vault wall end of the tilt platform, two pivoting posts, connected by a common shaft, absorb the scrap charging impact load. This serves to protect the tilt cylinders from the impact load. A single pneumatic cylinder actuates both posts. Limit switches on both posts indicate each bumper's up and down positions. These bumpers must be lowered to tilt the furnace to the slag side.

On the tap side, centered on each rocker, bumper posts, again connected by a common shaft, stabilize the furnace position, particularly when the roof is swung out for shell exchange. These bumper posts also actuate with a single pneumatic cylinder. Limit switches on both posts indicate each bumper's up and down positions. These bumpers must be lowered to tilt the furnace to the tap side.

Tilting of the furnace via the proportional valve is interlocked with the bumper positions. Automation assisted tilting sequence is provided in order to optimize the tilting movements.

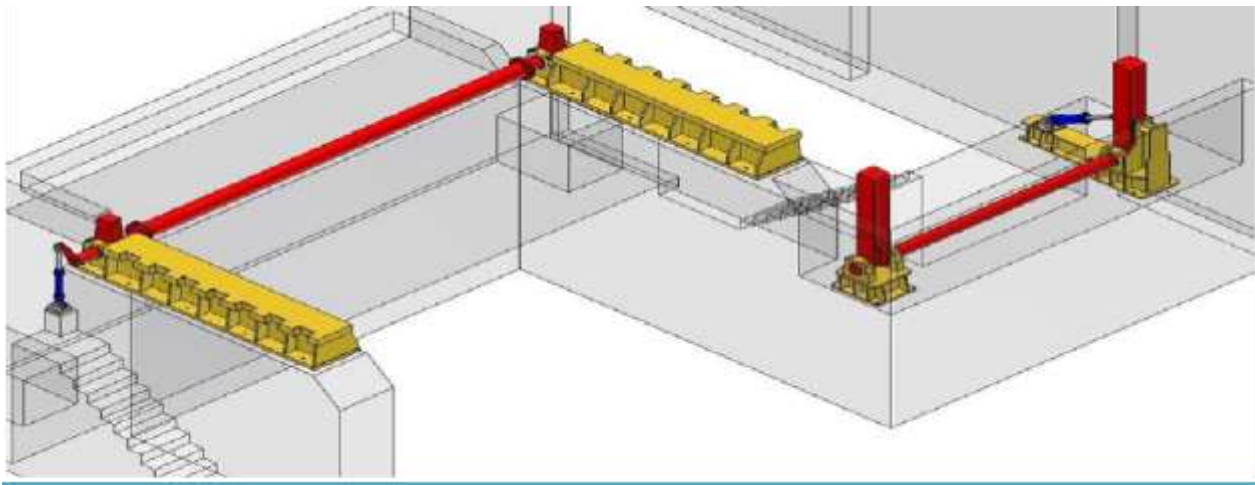


Figure 10.3-31.: Typical EAF Rocker Pedestals and Bumpers

### 10.3.4.3.2 Furnace Shell

Furnace shell	One-Piece Design	
Tapping system	Spout Type	
Inside plate diameter	20.0 [ft]	6200 [mm]
Shell height	9 [ft] – 10 [in]	3000 [mm]
Furnace internal net height (bottom roof)*	16.0 [ft]	4885 [mm]
Charging volume	6,350 [ft <sup>3</sup> ]	180 [m <sup>3</sup> ]
Bath depth to sill level	19.0 [in]	483 [mm]
Shell total weight with refractory lining	~280 [short tons]	~250 [metric tons]

Table 10.3-94.: EAF Furnace Shell Data

Note (\*): net height is calculated from the refractory bottom floor of the furnace to the top of bezel excluding the height of the roof

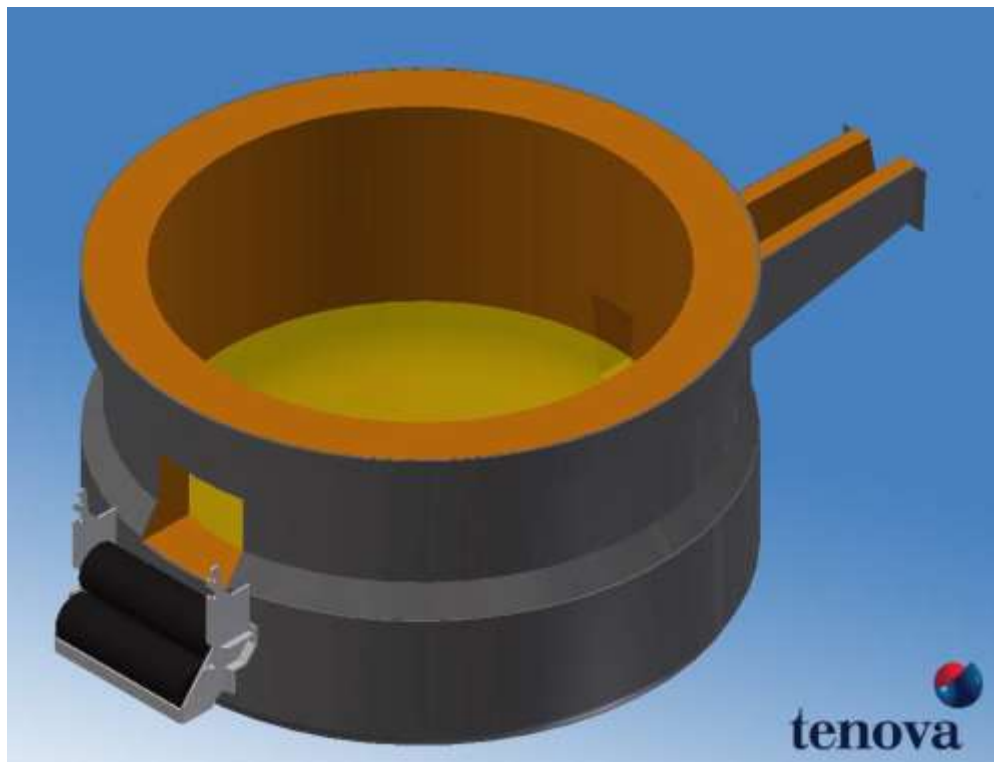


Figure 10.3-32.: door side 3D view of the EAF shell

The furnace shell is a one-piece design, spout type configuration.

The lower shell is a 2-radius shape with R1 being the main radius of the shell and R2 the slight radius sidewalls that provides keying action for the sidewall brick.

The shell mounting to the tilt platform allows free expansion of the shell and the platform, eliminated externally imposed stresses.

Lifting lugs on the shell allow for shell lifts.

The shell is reinforced for slag door device mounting.

The shell will ship for on-site reassembly.

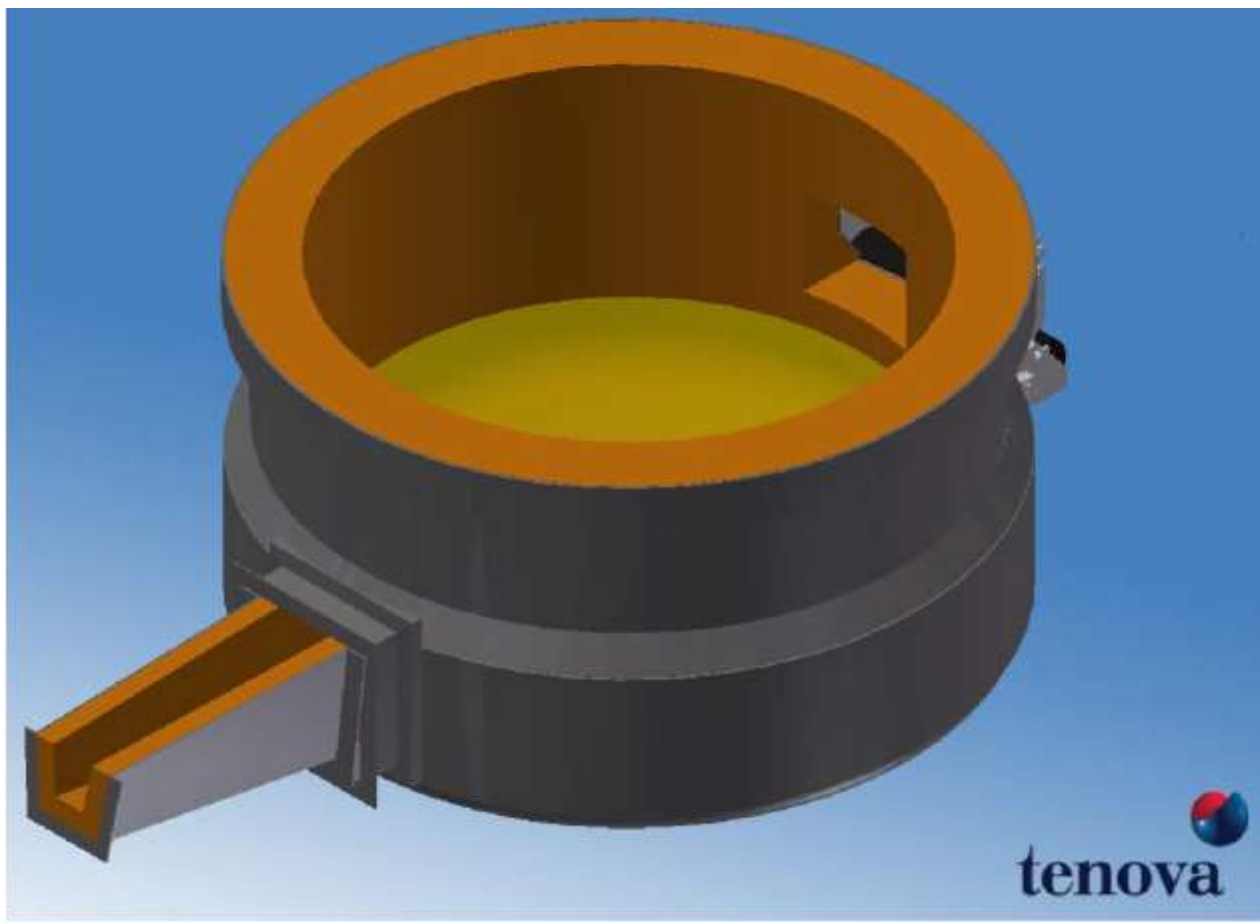


Figure 10.3-33.: spout 3D view of the EAF shell

In consideration of high sidewall shell temperatures that result from contemporary refractory practice, all lower shell materials are A516 grade 70 (or engineer-approved equivalent). Tenova will finite-element analyze (FEA) the shell for both mechanical and thermal stress to confirm material grade and plate thickness.

Centering devices guide the shell during replacement.

The external structure of the shell has multiple horizontal flanges (hoop stress containment) with vertical gusset plates between the flanges.




Shell lifting lug design accommodates a lift of shell with refractory with skull plus slag build-up.

Wireless Bottom Temperature Monitoring System

Thermoresistance type (RTD)	PT 100	
Measurement range	32-1,112 °F	0-600 °C

Table 10.3-95.: Wireless Bottom Temperature Data

The furnace wireless bottom monitoring system consists of:

-  One (1) Lot of Wireless RTD's for furnace bottom temperature monitor
-  One (1) Lot of Wireless Receivers
-  One (1) Lot of Accessories for the connection to the RIO network

Continuous monitoring of furnace bottom temperature can detect rapid temperature changes that could signal a hot spot. Continuous monitoring and trending provides heart sintering and wear indication.

#### 10.3.4.3.3 EAF\_Slag door

- Door:Refractory-lined (Refractory by Others)
- Size of slag door (width x height):~ 55 x 40 in (1600 x 1100 mm)
- Slag door operating device:one single acting hydraulic cylinder with pulleys and chain
- -Operating pressure:~ 725 psi (50 bar) (preliminary)
- -Max operating pressure:~ 2,030 psi (140 bar) (preliminary)

A doorway is cut through the cylindrical portion of the shell.

The slag door is located diametrically opposite to the spout.

The slag door will be made of copper on the inside of the door and steel on the outside of the door.

The door slides within removable guides and is operated by a hydraulic cylinder.

The door operating mechanism is of the low head room type and does not project above the furnace shell when closed.

The door will be operated remotely from the furnace control panel.

#### 10.3.4.3.4 Furnace Roof

Type of roof	Refractory-lined	
External diameter	24.6 [ft]	7500 [mm]
Number of openings	3 for electrodes, 1 for off-gas suction, 1 for additives addition	
Roof weight	~24 [short tons]	~21 [metric tons]

Table 10.3-96.: EAF Roof Data

The furnace roof is refractory-lined and contains a port for one (1) chute for additives.

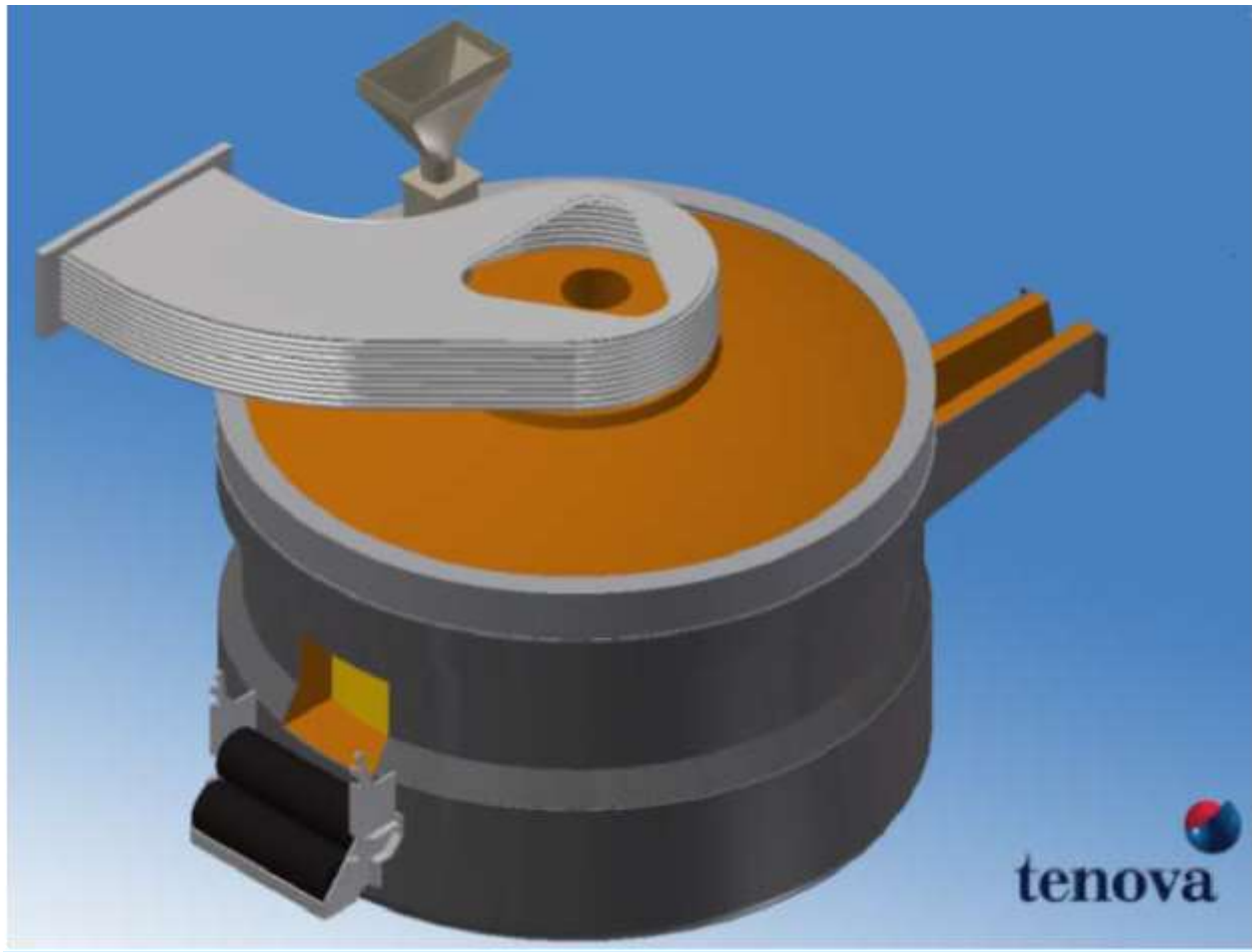


Figure 10.3-34.: Monolithic type, refractory roof with delta and side-draft hood (Tap side/Slag side)

The roof consists of:

- One (1) support/lifting structure
- One (1) monolithic-type roof
- One (1) center refractory delta (refractory by others)
- One (1) water-cooled roof ring
- The roof support/lifting structure consists of:
- Two (2) main lift/support arms with interconnecting transverse beams in water-cooled box beam construction

The arms of the lifting structure have shimmed wear plates that engage brackets on the lifting mast during lifting to enhance system stability.

The delta's ports are designed for proper insulating distance between the electrode and the metallic parts.

All water cooled parts are hydrostatically tested at 290 psi (2,000 kPa)

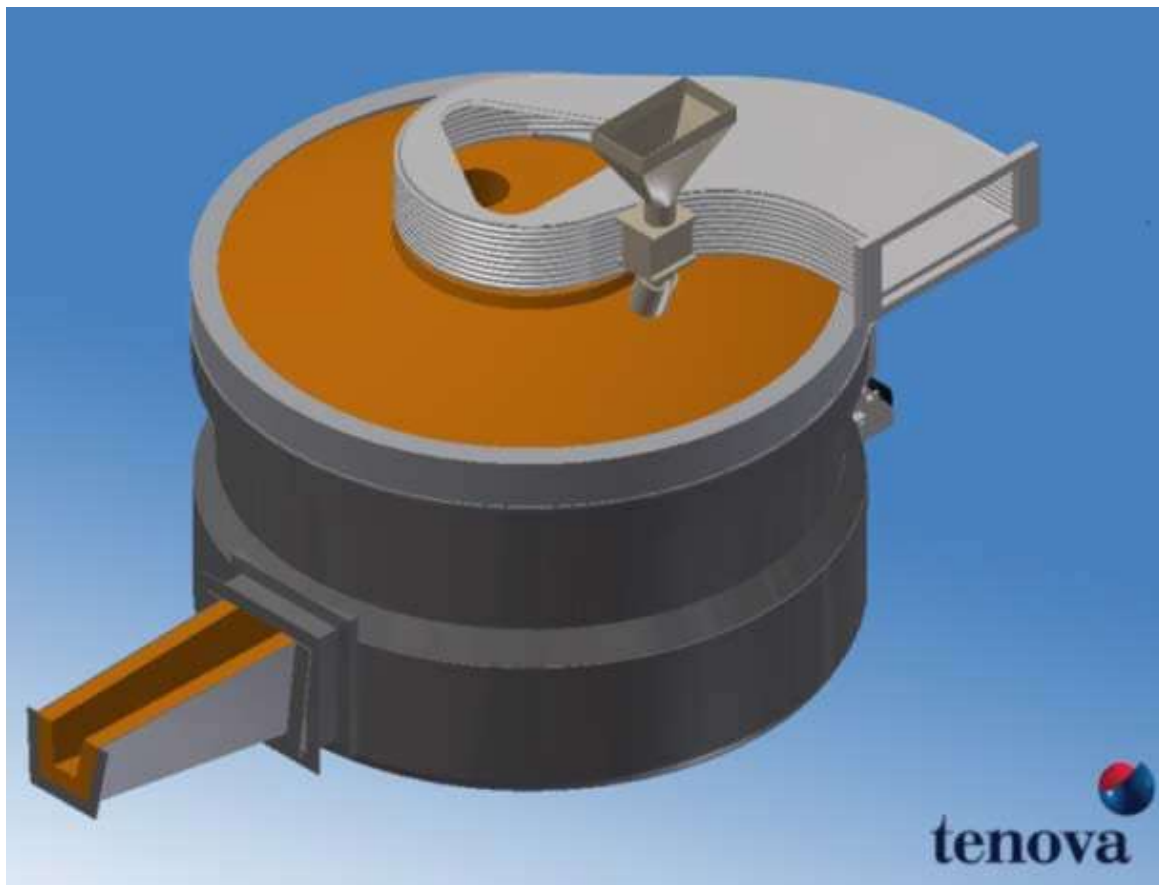


Figure 10.3-35.: spout 3D view of the EAF shell with the roof



### 10.3.4.3.5 Furnace Roof Supporting Arms

Number of arms	2
Type of arms	water-cooled welded box structure

Table 10.3-97.: Furnace Roof Supporting Arms Data

The water-cooled roof supporting beams will be used to supply and return water to and from the water cooled side draft. Electrode arms and clamps access is given by means of a platform. One (1) platform will be furnished to provide access to the electrode clamp heads which will be supported from the roof structure. Main platform structure is water cooled.

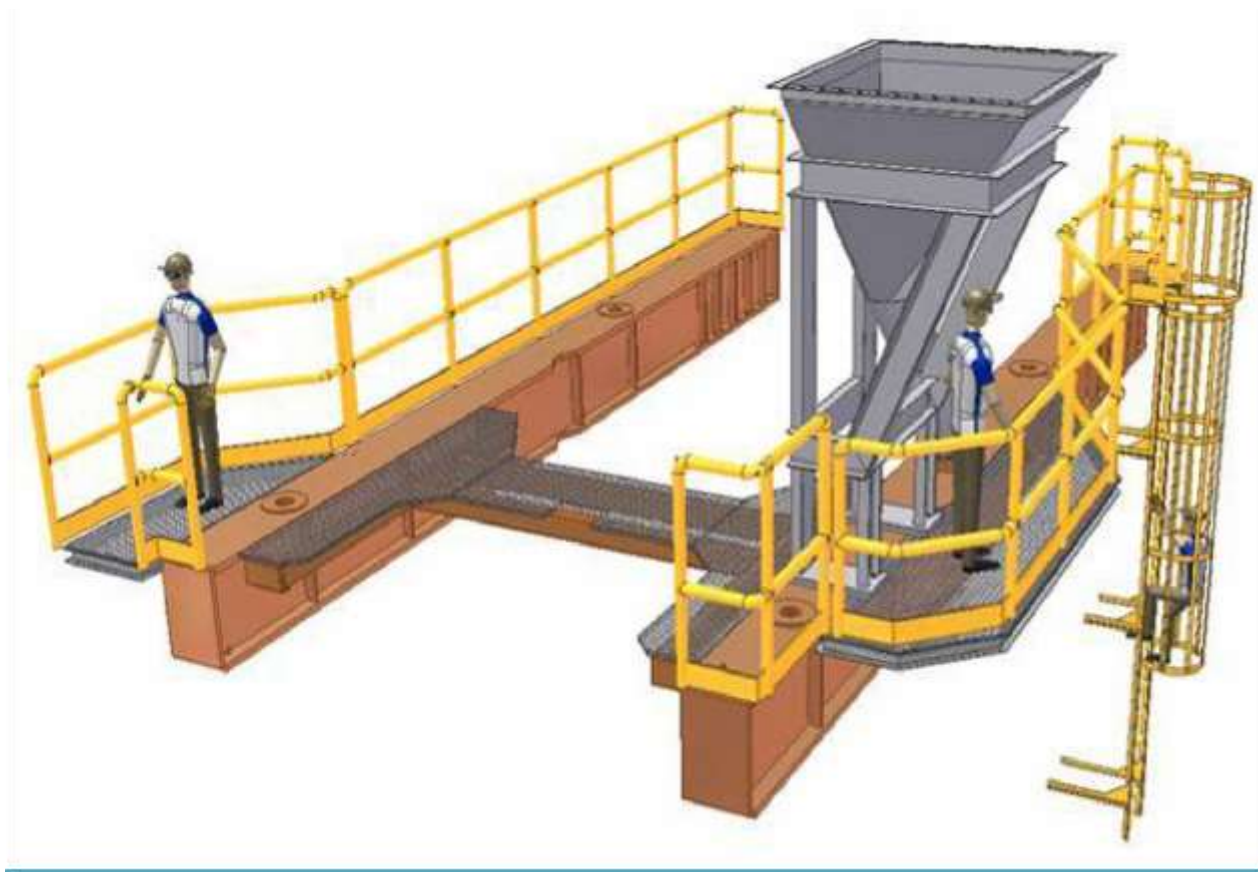


Figure 10.3-36.: EAF Roof Supporting Arms

#### 10.3.4.3.6 Furnace Roof Lift and Swing System

##### Roof lifting system

- Roof lifting: by two (2) double-acting hydraulic cylinder
- Roof rise: ~ 18.7 in (500 mm)
- Roof rising time: 6 sec. approx
- Max operating pressure: ~ 2,030 psi (140 bar)

##### Roof swinging system

- Roof swinging: by one (1) double-acting hydraulic cylinder
- Roof rotation angle: 65 degrees approx.
- Wheel diam.: ~ 31.5 in (~ 800 mm)
- Rail radius: ~ 158 in (4,000 mm)
- Wheel bogies: 2 (each 2 wheels)
- Cylinders max operating pressure: ~ 2,030 psi (140 bar)

In the modern Tagliaferri furnace design, lifting and swinging of the furnace structure supporting the roof and the electrodes is carried out by two (2) separate hydraulic mechanisms.

The roof lifting and swivelling structure is separate from the tilting movement of the furnace and sits on separate foundations from the shell platform.

The lifting cylinders, double-acting type, raise the roof supporting structure, which is guided by heavy duty chains sheave mounted, fitted on the rotating platform.

When the roof is raised and swung aside, the roof and electrode housing structure remain completely separated from the furnace shell and superstructure.

The superstructure will be a rotating design with a pivot pin type, heavy duty bearing assembly carried in a machined base structure for anchoring to the furnace platform. Outboard support is maintained by two (2) large diameter wheel/axle "AP" bearing assemblies.

The rotation of the superstructure will be done by hydraulic cylinder and will be sufficient that the outer edge of the roof clears the bezel ring of the upper shell by a minimum of 24 in (~610 mm) with the roof in the full off position.

The system design and arrangement/location of the king pin rotation bearing is such to allow large clearance of the furnace shell to roof swung aside with reduced rotation angle.

The contact surface between the rail and the wheels may have an inclination, to be defined during engineering phase.

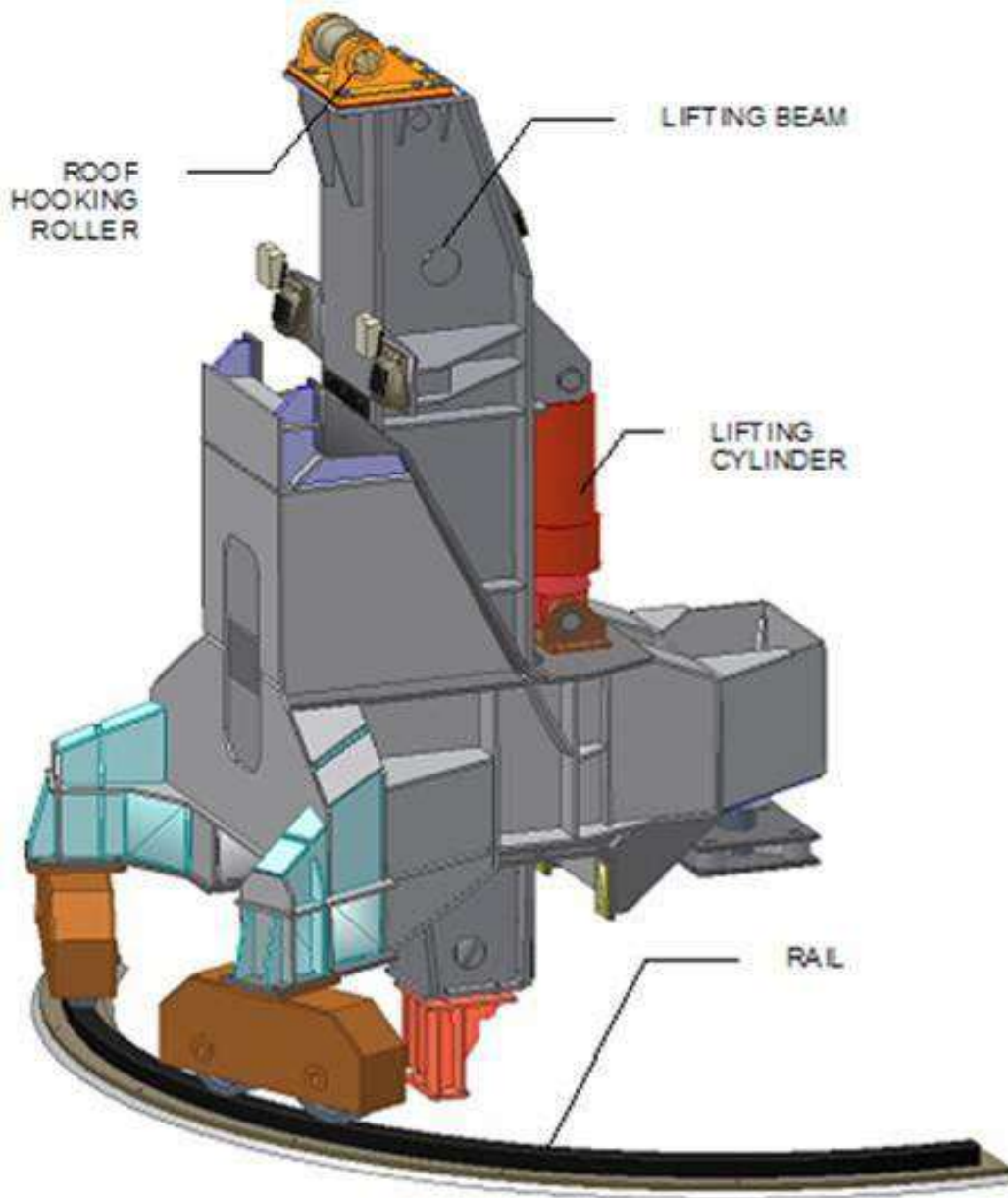


Figure 10.3-37.: EAF Roof Lift and Swing System

### 10.3.4.3.7 Electrode Mast and Mast Guide Roller System

#### Mast Assembly

Quantity	3	
Electrode- mast design	Rigid box beam construction with internally-mounted cylinder	
Mast stroke	19 [ft]	5800 [mm]
Electrode speed during regulation	up to 7.5 in/s	up to 11 m/min
Max rise speed (fast raise mode)	16 in/s (max)	25 m/min (max)
Hydraulic cylinder	single acting inside mast	
Operating pressure	2030 [psi]	140 bar
Mast stool	water cooled	
Mast locking system	mechanical pins activated by pneumatic cylinder	

Table 10.3-98.: Mast Assembly Data

The electrode mast design is a braced, box beam construction for maximum torsional resistance. The mast material is high-strength carbon steel. Accurately machined rolling surfaces assure accurate, vertical travel. Each mast is water-cooled along its entire length.

The stools atop each mast for electrode arm seating are water-cooled plate construction for induction heat dissipation.

Mast movement is by a single-acting hydraulic displacement ram housed internally to the mast. The ram's design allows in-place seal replacement.

Two sets of rollers (upper and lower) guide mast travel. There are two (2) rollers for each mast face, each roller positioned near the mast's corner. Roller adjustment is by eccentric shaft. Roller units can be individually removed for off-line repair.

Each electrode mast can be locked at different elevations, with mechanical pins actuated by pneumatic cylinders. The locking pins must be used during maintenance to guarantee the safety of the personnel. In case of electric power failure, the electrode masts automatically raise to top of travel.

Roller assemblies have steel protective covers that are bolted to the furnace structure.

For what concerns the proper maintenance, TENOVA's mast and guide rollers arrangement is the most rigid and easy to maintain in the market. TENOVA also provides an automated lubrication unit that permits the system to be properly lubricated and minimize wear. The guide roller design allows for easy adjustment of the rollers to the mast. Mast and rollers are inspected on a regular basis.

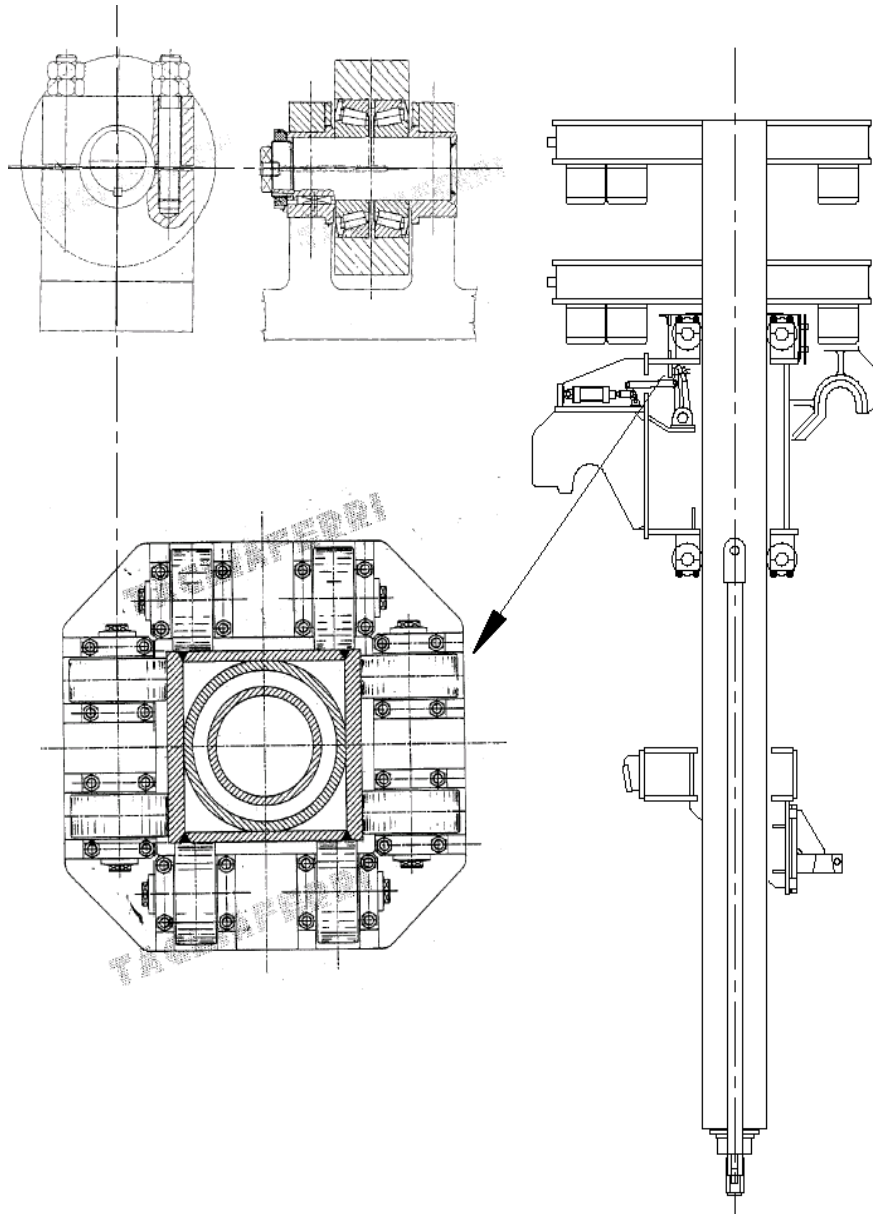


Figure 10.3-38.: Electrode Column Details



## Mast Guide Roller Assembly

Guide roller support systems	6 (two for each column)
Guide rollers	8+8 top and bottom on the four surfaces of the mast
Guide roller number	48
Guide roller adjustment	by eccentric for each single roller
Number of rollers bearing	2 for each roller
Roller lubrication	centralized
Lubrication type	portable pump

Table 10.3-99.: Mast Guide Roller Assembly Data

Each system consists of two roller assemblies, top and bottom of each electrode column. Each roller assembly consists of four roller pairs, each roller adjustable by an eccentric shaft for accurate column alignment. Roller adjustment range is  $\pm 0.2$  in ( $\pm 5$  mm). The guide rollers are assembled in a unit mounted into the superstructure support housing. Roller bearings are shielded from grit and dust and are equipped with grease fittings.

The centralized grease system for the masts guide rollers consists of:

-  Grease distribution blocks with connecting tubing and hoses
-  Manual pump

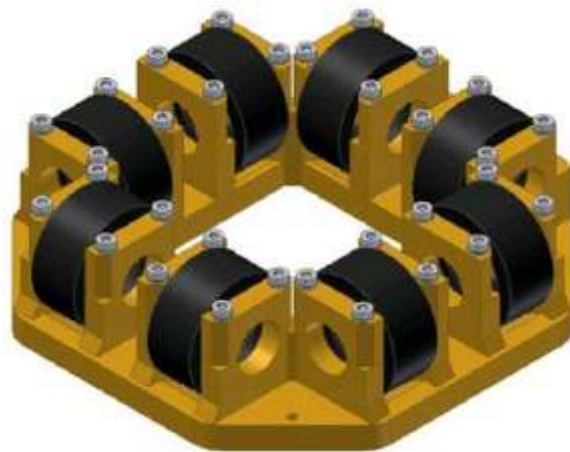


Figure 10.3-39.: Guide Roller Assembly

#### 10.3.4.3.8 Lubrication System

One (1) centralized greasing system complete with manual pumps, grease distribution blocks, etc. will be provided. The automatic lubrication will be provided for the mast guide rollers and for the equipment slewing movements.

The greasing system consists of grouped greasing connections to be fed by a manual grease gun.

Other lubricating points will be equipped with local fittings for manual greasing.

Alternatively, a portable electric pump can be supplied.



### 10.3.4.3.9 Electrode Power Conductive Arms

Type of arms	power conductive, water cooled, copper-clad steel plate	
Electrode diameter	24 [in]	600 [mm]
Electrode pitch diameter	48 [in]	1200 [mm]
Electrode clamp diameter	24 [in]	700 [mm]
Arm section	rectangular	
Type of cooling	forced water	
Type of contact shoe	forged copper, with direct cooling	
Clamping band	water-cooled stainless steel type	
Clamping mechanism	disk springs with hydraulic release	
Main insulation	at the connecting head to the mast	
Electrode cooling	water spray	
Interchangeable components	contact shoe, clamping band, clamping mechanism, electrical insulation	

Table 10.3-100.: Electrode Power Conductive Arm Data

The arms are triangulated to reduce the imbalance of phase reactance. The lateral arms converge towards the center in a short center arm arrangement.

The electrode clamping mechanism is housed in the arm body and used disk spring force to hold the electrode.

The arms are mounted mast stools with three high strength bolts. Superbolt® multi-jackbolt tensioners are used to secure the arms to the stools.

Protection caps for the nuts and insulating washers prevent dust infiltration.

The arms are equipped with electrode cooling by water spraying.

All supply and return lines for the required fluids are mounted inside the arms. Connection points are grouped at the rear end of the arm.



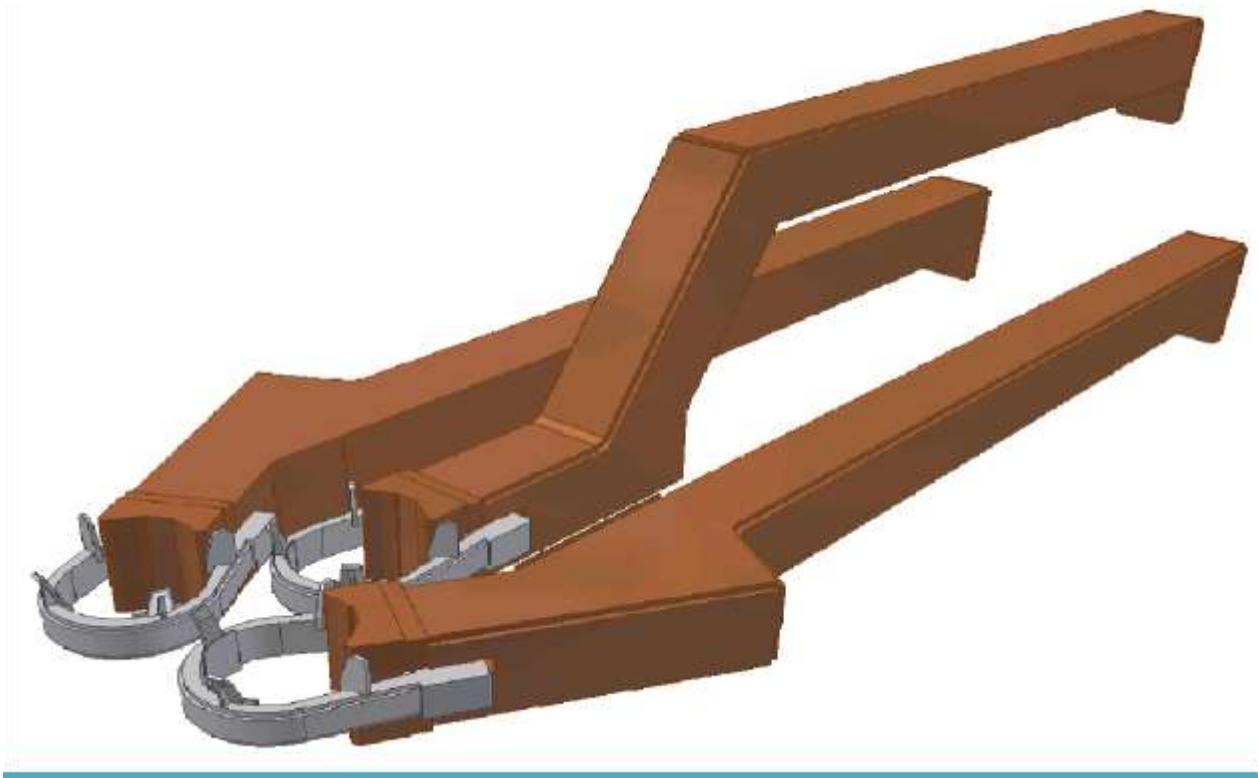


Figure 10.3-40.: Typical Power Conductive Arms

Feed pipes inside each electrode arm are:

- Cooling water: one for arm body and contact shoe, one for clamping band
- Electrode spraying: one to feed the spray ring
- Electrode blowing during slipping (length equalization): one to feed the compressed air on top of the clamp
- Hydraulic cylinder: one for hydraulic fluid

At the rear end (transformer side), the conductive arms are equipped with copper head connection for the flexible cables.

All lines inside the electrode arm body are in stainless steel.

### Conductive arm body

The electrode arm body is of rectangular welded box section.

The arm arrangement is as follows:

- The outside phase arm front ends converge towards furnace center to minimize the pitch diameter
- The center phase arm body, at a higher elevation than the outer arms, has its front end at same level as the outside phases to maximize the triangulation of the power circuit, both in plan and elevation

The triangulated arrangement in TENOVA furnaces is maintained throughout the full length of the power circuit, from transformer to electrode tips. Phase distances and characteristics of current conductors provide low reactance, high reactance balance and low losses.

Each arm's front end houses the clamping mechanisms, contact shoes and clamp ring. The electrode water spray system mounts below the electrode clamp.

On top side of the contact shoe, a compressed air blowing system facilitates dust removal during electrode slipping or exchange.

The rear ends have the copper terminals for the connection of the water cooled flexible cables.

### Contact Shoes

The contact shoes are forged from oxygen free copper (SE CU DIN 1787).

The contact shoes are machined on the rear contact surface to the copper front plate of the arm and on the front contact surface to the electrode.

Installation of the contact shoes to the electrode arms uses machined locators and non-magnetic stainless steel bolts. The purpose of the machined locators is to prevent shear forces on the bolts from the electrode during furnace operation and electrode replacement.

A very efficient direct cooling of the contact shoes is made via drilled channels. Supply and return connections mate to the front copper plate of the arm body.

Electrode movable clamping band

The electrode clamping bands are made from non-magnetic stainless steel with intense water cooling. Cooling water supply and return lines are stainless steel pipes, located inside the arm body, and non-magnetic stainless steel hoses allow the movement of the clamping band.

Electrode guides and pressure pads are provided.

The rear end of the clamp, sliding into the arm body structure, is equipped with special electrical insulation, both top and bottom.

Connection of clamp to the shaft of clamping mechanism is also electrically insulated.

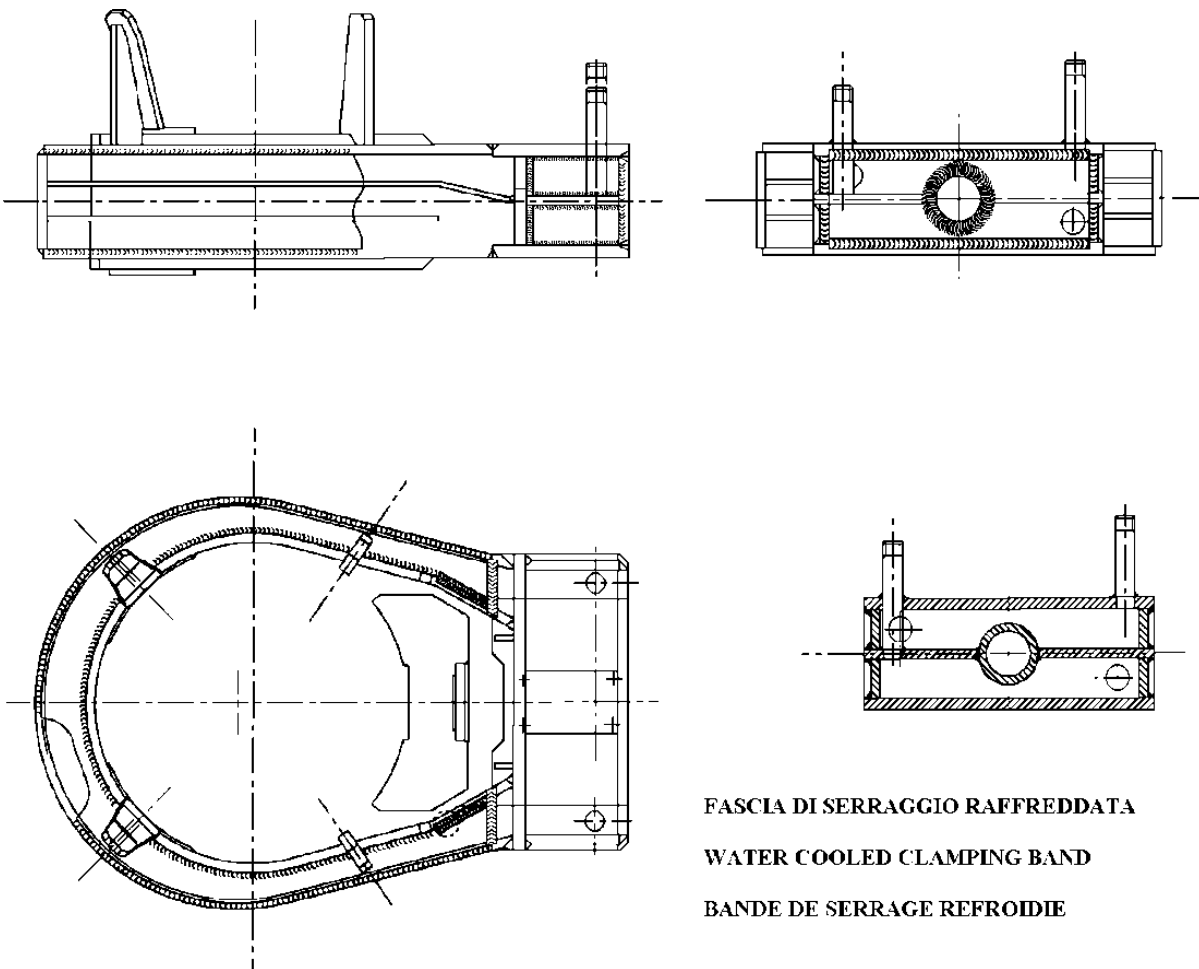





Figure 10.3-41.: Typical Water Cooled Clamping Band

### Clamping/Unclamping mechanism

The mechanism is located inside the arm body and is fully supported and guided by the arm body structure. The supporting and guiding structure of the clamping mechanism is fully water-cooled for long service life.

Dust infiltration protection is installed on both sides of the sliding parts of the clamp to prevent damage to the insulation material and to prevent arcing.

The mechanism consists of:




-  Hydraulic cylinder (single acting)
-  Disk springs
-  Connecting shaft

The clamping force is provided by the disk springs.

The unclamping action is provided by the hydraulic cylinder. The hydraulic fluid connection to the cylinder is made with a stainless steel pipe located inside the arm body up to the vicinity of the cylinder with a short external steel pipe.

### Electrode arm cooling

The electrode arm cooling system consists of the following circuits:

-  Arm body and contact shoe circuit (in series)
-  Clamp band circuit
-  Mast body and stool circuit

All cooling connections and those for hydraulic fluid, compressed air and electrode spray water, are located at the rear end of the arm. All piping inside the arm body is non-magnetic stainless steel.

### Electrical insulation and arm-to-mast connection

The supply includes the insulating material between the mast stool and the body of the arm, the large diameter tie rods with Superbolt® multi-jackbolt tensioners together with the associated insulating materials (tubes washers and caps).

### Particular features of conductive arms of TENOVA design

To face such conditions and to assure high availability of the electrode arm the following criteria are used:

- Strong and efficient cooling of the items exposed to furnace heat
- Front end plate of the arm in high conductivity copper for current transfer only to the contact shoe (no mechanical functions as clamping mechanism guide/support are made by the front plate)
- Centering/supporting machined locators to free the fixing bolts from shear forces
- Efficient heat removal from connection bolts to prevent loosening
- Heat protection shield on bottom face of shoe to arm connection
- Sizing of arm body with very high resistance to bending and torsion to minimize arm deflection and electrode oscillation
- Accurate sealing of electrically insulated areas to prevent dust infiltration
- Heat shields in the front part and in the areas of arm-to-stool insulation.

### 10.3.4.3.10 Hydraulic System

Fluid	synthetic not flammable type according to ISO 12-922 HFC: water-glycol (35-55% water) – HOUGHTON SAFE 620 or equivalent	
Working pressure	2030 [psi]	140 [bar]
Tank and main pumps group		
Tank capacity	1,500 [gallons]	5,600 [liters]
N. of high pressure pumps	3 (+1 in stand-by)	
Type of pump	piston type	
Flow rate	71.3 [gpm]	270 [l/min]
Electric motor	6 poles, 150 HP (110 kW), 50 Hz	
Filter type	one on each inlet line	
Filtration grade	<10 $\mu\text{m}$	
Fluid conditioning circuits		
N. of recirculating pumps	1 (+1 in stand-by)	
Type of pump	fixed displacement vane pump (or gear pump)	
Working pressure	102 [psi]	0.7 [MPa]
Flow rate	71.3 [gpm]	270 [l/min]
Electric motor	4 poles, 10 HP (7.5 kW)	
Cooling system	1x100% oil/water with thermostatic valve	
Filter type	duplex type on each outlet line	
Filtration grade	<5 $\mu\text{m}$	
Heat Exchanger	plate type	
Accumulator system		
N. of Accumulators	8	
Accumulator type	piston type	
Capacity of each accumulator	80 gal/each (303 l/each)	
N. of Nitrogen bottles	4 x 4.2 x 13.2 gal (4 x 16 x 50 l)	
Working pressure	2030 [psi]	140 [bar]

Design pressure	3046 [psi]	210 [bar]
Accumulator design	will provide stored energy for emergency movement only during power failure	
Hydraulic blocks	roof lift/lower roof swing platform tilting and fast return electrode clamp release slag door rising/lowering rear and front bumper movements roof swing lock	
HRR-2 valve stand		
Purpose	for electrode regulation (and roof swinging)	
HRR-2 valves	3 (+1 in stand-by)	
HRDE valves	1 for roof swinging	

Table 10.3-101.: EAF Hydraulic System Data

The Hydraulic skids are complete with filter/breather assembly, sight level gauge/thermometer, clean out covers and drain plugs, directional, pressure and flow control valves as requested.

The hydraulic unit includes:

- One (1) hydraulic fluid, steel fabricated tank (atmospheric tank) provided with level and temperature controls, filter on each inlet line, pump suction connections, etc.

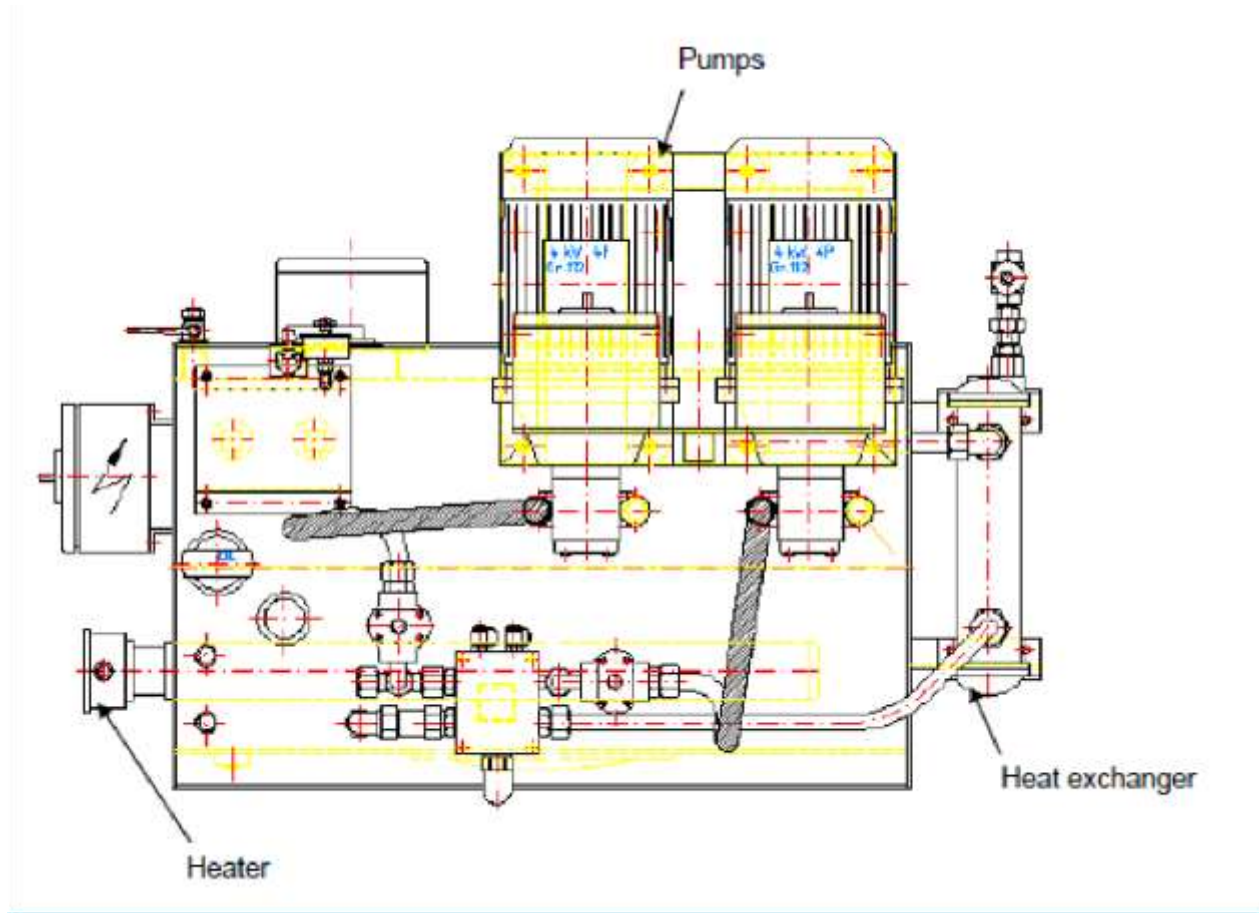


Figure 10.3-42.: Typical EAF Hydraulic Unit



- Four (4) (3+1 stand by) pump-motor groups. Each pump-motor group consists of a three phase motor coupled to the pump, all on a common steel base anchored to the foundation (floor). The main pumping system is for equipment functions, sending fluid to the circuits. The main pump does not require to be hooked on emergency electrical power, since the emergency hydraulic movements are by the accumulators.

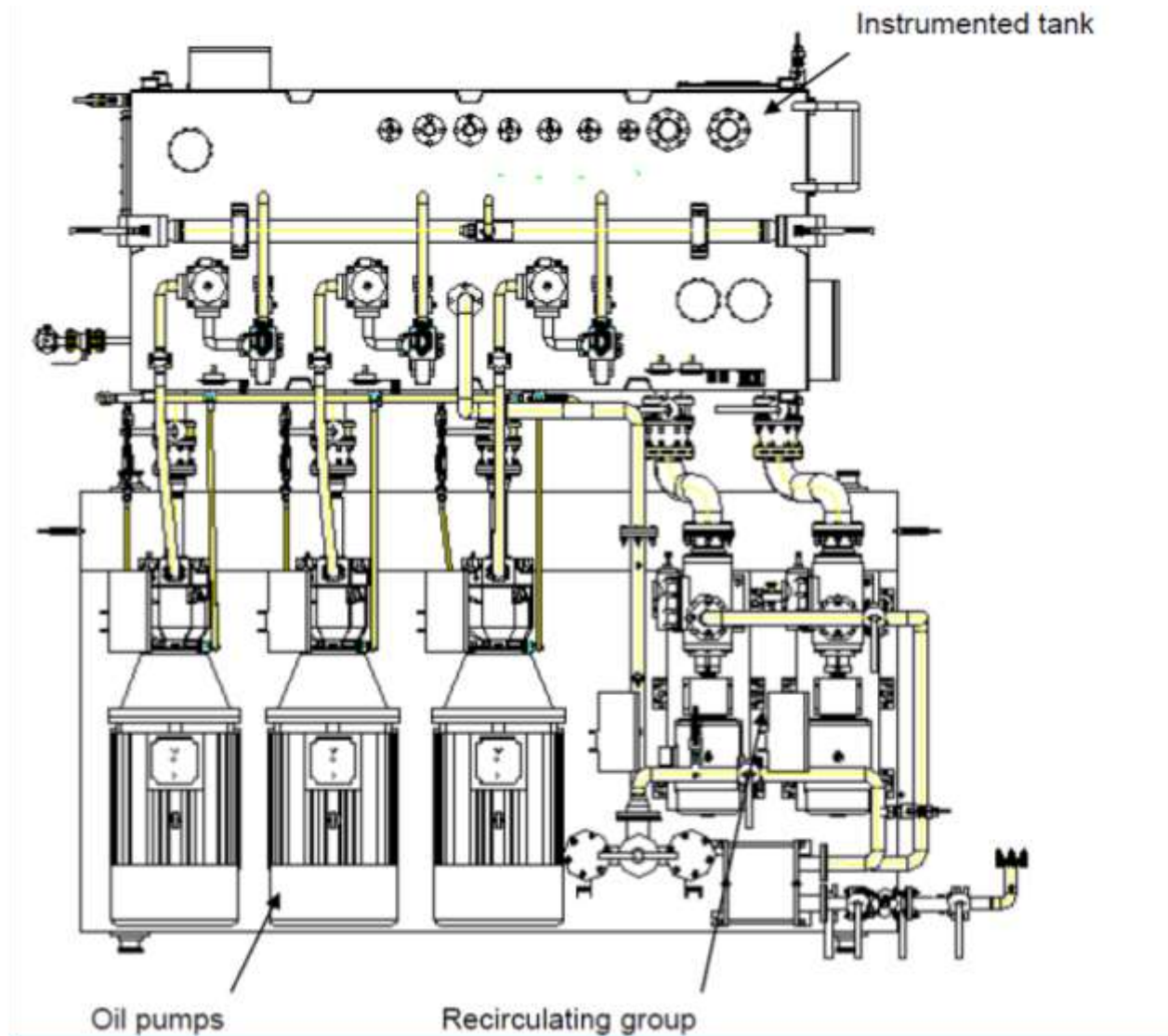


Figure 10.3-43.: Typical Hydraulic Pump Arrangement


-  One (1) set of accumulators complete with accessories (pressure gauge, safety valve, etc.), flanged and threaded connections to the hydraulic unit piping and to the nitrogen bottles. The eight (8) 80 gpm each volume has been calculated based on the emergency requirements for moving the critical equipment: raise the electrodes; raise the roof (no roof swing required in electrical power loss mode) and EAF bumpers operation to maintain the EAF level horizontal. The EAF will naturally tilt back, if in tapping position, without requiring any hydraulic assist (safe EAF design).



Figure 10.3-44.: Typical Hydraulic Accumulators

- Two (2) pump groups for filtering and cooling circuit of the hydraulic fluid, complete with outlet filters, heat exchanger and water control. The side stream pumps in a form of a kidney loop are used for cooling and filtration of the fluid in the reservoir.

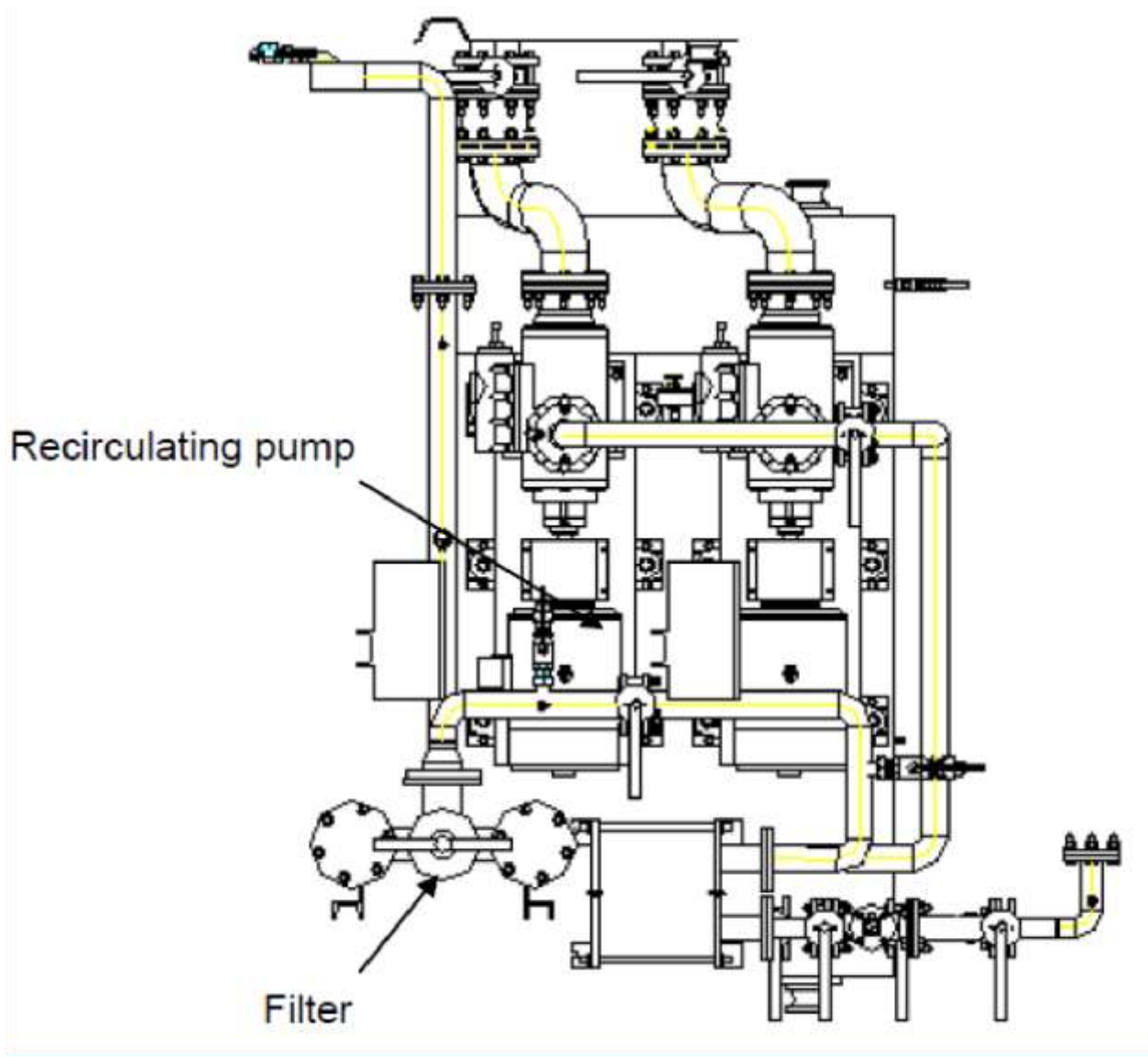


Figure 10.3-45.: Typical Hydraulic Recirculating Pumps

- One (1) HRR-2 valve stand including HRR-2 servo-valves and instrumentation for electrode arm regulation (and HRDE valve for roof swinging at high speed), connected to a dedicated hydraulic unit for HRR-2 actuator control.

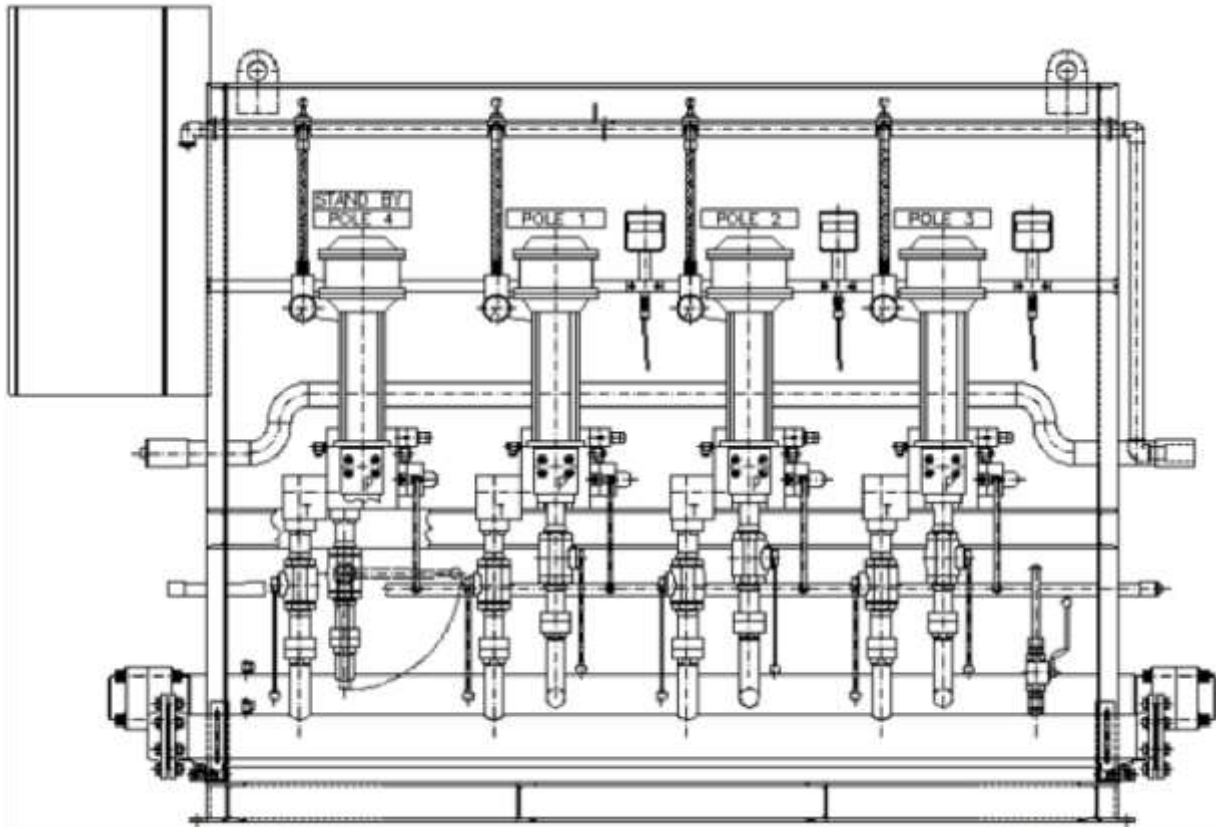


Figure 10.3-46.: Typical HRR Valve Stand

- One (1) hydraulic valve stand for EAF movements on which are installed hydraulic manifolds, servo-valves, logic elements, proportional valves and all the necessary instrumentation to perform hydraulic movements.

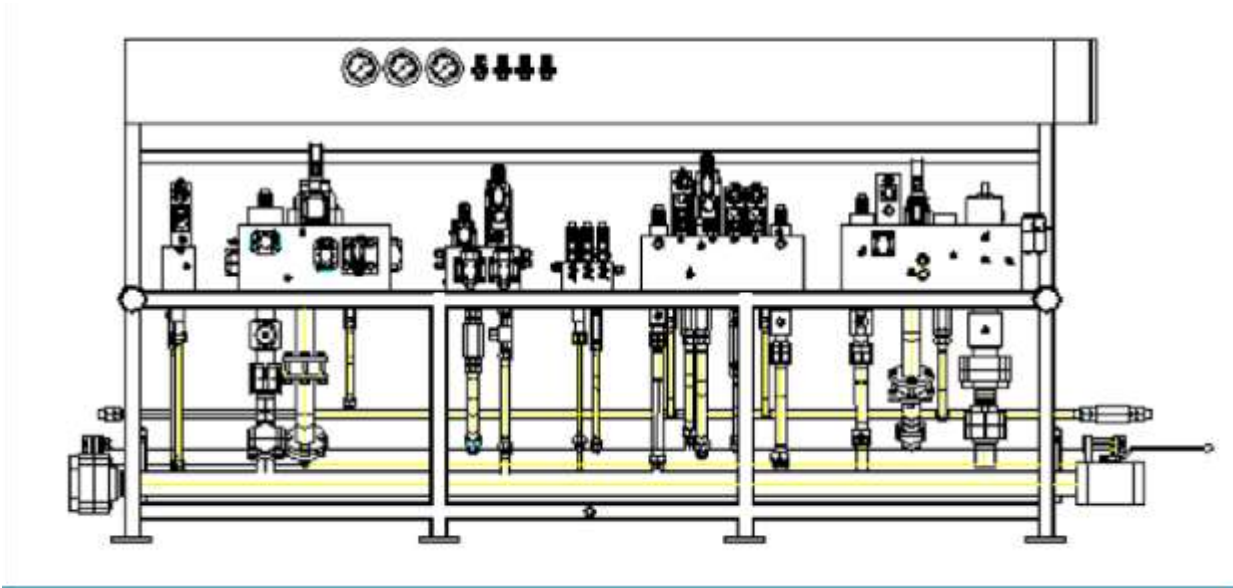


Figure 10.3-47.: Typical Hydraulic Valve Stand

- One (1) set of manual hydraulic blocks for emergency interventions on hydraulic movements such as block for furnace tilting in emergency, block for roof swinging in emergency, etc.

#### Hydraulic valves

Two main hydraulic valve stands are installed:

- Electrode position regulation valves
- Other furnace movements control valves

Electrode position regulation valve stand

Type	TENOVA HRR2 (electrode regulation) and HRDE (roof swing)		
Servo-valves	electro-hydraulic proportional type		
Hydraulic unit for actuator:			
- Pump	10.6 [gpm]	40 [l/min]	
- Working pressure	3046 [psi]	210 [bar]	
- Electric motor	4.7 HP	3.5 kW	
- Tank capacity	42.3 [gallons]	160 [liters]	

Table 10.3-102.: Electrode Position Regulation Valve Stand Data

The proportional valves, of TENOVA make, will receive the electric control signal  $-10 \pm 10$  V from the output card of the digital electronic system TDR-H of TENOVA design.

The position of the hydraulic distributor is controlled by the hydraulic HRR2 servo-valve. The essential items composing the servo-valve are:

- 1) A synchro-motor acting as a torque generator
- 2) An intermediate device composed of a differential piston and a sector valve
- 3) A feedback device transmitting the displacement of the differential piston to the synchro-motor
- 4) A calibration device to set the zero point of the system
- 5) An oil pump to supply the oil under pressure to the system

The lower end of the differential piston connects to the spool of the hydraulic distributor.

Groups 1), 2), 3) and 4) are mounted on a single assembly (see HRR-2 servo-valve figure).



Brief description of the hydraulic actuator

The rotor of the synchro-motor is connected to the sector valve regulating the oil flow.

The stator winding is fed by the fixed excitation signal. The rotor winding is fed by the "error" signal (see P&I diagram PD-7146).

For zero signal, rotor and sector valve are in zero position.

Rotation in one direction or in the opposite one is obtained by applying positive or negative signals.

The actuator device consists of a cylinder having a particular shape in which a differential piston slips.

An orifice connects the zone under the piston (oil chamber) to the head of the piston where the sector valve is controlled by the torque generator.

When the sector valve leaves the hole open, the oil chamber is connected to the discharge and oil returns by gravity to the oil tank. In this case the opposing spring keeps the piston at the lower limit.

If the hole is completely closed by the sector valve, the oil pressure in the chamber rises up to the maximum value.

The piston moves to the upper position as the force, generated by the oil pressure, is greater than the lowering one given by the opposing spring.

Intermediate rotations of the differential piston and of the spool of the hydraulic distributor are therefore strictly proportional to the signal value.

The flow of the hydraulic fluid to the electrode cylinder is proportional to the error signal.

Both excitation signal and error signal are provided by the TDR-H.

Main hydraulic parts of the electrodes regulation system

**Hydraulic distributor:** connected to the supply manifold and discharge manifold of the main hydraulic unit, and to the electrode cylinders. Latest development of the servo-valve includes fast raise of electrodes without additional flow from an external on-off fast rise valve. The continuity of the response is highly improved over systems relying on external valves.

The external fast rise valve is used only for both manual control and/or automatic mode in case of cave-in.

**Actuator:** sets displacement of the hydraulic distributor proportionally to the input signal from TDR-H. One hydraulic unit provides oil in pressure to operate the actuators.

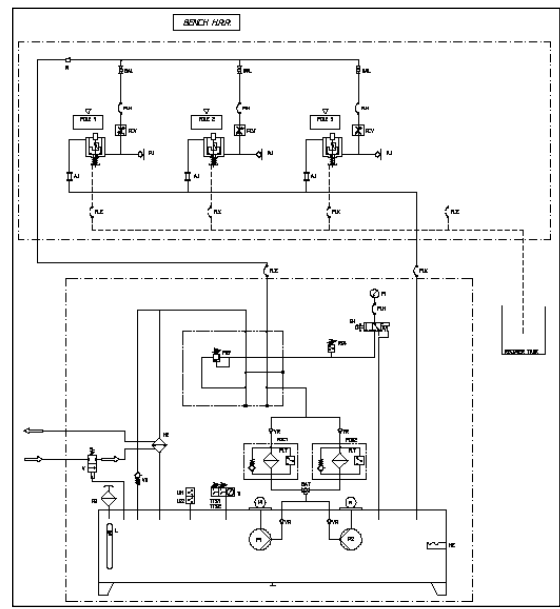


Figure 10.3-48.: Typical Hydraulic System and circuit design



**Valve stand:** completely assembled and wired including:

- 3+1 HRR-2 servo-valves
- 3+1 fast raise valves and 3 quick sectioning valves to stop the electrode movement and hold it in position
- 1 HRDE valve for roof swinging
- one set of manual valves for manual circuit shut-off
- 3+1 digital pressure transducers for electrode protection (cylinder pressure control)
- 1 digital pressure transducer for roof swinging (cylinder pressure control)

One **oil unit**, 42.3 gallon (160 liters) capacity, for actuator operation, composed of tank, pump with electric motor, heat exchanger, thermostatic valve, set of instrumentation (level switches, temperature switches, pressure switch). Pump motor rating is 4.7 HP (3.5 kW).

The unit is delivered completely assembled and wired.








#### Other furnace movements control valves

Proportional valves and solenoid valves provide directional control for all other furnace movement.

All valves are manifold-mounted on pre-piped and pre-wired valve stands. Valve stands have drip pans with drain plugs. Wire ways extend above the valves and the cables down to the valves include a “drip loop” to prevent fluid from entering the electrical connections.

#### 10.3.4.3.11 Pneumatic System

The customer's plant air system will be used for the following:

-  Slag side safety posts (bumpers)
-  Tap side tilt locks (bumpers)
-  Mast locking pin cylinders
-  Electrode spray cooling system (purge of the circuits)
-  Electrode contact shoe cleaning (when slipping/adding)
-  Swing rail cleaning
-  Others (minor)

The supply includes all pneumatic components: the pneumatic solenoid valves will be manifold- mounted on a valve stand.



The pneumatic valve stand will be supplied complete with inlet filter, pressure gauge, piping, wiring up to the on board junction box.

At the inlet connection of the pneumatic valve bench with the compressed air line of the plant, one filtering unit will be provided.

Regulators, lubricators and dryers will be supplied as individual actuators/services require.

For the carbon injection system, compressed air will be directly supplied to the compressed air rack on board of the carbon propeller, to inject carbon through Trufire™ lances. For carbon injection, the air dew point should be 0° F or lower.

#### Compressed air characteristics

-  Supply pressure:87 psi (6 bar)
-  Quality:dry/oil free

#### 10.3.4.3.12 Water Cooling System

The following parts of the EAF and EAF auxiliaries are water-cooled:

-  Slag door
-  Monolithic roof ring
-  Roof superstructure
-  Masts and stools
-  Electrode arms and clamps
-  Flexible cables
-  Secondary delta closure
-  Furnace transformer and reactor
-  Hydraulic fluid heat exchangers
-  Electrode spray cooling
-  Side draft hood

Cooling circuits for electrode arms, flexible cables, transformer, etc. will be of the open type (return to collecting tank at atmospheric pressure).

Cooling water will be supplied by a multi-connection manifold provided with shut off valve on each circuit. Cooling water temperatures, except from the shell and roof already described, are monitored with flow switches and RTDs on each return line.

Water pressure will be monitored at the supply and return manifolds of the shell and roof.

Cooling water flows of electrode arms, etc. will be measured through calibrated orifices and differential pressure transducers.

### 10.3.4.3.13 Weighing System

Strain gauge accuracy	0.03%
Control of the weighing system	via the EAF PLC
Type of output signal	4-20 mA
Type of visualization	HMI




Table 10.3-103.: Weighing System Data

TENOVA's weighing system has a cutting-edge design concept that allows accurate weight measurements even in the extremely tough conditions of the melt shop environment.

The tilting platform rocker pedestals house the load stand/cell frames integral within each pedestal. The load cells, which the furnace rests upon in the level position, allow weighing of all furnace parts with the changing steel weight measurements. The supporting structures of the load cell stands are air-cooled to maintain accurate function in the high temperature environment.

The furnace weight signal is sent to the PLC by a 4-20 mA signal.

The weighing system consists primarily of the following parts:

-  One (1) weigh indicator
-  Two (2) air-cooled supporting structures nested into the furnace pedestals
-  One (1) set of special connecting cables

#### 10.3.4.3.14 Automatic Temperature/ Sampling Robot

The present chapter describes the innovative TENOVA solution for steel temperature measurement and steel sampling performed through an anthropomorphic robot remotely controlled from the main control pulpit avoiding any intervention of operators in the EAF area with the aim to enhance the safeness of the EAF melting operation.







The anthropomorphic robot operates with an automatic cartridge storehouse (automatic cartridge storehouse) for the automatically charging of the robot finger. Moreover, it can operate also with a sample cutting & transport system for the complete automatic operation.

The temperature measurement and sample system permits to drastically reduce the cycle time, to reduce at minimum the opening of the slag door and to eliminate any operator presence on the EAF platform.

The automatic temperature measurement and steel sampling system is composed of the following parts.

##### **Anthropomorphic Robot**

The supply consists of:

-  Robot, Foundry type
-  C5G Controller
-  Programming terminal with cable and extension cable
-  Robot cables kit
-  Profibus board Slave
-  Robot fixing kit

The new C5G robot controller is based on the industrial PC APC820 with Dual Core technology that assures high performances and reduced energy consumption with modular servo actuation system for unit expansion up to 9 axis.



Figure 10.3-49.: Typical Robot and Accessories

The supply consists of:




- Lance for sample tip handling
- Sample tip
- Protections for wrist and forearm of the robot and for motors in stainless steel
- Fire-resistant protection clothing (axis 1 – axis 6); max temperature 2552 °F (1400 °C).
- Fire-resistant protection sheath for robot cables (where necessary)
- Fire-resistant protection boxes for plugs on board
- Air cooling circuit (where necessary)
- Robot controlling software comprehensive of:
  - Robot repositioning in case of collision or anomaly during sampling operation
  - Robot repositioning in case of operator request
  - Robot repositioning in case of emergency operation
  - Automatic positioning in “Parking Position”
  - Automatic positioning in “Cartridge Change Position”






Figure 10.3-50.: Fire-resistant Protection Clothing

### Cartridge storehouse for automatic robot charging

The cartridge storehouse is designed in order to manage three kind of cylindrical cartridge:

-  Temperature only
-  Temperature and C/O2 ppm
-  Complete sample

The supply of the storehouse consists of:

-  Cartridge storage machine with a reservoir of 40 cartridges
-  Tolerance control system for sampling lance tip distortion
-  Electrical board slave






The technical characteristics of the storehouse will be defined during the detail engineering phase.

### Cartridge discharging device

The system is equipped with a mechanical retention device for the used cartridge removal. The extracted cartridge slides on an inclined surface that permits the piking of the sample and/or the elimination of the used cartridges.

In order to integrate the operation of the anthropomorphic robot and its devices (automatic cartridge storehouse and cartridge discharging) in the EAF automation, it is foreseen to supply the following equipment:

### Integration with EAF automation

-  Application Box
-  PLC
-  Emergency managing module
-  Signal control board
-  Push-button panel for area access and relevant light indication Integration of the robot HMI in the EAF SCADA



#### 10.3.4.4 EAF Electrical Equipment

##### 10.3.4.4.1 Water Cooled Cables Main Characteristics

- Terminal heads:copper plates welded to bus tubes
- Number of flexible cables:4 per phase
- Copper section:10000 MCM ( 5000 mm<sup>2</sup>) per cable
- Length:40ft (to be confirmed during engineering stage)
- External sheathing:high temperature resistant
- Type of flexible cables:copper - water cooled

##### 10.3.4.4.2 Medium Voltage Equipment

###### Furnace Metal Enclosed Switchgear

The switchgear will be metal enclosed type with internal lighting and heaters rated for indoor installation. Front and Rear doors together with side access panels will provide the proper maintenance access to the internal components. The switchgear will be divided in cubicles to host the different type of equipment.

All characteristics below listed have to be considered preliminary to be fully defined during design stage.

Main switchgear characteristics:

- Protection Degree:NEMA 1 Indoor
- Service Voltage:34.5kV @ 60 Hz
- Rated Voltage:38kV @ 60Hz
- Rated Current:2000A
- BIL:200kV
- S.C. Current:31.5kA
- Control Voltage:120Vac

### Main Components

The main components of the switchgear are:

One (1) Motor Operated Non-Load Disconnect Switch

- Service Voltage:34.5kV @ 60 Hz
- Rated Current:2000A
- BIL:200kV
- Operation:Motorized

One (1) Furnace Circuit Breaker

- Type:Vacuum Type
- Service Voltage:34.5kV @ 60 Hz
- Rated Current:1250A
- BIL:195kV
- Interrupt. Capacity:31.5kA

The Vacuum Circuit Breaker is a special purpose EAF duty; fixed-mounted circuit breaker and will be used to perform routine switching of the arc-furnace transformer. The Vacuum Circuit Breaker is Siemens type 3AH4. This model is designed specifically for EAF switching duty with a total operating life of 120,000 operations under typical operating conditions with overhauls performed at intervals of 30,000 operations.

Three (3) Primary Potential Transformers

- Service Voltage:34.5kV @ 60 Hz
- Ratio:34500: $\sqrt{3}/120$ : $\sqrt{3}/120$ : $\sqrt{3}$  V
- Type:50 VA cl. 0.550 VA cl. 3P

Three (3) Primary Current Transformers

- Service Voltage:34.5kV @ 60 Hz
- Ratio:2000/5/5/5 A
- Type:50 VA cl. 0.5 for TDR-H metering 20 VA cl. 0.5 available 15 VA cl. 5P10 for protection

### Accessories

The switchgear comes with a number of accessories:

- Access Protection by mean of a key system.
- Lockout Relay (86)
- Local Control Switches (Maintenance Operations)
- Voltage Indicators
- Viewing Windows w/ Camera mounting predisposition.
- Protective Relay w/ Ethernet to perform:
  - Three Phase Primary Overcurrent Protection (50/51)
  - Three Phase Primary Under/Overvoltage Protection (27/59)
  - Metering Unit

### MOD Observation CCTV System

A closed circuit, color T.V. monitoring system (i.e. camera and monitor) will be furnished to enable personnel in the EAF control pulpit to observe the position of the disconnect switch contact blades in the metal enclosed switchgear.

The scope of supply includes:

- Qty One (1) Color Camera w/ mounting bracket
- Qty One (1) 15" Color Monitor w/ adjustable arm
- Qty One (1) Fiber Optic Video Transmitter & Receiver
- Qty. One (1) Set of accessories

### Key Interlock System (Kirk Key)

A key interlock (Kirk Key) will be supplied to limit the access to specific restricted areas/equipment unless the Medium Voltage equipment is properly disabled.

This system will be composed by a number of coordinated electrical and mechanical locking devices. This system will be also coordinated with the external systems (by others).

## Transformer Vault Equipment

### Motor Operated Disconnect:

One (1) Motor Operated Non-Load Disconnect Switch equipped with manual operated Ground Switch will be installed on open frame in the transformer room.

This switch will be operated to maintain the transformer and the medium voltage equipment in the transformer room.

The main characteristics are:

- Quantity:One (1)
- Service Voltage:34.5kV @ 60 Hz
- Rated Voltage:38kV @ 60Hz
- Rated Current:2000A
- BIL:200kV
- Operation:Motorized

### Overvoltage Protection:

The supply includes a complete set of Overvoltage protections. The equipment will be installed on open frame into the transformer room, as close as possible to the transformer primary side. It will be connected to the copper bars and to the grounding network

In principle the protection system will include:

- One (1) lot of star/delta surge arresters
- One (1) lot of RC units

A study on the parameters of the complete furnace supply system configuration will determine the final characteristics and quantities of the Overvoltage Protection equipment.

### Insulators and Bus Bars:

One (1) lot of insulators and copper bars will be supply to connect the furnace switchgear, the medium voltage equipment and the furnace transformer inside the transformer vault.

#### Furnace Transformer:

Furnace transformer is continuous duty, indoor type.

A wide range of secondary voltages is provided: the tap-changing is on-load on the whole range, without star/delta switching.

The secondary outlets of the transformer are in copper tubes on the lateral wall.

#### Tap Changer:

The transformer tap changer will be on-load vacuum type. The diverter switch of the on-load tap-changer is located in a separate tank, segregated from the main transformer tank and provided with protective relay and motor-driven. The tap-changer is provided with local and remote electrical control, local manual operation and remote control from main control desk (manual) and from PLC (automatic melt down), operation counter, repeating contacts for remote position indication, etc.

#### Cooling:

The transformer will be OFWF (Oil Forced, Water Forced) cooling system.

Each heat exchanger will be connected to the transformer by valves and flanges and will be fitted with oil drain and filling plugs, in order to allow removal and replacement of the exchanger with the transformer in working conditions.

Each cooling circuit is supplied complete with a pump for oil circulation complete with motor and starter. The oil pump will be manually operated locally and remotely through the PLC.

A lot of monitoring devices for water and oil circulation with alarms will be provided.

#### Core:

The magnetic circuits will be column type, with inserted joints. They will be built in transformer core sheets, reheated in controlled atmosphere and insulated between them with carlite.

#### Windings:

The windings, which are circular, will be concentric type.

The complete columns, before being fitted on the transformer, will undergo a suitable treatment for avoiding normal contractions, which may rise during plant operation.

The windings will be separated from the core and from each other not only by large oil channels but also by insulating cylinders.

The secondary outlets of the transformer are water-cooled tubes on the sidewall of the transformer.

The secondary outlets, at open delta, are interleaved for better compensation.

#### Tank:

It will be perfectly oil-tight, manufactured in welded plates and reinforcing sections. Adequate access will be provided for inspection and it will be painted of all external parts.

Accessories:

The transformer will be supplied with following accessories:

- Diagrammatic nameplate
- On-load tap-changer, motor operated, with provision for emergency manual operation
- Coolers complete with motor pumps, oil and water flow switches for alarm
- Top oil thermometer, with alarm and trip contacts
- N° 2 Oil level gauges, with alarm contacts, one for each section of
  - Conservator for alarm.
- N° 2 Gas flow Buchholz relays for transformer (alarms and trip)
  - Diverter switch tank (trip)
- Silica-gel breathers for oil conservator
- Pressure relief devices with trip contact
- Ground pads
- Drain valve, oil sampling valve, filter-press connections, quick emptying valve
- Jacking bosses and lugs
- Lifting lugs for complete transformer, for complete core and winding assembly removal and tap-changer removal
- N° 3 porcelain bushings at primary side
- Set of copper tubes on the wall at secondary side
- Auxiliary circuit box
- Set of wheels designed to support the transformer
- First filling of insulating oil Piping flanges, cabling, terminal box on board of the transformer

Ladder for maintenance, welded on the transformer

Transformer Characteristics:

Transformer type	Oil immersed	
Number of phases	3	
Rated power	55 MVA	
Overload	NO	
RAL	To be defined	
Cooling system	OFAF	
Rated frequency	60 Hz	
Primary rated voltage	34.5 kV $\pm$ 10%	
Primary max operating voltage	TBD	
No-load secondary rated voltages	500 – 660 V	
Constant current range	500 – 548 V	
Constant power range	548 – 660V	
Winding connection	Delta/Open delta (D/iii)	
Maximum secondary current	57.95 kA	
	Primary	Secondary
Insulation class	A	A
Type of insulation	fully uniform	fully uniform
Standard insulation level	38kV	-
Short-duration power frequency withstand voltage 1 min	95 kV	8 kV
B.I.L.	250 kV	-
Number of terminals	3	/
Winding material	Cu	Cu
Predisposition terminal	M.V. bus-bars (porcelain)	copper tubes
Short circuit voltage referring to rated power (Vcc%)	~ 8 % at max voltage V ~ 12 % at reference voltage V	
Tap changer type	On-load Vacuum Type	
Number and ratio of taps	10 steps (11 taps)	
Water inlet max temperature	95°F (35 °C)	
Heat exchangers	Nr. 2 each designed for 100% of total losses	
Oil/Winding temp. rise	122 / 131 °F	50 / 55 °C
Oil/Winding temp. rise (overload)	140 / 149 °F	60 / 65 °C
Ref. Standard	ANSI/IEEE	

Table 10.3-104.: EAF Transformer Characteristics



#### 10.3.4.4.3 Low Voltage Equipment

##### Delta Closure and Water Cooled Cables

The whole secondary circuit is made of electrolytic copper conductors is supplied ready for the erection: all the conductors are ready, shaped and bent.

The scope of supply includes:

- Three (3) groups of secondary electrolytic copper conductors connecting the transformer to the furnace water cooled cables.
- Three (3) groups of copper, water-cooled flexible cables for the connection of the above mentioned secondary circuit to the furnace.

All the relevant insulating materials, fastening bolts, washers, terminals, water-cooling connections, etc. are also included.

The secondary circuit will be delivered complete with:

- Connecting clamps between secondary circuit and transformer
- Water cooled copper tubes and copper heads
- Insulating materials
- Closure for transformer wall opening
- Support structure (inside and outside transformer room)

##### Delta Closure Main Characteristics

- Copper section/phase:to be defined
- Copper quality:Cu OF (Oxygen Free)
- Connection to transformer:by connecting clamps
- Connection to flexible cables:by copper heads designed for four (4) cables/phase
- Copper tubes arrangement:fully triangulated plan and elevation

##### Water Cooled Cables Main Characteristics

- Terminal heads:copper plates welded to bus tubes
- Number of flexible cables:4 per phase
- Copper section:TBD
- External sheathing:high temperature resistant
- Type of flexible cables:copper - water cooled

### Secondary Side Potential Transformers

One panel containing a lot of three (3) secondary side potential transformers will be supplied and located inside the transformer vault.

### Motor Control Center

One (1) Motor Control Center will be required to contain the necessary feeder breakers, starters and drives to power the EAF System and its Auxiliary Systems. It will include:

- Main Incoming Circuit Breaker
- Power Quality Meter w/ Network Communication
- Feeders and Motor Starters for:
  - Hydraulic Power Unit
  - HRR Pilot Unit
  - Transformer Pumps and Auxiliaries
  - MHS Equipment (Materials at Tap)
  - MV Switchgear
  - EAF Ladle Car
  - UPS System
  - Furnace Control System (UPS & Auxiliary Power)

MCC main characteristics:

- Wiring:NEMA Class 1 Type B
- Protection Degree:NEMA 1A Gasketed
- Service Voltage:600Vac 3Ph. 3W. @ 60Hz
- Grounding:Solidly Grounded
- Bracing:TBD
- Rating:800A (Preliminary)
- Spare Space/Load:10%/10% minimum

### Electric Low Voltage Motors

The motors used will be squirrel cage three phases-asynchronous motors.

Main technical data:

- Insulation class:F/B
- Protection degree:IP54
- Constructive form:B, V or other depending on the application
- Ventilation:forced self-ventilated (TEFC)

### Field Instrumentation

The supply will include all field installed and on-board instrumentation necessary for the equipment proper operation.

In general the supply includes:

- RTD sensors
- Flow meters and switches
- Pressure meters and switches
- Electric position switches (proxy or limit switches)
- Etc.
- Local Control Stations and Junction Boxes will be provided according to the electrical engineering and the installation requirements. Depending on the application and the installation location these stations will be rated NEMA 12 or NEMA 4.

### Uninterruptible Power Supply

The Uninterruptible Power Supply (UPS) system will be provided to supply the Automation Control System and Panels, Electrode Regulation and Server/Client Computer System.

- Input:220VAC, 60Hz
- Output:220VAC, 60Hz
- Nominal Power:To be defined during engineering phase
- Batteries Capacity (Runtime):15/20min

The UPS System consists of the following:

- UPS cabinet
- Maintenance bypass cabinet

### 10.3.5 Pig Casting Machine

The Pig Casting Machine has been technically defined by Paul Wurth and a complete technical and commercial proposal has been issued for that purpose.

The Pig casting machine is a conventional type of equipment that has been used for years in the iron and steel industry.

Paul Wurth has specified a 100 tph machine, tapping the 120 tons of the PURE FONTE LTÉE ladle every 73 minutes approximately.

Being the EAF tap to Tap time of about 120 minutes, the turnaround time for the machine is then about 47 minutes

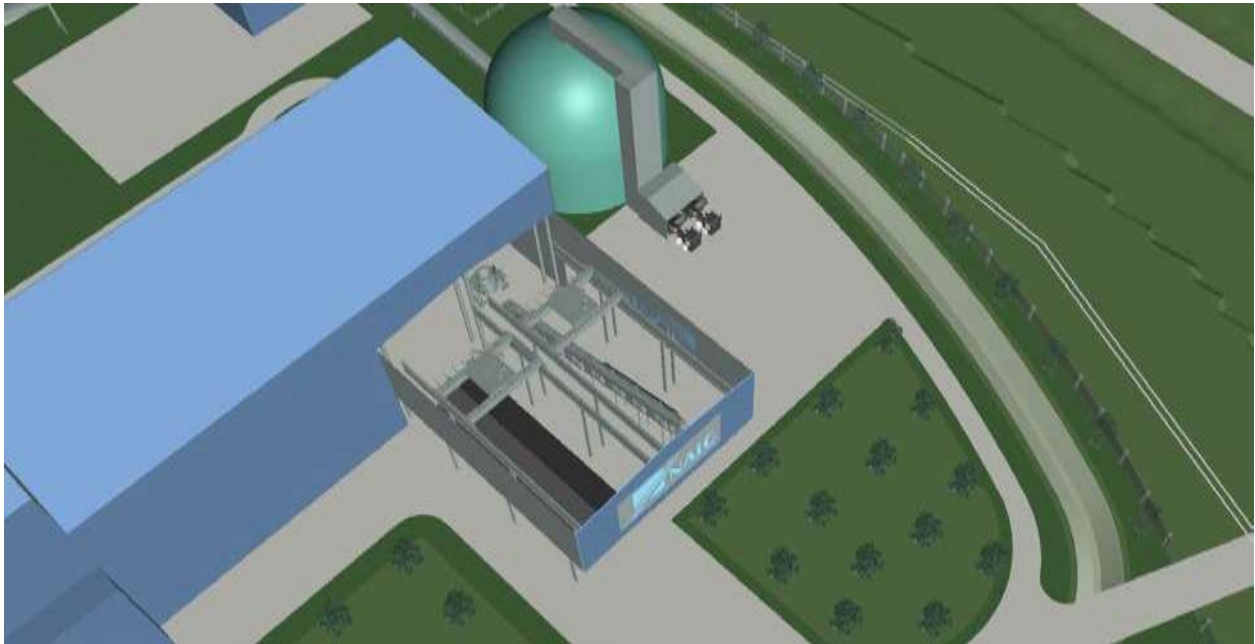


Figure 10.3-51.: position of the Pig Casting machine and pig Iron storage in the plant

# **PAUL WURTH**

SMS group

**Paul Wurth Inc.**

2800 East Evans Avenue

Valparaiso, IN 46383



. corporation

## **COMMERCIAL PROPOSAL SINGLE STRAND PIG CASTING MACHINE NORTH ATLANTIC IRON CORPORATION**

---

Attention: Mr. Chris McKinney

**January 11, 2016**

**ZQ-71806 RO**

**!Part A - Commercial Proposal!**

**Part B - Technical Proposal**

For technical Information:	William EBNER	Tel.: 219-850-1660 Fax: 219-460-0320 bill.ebner@paulwurth.com
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Editors:	GMH

## Revisions

REVISION	DATE	AUTHOR	APPROVED	REVISED PAGES	COMMENTS
0	01/11/16	BER	GMH	-	Initial

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- 1) Terms and Conditions of Sale of Equipment
- 2) 2015 Field Service Terms and Rates
- 3) Technical Proposal (including Reference List)

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## I. COMMERCIAL OFFER

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### 1 CONTENT OF THE OFFER

PAUL WURTH offers the engineering and supply of one single strand pig casting machine. Two options are presented - Option 1 - 75 tph, Option 2 - 100 tph, including all the details of the equipment offered as well as of the services supplied are described in the second part of the current offer, titled, "Technical Proposal".

### 2 PRICE (BUDGETARY)

#### 2.1 Option 1: 75 tph Single Strand Pig Casting Machine

Seller proposes to provide the equipment and services as described in the "Technical Proposal" for the budgetary price ( $\pm 20\%$ ) of:

**\$3,600,000 USD**

**(Three Million Six Hundred Thousand US Dollars)**

#### 2.2 Option 2: 100 tph Single Strand Pig Casting Machine

Seller proposes to provide the equipment and services as described in the "Technical Proposal" for the budgetary price ( $\pm 20\%$ ) of:

**\$3,800,000 USD**

**(Three Million Eight Hundred Thousand US Dollars)**

### 3 PRICE BASICS

3.1 Our price is a Budgetary Price subject to conditions in Section 1 and will remain in effect during the validity period of this offer as per Clause 12.

3.2 The Paul Wurth Brazil portion of this quotation is based on the current exchange rate of 1 US\$ = 4.0 Brazilian Real and will be adjusted  $\pm$  at the time of order.



3.3 The above mentioned price is exclusive of any and all taxes and duties.

## 4 TERMS OF DELIVERY

### Delivery time

4.1 The delivery will be made 46-50 weeks after the effective date of the contract (and receipt of the necessary reference drawings, assuming timely receipt of the down payment).

### Terms

4.2 Delivery will be made F.O.B. Brazilian port according to INCOTERMS 2010 including packing for sea transportation.

## 5 TERMS OF PAYMENT

The payment of our equipment and services will have to be done on the following bases:

- 5.1 15 % Down payment, to be invoiced upon finalization and execution of the contract documents.
- 5.2 15 % Upon submission of General Arrangement Drawings and Piping & Instrumentation Diagrams.
- 5.3 50 % Progress payments during the manufacturing phase (5 - 6 month period).
- 5.4 10 % Upon confirmation by Seller that the major equipment is ready for shipment.
- 5.5 10% After start-up but no later than 120 days after receipt of last piece of equipment at the Site.



5.6 Our invoices are payable net, without discount, not later than 30 days after date of the invoice.

## **6 QUALITY STANDARDS**

### 6.1 STANDARD

The supplies and documentation relating hereto are produced in accordance with PAUL WURTH® standards, which are in substantial compliance with American Welding Society and American steel industry standards. Possible deviations from to these standards may be requested for a particular project, but are subject to Seller's technical approval and possible price adjustment.

### 6.2 EC-DIRECTIVES

The equipment relating hereto are conceived and built in accordance with the relevant EC-directives regarding safety and health requirements.

### 6.3 FACTORY TESTS

Factory tests shall be carried out at the manufacturing facilities of PAUL WURTH or those of its equipment suppliers. All such tests shall be performed during normal working hours and prior to the shipping of the equipment, according to the general practice of the branch of industry.

The PURCHASER is allowed to attend the tests; provided operations are not delayed or impeded; the costs relating to the attendance by his personnel or the personnel of a third party charged by him are payable by the PURCHASER.

### 6.4 ENVIRONMENT

All PAUL WURTH activities and production comply with the ISO 14001 standard referring to the impact of these activities on Environment.

## **7 WARRANTY**

PAUL WURTH warrants that its scope of supply shall be free from defects in design, materials and workmanship, that it infringes no domestic U.S. or foreign patents, and that when delivered it shall be free from third party claims of ownership or title.

Should any part of PAUL WURTH's scope of supply prove defective during the first 12 months from the date of commissioning of the PAUL WURTH equipment, (not to exceed 18 months after the date of shipment), then PAUL WURTH shall repair or replace, at its sole discretion and free of charge, all pieces proven defective. PAUL WURTH's maximum liability under the Warranty shall be the replacement cost of the defective goods. Shipping charges are for the account of the PURCHASER. The replaced goods shall, upon PAUL WURTH's request, become the property of PAUL WURTH.

PAUL WURTH's contractual liability does not include defects or failures resulting from normal wear and tear, accidental damage, misuse or incorrect installation, lack of maintenance and/or any other factor outside the reasonable contemplation of Seller at the time of sale. Furthermore, PAUL WURTH's liability does not apply to supplies on which unauthorized repairs or replacements have been carried out during the guarantee period by the PURCHASER or a third party.

**The foregoing warranties and remedies are exclusive and in lieu of all other express or implied warranties and remedies, including the implied warranties of MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, which are expressly disclaimed.**

## **8 DRAWINGS AND MOLDS**

The PURCHASER shall be fully liable for the accuracy of all drawings, documents and information transmitted by PURCHASER to PAUL WURTH for the preparation of this quotation or the execution of the contract / order.

PAUL WURTH shall provide drawings, calculation sheets and technical documents in quantity, quality and on support in accordance with the provisions of the contract / order. Drawings and documents will be presented in Acrobat (.pdf) and in AutoCAD (.dwg) files as appropriate, however, PAUL WURTH shall not provide factory fabrication drawings.

All documentation will be in the English language.

All the patterns and/or molds used for casting specific parts of equipment will remain the property of PAUL WURTH.

## **9 INTELLECTUAL PROPERTY**

All drawings, documents and information transmitted by PAUL WURTH or its sub-contractors to the BUYER before and/or during the execution of the contract shall remain the intellectual property of the PAUL WURTH. All drawings and documents and information considered confidential shall be marked accordingly, and BUYER shall adhere to any specific restrictive marking contained on the drawings.

The BUYER shall use such drawings, documents and information only for the purpose of erection, maintaining and repairing the equipment sold under the contract/the order. He shall not make them available or transmit them to a third party nor use them to construct any equipment or plant of the same or similar nature, neither for his own use, for the use of any affiliate of BUYER, nor for that of a third party.

The BUYER shall not give third parties insight into drawings, documents and information, be it for reasons of maintenance or repair of the equipment or plant, unless approval is given by PAUL WURTH and unless such third parties have previously signed a secrecy agreement obliging them not to use or to disclose the know-how of PAUL WURTH.

## **10 LIMITS OF SUPPLY**

The limits of supply are defined in our technical offer (Part 2 of the current document).

## **11 GENERAL CONDITIONS OF PURCHASE**

The "General Conditions of Purchaser" (if any) enclosed or referred to in your inquiry are not accepted by PAUL WURTH to the extent that they conflict with our offer.

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**12 VALIDITY OF OFFER**

12.1 This offer is valid for 90 days from the issue date.

Since this offer is budgetary, upon request a firm lump sum price proposal can be submitted.

Respectfully submitted by PAUL WURTH INC.

By:

  
\_\_\_\_\_  
Jey VANDIVINIT  
Manager of Engineering

By:

  
\_\_\_\_\_  
George MacCUIISH, P. Eng.  
President

## GENERAL CONDITIONS OF SALE FOR EQUIPMENT

### 1. GENERAL

- 11 Any PURCHASE ORDER accepted by PAUL WURTH is subject to the present GCSE
- 12 Unless otherwise agreed by PAUL WURTH in writing, should any provisions of the present GCSE be in conflict with any of PURCHASER's General Conditions or Purchase, then the provisions of the present GCSE shall prevail and shall automatically modify and amend PURCHASER's General Conditions of Purchase.
- 13 Any PURCHASE ORDER entered into by PAUL WURTH shall only become valid upon PAUL WURTH's express written acceptance
- 14 Any modifications to the present GCSE shall only be applicable if PAUL WURTH has agreed to it in writing

### 2. DEFINITIONS

- For the purpose of the present GCSE, the following terms shall have the meaning as defined here below:
- 21 "GCSE" shall mean the present General Conditions of Sale for Equipment;
- 22 "ORDER ACKNOWLEDGEMENT" shall mean the letter or document in which PAUL WURTH acknowledges its acceptance of the PURCHASE ORDER;
- 23 "PURCHASER" shall mean any person, company or entity, and shall include any permitted successor or assignee thereof, that places a PURCHASE ORDER with PAUL WURTH;
- 24 "PURCHASE ORDER" shall mean a purchase order, agreement or contract placed by PURCHASER with PAUL WURTH as accepted and/or amended by PAUL WURTH in its ORDER ACKNOWLEDGEMENT, and shall include all terms, conditions, amendments, general and particular conditions and other documents specially incorporated therein;
- 25 "TENDER" shall mean PAUL WURTH's tender document in which PAUL WURTH offers the scope of supplies and/or services to the PURCHASER including the present GCSE and any other document which may be included in the tender;
- 26 "SELLER" shall mean PAUL WURTH Inc., a company incorporated in the Commonwealth of Pennsylvania (USA) and having its principal offices at, Steinhilber Technology Center, 333 Technology Drive, Canonsburg, PA 15317-9581

### 3. TENDERS

- 31 TENDERS cover only such supplies and/or services as are expressly stated therein
- 32 The terms and conditions set forth in the PURCHASER's request for proposal ("RFP") shall not be binding on SELLER, and any weights, quantities and dimensions indicated on drawings and/or documents provided with the RFP or during negotiations are to be considered reference values and shall not give rise to any contractual obligations of whatsoever nature
- 33 TENDERS, as well as all included or referenced drawings and documents shall remain the intellectual property of SELLER and shall be strictly confidential, and may not be used by PURCHASER for any purpose other than evaluation of SELLER's TENDER, nor may they be divulged by PURCHASER, directly or indirectly, to any third party without the prior written consent of SELLER.
- 34 Unless otherwise stated in the TENDER, the TENDERS are open for acceptance for a period of no longer than thirty (30) calendar days from the date of the issuance of such TENDER. Terms of PURCHASER's order that are at variance with any part of the TENDER shall be considered by SELLER as a counter-offer, subject to acceptance or rejection by SELLER, as it may elect
- 35 TENDERS are not binding unless otherwise stated. TENDER may be withdrawn by SELLER at any time after the expiration of the validity period

### 4. EFFECTIVENESS OF THE PURCHASE ORDER AND SCOPE OF SUPPLY

- 41 Unless otherwise agreed, any PURCHASE ORDER to SELLER shall only be effective upon the latest of the following dates:
- Date of the ORDER ACKNOWLEDGEMENT by SELLER;
  - Date of receipt of the down payment in SELLER's bank account;
  - Date of receipt of the import license, if applicable;
  - Date of receipt of the Letter of Credit or an equivalent payment security acceptable to SELLER;
  - Date of notification by SELLER to the PURCHASER that, if applicable, the required insurance cover from the competent Export Credit Agency has been granted to SELLER
- The Purchaser and SELLER will inform each other in writing immediately after any of the aforementioned conditions have occurred

In case any of the aforementioned applicable conditions have not occurred within ninety (90) days after the date of the PURCHASE ORDER, then the PURCHASER and SELLER shall consult with each other in order to analyze the reasons of such delay and agree on mutually acceptable solutions

- 42 In case no solution was agreed within another thirty (30) calendar days, the provisions of clause 5.1.1 become applicable
- 43 SELLER's scope of work under a PURCHASE ORDER shall be the scope of work as accepted in SELLER's ORDER ACKNOWLEDGEMENT.
- 44 SELLER reserves the right to make changes in design and construction of the scope of work to be supplied, provided such changes do not negatively impact performance, operating efficiency, reliability, or cost. Any such changes shall be fully documented in accordance with the requirements of the PURCHASE ORDER

### 5. DRAWINGS AND DOCUMENTS

- 5.1 PURCHASER shall be fully liable for the accuracy and completeness of any and all drawings, documents and indications transmitted by it to SELLER for the establishment of the TENDER and for the execution of the PURCHASE ORDER
- 5.2 SELLER shall provide drawings, as well as technical documents in quantity, in size and in the agreed format in accordance with the provisions of the PURCHASE ORDER. However SELLER shall not undertake to supply any calculation sheets, factory or manufacturing drawings

### 6. STANDARDS

- 6.1 The equipment and the documentation are supplied in accordance with SELLER's standards as specified in the TENDER. Modifications to these standards may be requested as far as technically acceptable to SELLER, however, SELLER reserves the right to modify the price and conditions of the TENDER or the PURCHASE ORDER

### 7. INTELLECTUAL PROPERTY

- 7.1 The technology and know-how incorporated in all drawings and all other confidential technical documents and information disclosed by SELLER and/or its sub-suppliers for the purpose of carrying out the provisions of the PURCHASE ORDER, either during TENDER stage or during the execution of the PURCHASE ORDER, shall remain the intellectual property of SELLER or its sub-suppliers
- 7.2 PURCHASER shall use such drawings, data and documents only for the purposes of evaluating SELLER's TENDER and for erecting, operating and maintaining the equipment supplied by SELLER under the PURCHASE ORDER. PURCHASER shall observe strict secrecy and shall not disclose any drawing and/or any other confidential technical document, data or information to any third party, nor shall PURCHASER use any such drawing, document, data or information disclosed to it during TENDER stage or during the execution of the PURCHASE ORDER to design, construct, install and/or operate, neither directly nor indirectly, any equipment or part of any equipment or plant of the same or similar nature neither for its own works nor for those of any third party
- 7.3 PURCHASER is only allowed to give access to any third party to SELLER's drawings, data and/or documents, as well as equipment or any part thereof for reasons of maintenance, if such third party has signed prior to disclosure to them a confidentiality agreement with PURCHASER in order to protect SELLER's interests. Such a confidentiality agreement shall be in a form acceptable to SELLER and a copy of the signed confidentiality agreement shall be made available to SELLER immediately after signature between PURCHASER and any third party.
- 7.4 PURCHASER shall be fully liable for any damages caused to SELLER resulting out of the non-observance of the above clauses.

### 8. PATTERNS

- 8.1 In case PURCHASER provides for the pattern of the castings, such pattern shall be issued to, of charge to SELLER or to the factories of its sub-suppliers. Any pattern provided by SELLER will remain SELLER's property

### 9. FACTORY TESTS

- 9.1 Factory tests shall be carried out at the factories of SELLER or those of its sub-suppliers, during normal working hours and prior to the shipping of the equipment. Tests that SELLER judges necessary shall be carried out according to SELLER's testing instructions. PURCHASER delegates may attend the tests. All related charges to such attendance shall be to the PURCHASER's account.

## GENERAL CONDITIONS OF SALE FOR EQUIPMENT

### 10. DELIVERY

10.1 Delivery of the equipment by SELLER shall be defined in the PURCHASE ORDER in accordance with the INCOTERMS Edition 2000, or the latest revision thereof. Pinnill deliveries are at SELLER's discretion. Despite the stipulations in INCOTERMS Edition 2000, or the latest revision thereof, SELLER shall in no case be responsible in charge of unloading the equipment.

10.2 The delivery period is reckoned from the effective date of the PURCHASE ORDER.

10.3 In the event of the delivery of the equipment being delayed by any reason not attributable to SELLER, the equipment shall be put at the disposal of PURCHASER in SELLER's factories and/or in those of its sub-suppliers and/or any third parties storage place, independently of any different terms of delivery provided for in the PURCHASE ORDER. Upon notification of readiness for shipment by SELLER to PURCHASER, the shipmen, shall be deemed as effected and the respective payments shall be due. Any cost and liabilities associated with the intermediate storage and handling of the equipment shall be borne by PURCHASER.

10.4 In the event that after having given notice and the delivery is delayed for any reason not attributable to SELLER, SELLER may treat such failure as material breach of the PURCHASE ORDER and reserves its right to either terminate the PURCHASE ORDER or to freely dispose of the equipment. In the latter case, the contractual delivery dates will be postponed accordingly.

10.5 SELLER's obligation to effect delivery in time shall be waived in case: the PURCHASER does not respect the contractually agreed payment terms; the drawings, documents and/or any other information or other supplies or services to be provided by PURCHASER for the execution of the PURCHASE ORDER are not supplied in time; any part of SELLER's work is delayed by a Force Majeure event.

### 11. SITE SERVICES

If site service; are applicable, they shall be rendered in accordance with the TENDER of SELLER.

### 12. TRANSFER OF RISK

12.1 The transfer of risk from SELLER to PURCHASER shall take place at delivery as defined in the PURCHASE ORDER in accordance with the INCOTERMS Edition 2000, or the latest revision thereof. Should, due to reasons not attributable to SELLER, delivery of the equipment not be effected by the due date, the risk in the said equipment shall pass to PURCHASER upon notification of the readiness for delivery by SELLER and SELLER may store the equipment at PURCHASER's risk and expense and following notification of their availability, invoice the equipment as having been delivered. In case PURCHASER does not pay upon SELLER's invoice(s), issued under the present clause 12.1, within the time limits as per clause 16.1 of the present GCSE, SELLER remains entitled at its own discretion, without any special notice, to resell the equipment and to claim applicable damages from PURCHASER.

### 13. WARRANTY

13.1 SELLER's exclusive contractual warranty with respect to quality is that its products and services shall be free from defects in conception, design, materials, and workmanship.

13.2 Unless otherwise explicitly agreed, SELLER's defects liability period is limited to the shorter period of twelve (12) months starting with the date of commissioning of SELLER's equipment or eighteen (18) months after the date of delivery (or after the date of readiness for delivery of the equipment in case of a delay attributable to PURCHASER).

13.3 Until the end of the defects liability period as stated under clause 13.2 above SELLER shall, at its own discretion, repair or replace, free of charge, Ex Work in accordance with INCOTERMS Edition 2000, or the latest revision thereof all pieces proven defective. If SELLER elects to replace such defective equipment, then all replaced equipment shall become the property of SELLER.

13.4 Equipment or any part thereof repaired or replaced under the warranty arc guaranteed only for the remainder of the original defects liability period.

13.5 PURCHASER has to notify SELLER in writing immediately of any defect or alleged defect within the defects liability period. For all such notification received after the end of the defects liability period SELLER shall not be obliged to replace or repair any pieces which fail in service.

13.6 PURCHASER shall be responsible for any erection activity/cost as well as to assist SELLER in verification of the default and allow SELLER to effect the chosen remedy. The PURCHASER will grant SELLER adequate time and reasonable opportunity to inspect and remedy the defect.

13.7 SELLER's obligation under this clause 13 shall not apply for any defects which are caused by normal wear and tear, incorrect storage, handling or installation, misuse, lack of maintenance and/or any other operation not in accordance with SELLER's specifications, manuals and/or instructions. No liability shall be assumed by SELLER in respect of parts replaced.

repaired and/or manufactured by PURCHASER or any third party or by any act or omission beyond SELLER's reasonable control.

13.8 The remedies provided for under this clause 13 are the sole and exclusive indemnification of SELLER to PURCHASER in terms of its liability for the warranty. SELLER's liability under this clause 13.8 shall in no case extend to any consequential and/or indirect damages and/or damages like loss of profit, loss of production and/or losses of any nature whatsoever.

13.9 The PURCHASER is not allowed to suspend any payments for reasons invoking this clause 13.

UNLESS OTHERWISE SPECIFICALLY AGREED BY THE SELLER IN WRITING, THE FOREGOING CONSTITUTE THE SOLE AND EXCLUSIVE WARRANTIES AND REMEDIES OFFERED BY SELLER WITH RESPECT TO DEFECTIVE EQUIPMENT. SELLER EXPRESSLY DISCLAIMS AND SHALL NOT BE SUBJECT TO THE IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

### 14. LIMITATION OF LIABILITY

14.1 The indemnification and/or compensation for any prejudice caused to the PURCHASER under clause 13 above shall be limited to the specific remedies as set forth in the 10.1 clause.

14.2 SELLER's aggregate liability under a PURCHASE ORDER for any reason whatsoever is limited to ten percent (10%) of the PURCHASE ORDER Price.

14.3 NOTWITHSTANDING ANYTHING TO THE CONTRARY IN THE PRESENT GCSE OR THE PURCHASE ORDER, SELLER SHALL IN NO CASE BE LIABLE WHETHER IN CONTRACT, TORT, OR ANY THEORY OF LAW, FOR ANY CONSEQUENTIAL AND/OR INDIRECT AND/OR SPECIAL DAMAGES AND/OR DAMAGES LIKE LOSS OF PROFIT, LOSS OF PRODUCTION AND/OR LOSSES OF ANY NATURE WHATSOEVER.

14.4 The personal liability of SELLER's employees is excluded.

14.5 Unless otherwise agreed all claims against SELLER must be brought (i) within six (6) months after the cause of action arises or, in the case of claims for defective equipment under warranty, (ii) within the defects liability period as per clause 13.2, and PURCHASER expressly waives any longer statute of limitations.

### 15. PRICES

15.1 Unless otherwise stated in the TENDER, all prices are based on the labor and material cost and the exchange rates valid at the TENDER date. Any increase due to a change in either the labor and/or material costs and/or the exchange rates occurring after the expiration of the validity date of the TENDER shall be for PURCHASER's account.

15.2 All prices are exclusive of any taxes and/or duties which may be levied outside of the Commonwealth of Pennsylvania, such as but not limited to import and/or custom duties and/or sales or income taxes.

### 16. PAYMENTS

16.1 Invoices of SELLER are fully payable net latest ten (10) calendar days after receipt of SELLER's invoices by PURCHASER in the currency stated on the invoices, unless otherwise stated in the TENDER, and all payments shall be deemed effected only after they have been credited to one of the accounts SELLER stated on the invoice, without deduction and without reservation.

16.2 Any and all charges, fees, commissions and any other expenses in relation of Letters of Credit or of any payment security by the PURCHASER shall be paid for by the PURCHASER.

16.3 Any amount(s) due and not paid by the PURCHASER shall bear late interest without prior notice. The interest shall be calculated on basis of EURIBOR 3 months borrowing rate determined by the Banking Federation of the European Union plus five percent (5%), calculated on the EURO amount, starting from the due date of the payment until the date the payment has been credited to one of the accounts of SELLER stated on the invoice.

16.4 If, due to PURCHASER's failure to pay the invoiced amount on the due date, SELLER incurs losses on the foreign exchange rates, such losses shall be borne by PURCHASER.



## GENERAL CONDITIONS OF SALE FOR EQUIPMENT

165 PURCHASER may not effect any settlement with other claims. The PURCHASER and/or any company affiliated with PURCHASER may have against SELLER and/or any company affiliated with SELLER.

166 No claim of whatsoever nature may entitle the PURCHASER to postpone or suspend any payment. Otherwise due.

167 In the event the financial situation of the PURCHASER materially deteriorates during performance of the PURCHASE ORDER, SELLER has the right to either demand immediate payment of the balance of the PURCHASE ORDER price due or to claim supplementary guarantees in respect of the performances of the PURCHASE ORDER. SELLER has the right to cancel all PURCHASE ORDERS with the PURCHASER, if such payment, and/or guarantee/ICCS are not received within eight (8) calendar days after the date of having given formal demand.

17. TRANSFER OF TITLE

171 It is explicitly abt'd between the parties that the ownership of the equipment supplied shall only pass to PURCHASER at the complete fulfillment of PURCHASER's payment obligation, under the PURCHASE ORDER.

17.2 SELLER's equipment, goods and/or plants may not be given in pledge and title may not be passed to third parties by PURCHASER until the transfer of ownership has been taken place in accordance with the provision of clause 17.1 hereof. In case the equipment, goods and/or plants are being part of a whole sold by PURCHASER to a third party, PURCHASER shall reserve title of SELLER with said third party and/or any other third party.

17.3 As of transfer of risk and prior to the passing of ownership, PURCHASER shall be responsible for the safe custody, protection and preservation of the equipment, goods and/or plants and shall take all proper steps in respect of the adequate insurance thereof.

18. TERMINATION, POSTPONEMENT

18.1 Termination by SELLER.

18.1.1 SELLER shall consider, at its own discretion, the PURCHASE ORDER as being terminated without giving rise to any obligation to SELLER toward PURCHASER if the effectiveness was delayed and no agreement was achieved as per clauses 4.1 and 4.2.

18.1.2 In case the PURCHASER fails to meet any of its major contractual obligations SELLER has the right to terminate the PURCHASE ORDER and is entitled to recover any excess cost and damage from the PURCHASER.

18.1.3 If the PURCHASE ORDER is suspended for reasons attributable to PURCHASER, or is suspended by PURCHASER for a period exceeding sixty (60) calendar days, SELLER has the right to terminate the PURCHASE ORDER and recover any excess cost and damage incurred by SELLER from the PURCHASER.

18.2 Termination and/or postponement by PURCHASER

18.2.1 The PURCHASER cannot cancel or postpone the PURCHASE ORDER or any part thereof except with SELLER's written consent and upon terms that will indemnify SELLER against any losses.

18.2.2 If SELLER agrees to cancel or postpone the PURCHASE ORDER or any part thereof, PURCHASER shall pay to SELLER the greater of an amount equal to (i) hundred percent (100%) of the price of such cancelled Equipment, or (ii) the costs and/or damages incurred by SELLER.

19. FORCE MAJEURE

19.1 SELLER shall not in any way be held liable for any non fulfillment of its contractual obligations resulting in whole or in part from any war (whether declared or not), act of terrorism, strike, labor conflict, accident, fire, flood, Acts of God, delay in transportation, shortage of materials, equipment breakdowns, changes or enactments of laws or regulations, orders or acts of any governmental agency or body, or any cause beyond the reasonable control of SELLER, or rendering performance by SELLER impracticable due to the occurrence of a contingency the non-occurrence of which was a basic assumption on which the PURCHASE ORDER ACKNOWLEDGMENT was issued. In any such event SELLER shall be entitled to such additional time to perform as may be reasonably necessary and shall have the right to apportion its works, under purchase orders/contracts or not, among its customers in such manner as it may deem equitable. The occurrence of any such event for Force Majeure by one party shall be conveyed in writing to the other party within ten (10) working days of the occurrence of any such event. Any additional costs which will occur to SELLER due to the occurrence of Force Majeure will have to be paid by PURCHASER to SELLER on the same basis as in case of a postponement of the PURCHASE ORDER in accordance with clause 18.2.2. SELLER will automatically be granted an extension of time by PURCHASER due to the occurrence of Force Majeure of the same period as the case(s) of Force Majeure will last plus a reasonable period of time which SELLER will need to resume the work under the PURCHASE ORDER. In case an event of Force Majeure will continue uninterrupted for a period of three (3) months, PURCHASER and SELLER will mutually agree on the performance of the PURCHASE ORDER and shall mutually agree on a

solution, failing which, either PURCHASER or WURTH shall have the right to terminate the PURCHASE ORDER. In case of termination of the PURCHASE ORDER, SELLER shall be entitled to the payment of an adequate remuneration inclusive of the expenses incurred up to that time and on submission of a substantiated invoice.

### 10. ASSIGNMENT

20.1 SELLER shall not have the right to grant any of its obligations, rights and/or title under the PURCHASE ORDER to any third party without the prior written consent of the PURCHASER except to any member of the SELLER Group, its insurance companies and/or its Export Credit Agency as the case may be.

20.2 PURCHASER shall not have the right to grant any of its obligations, rights and/or title under the PURCHASE ORDER to a successor or assignee without the prior written consent of SELLER.

### 11. SEVERANCE OF TERMS

21.1 If any provision of a PURCHASE ORDER and/or the present GCSE shall be declared invalid, unenforceable or illegal by the courts of any jurisdiction to which it is subject, such invalidity, unenforceability or illegality shall not prejudice or affect the remaining provisions of the PURCHASE ORDER and/or the present GCSE, which shall continue in full force and effect notwithstanding such invalidity, unenforceability or illegality. SELLER and PURCHASER agree to replace such inappropriate provision by a new provision of the nearest legally acceptable arrangement in substance to replace the ineffective provision.

### 22. GENDER

22.1 Words importing persons or parties shall include firms and corporations and any organization having legal capacity. Words importing the singular also include the plural and vice versa where context requires. Words importing one gender also include the other gender.

### 23. U.N. CONVENTION

23.1 All of the terms of the United Nations Convention on Contracts for the International Sale of Goods (adopted in Vienna, Austria on 10 April 1980) are expressly excluded from any PURCHASE ORDER.

### 24. JURISDICTION

24.1 for any dispute arising from and in execution of the PURCHASE ORDER the Courts of the Commonwealth of Pennsylvania shall have the exclusive jurisdiction as to any and all disputes arising in connection with said PURCHASE ORDER. SELLER reserves however the exclusive right to bring any dispute involving CUSTOMER before the Courts of Customer's jurisdiction of incorporation or the jurisdiction of the facility in which the SELLER scope of supply shall be installed, as SELLER may elect. The Laws of the Commonwealth of Pennsylvania shall be the applicable law in all disputes arising under any PURCHASE ORDER. Notwithstanding clause 24.1, SELLER may, at its own discretion, decide to submit any dispute arising from and in execution of the PURCHASE ORDER to arbitration in accordance with the Construction Industry Rules of the American Arbitration Association. The venue of arbitration will be the Greater Pittsburgh Area, or such other venue as the parties may agree.

24.2 The arbitration award shall be binding upon both Parties and may be enforced in any court having jurisdiction over the Party against which enforcement is sought.



**FIELD SERVICE TERMS AND CONDITIONS**

Effective 01/01/15

**1. SCOPE OF APPLICATION**

The following terms and billing rates shall apply to the field services provided by **PAUL WURTH INC.** and/or its overseas affiliates ("Seller") in the contiguous United States and Canada. Rates and invoicing/payment provisions apply to those services which are not clearly indicated as being included in Seller's equipment price, or in any lump-sum quotation for services. These terms are supplemental to the terms of Paul Wurth's proposal; should any of these terms be different from those stated in the proposal, the terms of the proposal shall take precedence.

**2. MAKE-UP OF CHARGES**

2.1 The rates indicated below shall be payable in respect of every working hour or calendar day from the date of departure from the Service Provider's home base until the date of arrival there on return. Such daily remuneration includes all payroll taxes imposed by governmental entities at all levels.

	Basic Hourly Rate	Overtime Hourly Rate	Weekend/Holiday Hourly Rate
<b>Technician</b>	\$130.00	\$169.00	\$195.00

**NOTE: Technicians and Engineers from Europe will be quoted for Individual projects & tasks.**

2.2 Normal working hours are presumed to be five (5) eight-hour days per calendar week, with one hour for lunch, starting no earlier than six o'clock a.m. local time and ending no later than seven o'clock p.m. local time. Night work premium applies to any and all hours worked between the hours of seven o'clock p.m. and six o'clock a.m. local time. Weekend premium applies to all hours worked between 7:00 PM on Friday and 6:00 AM on Monday. Holiday premium applies to all hours worked on any day that is a legal holiday (i.e., banking institutions closed) in the local governmental jurisdiction. For service providers working away from their home base, eight (8) hours shall be charged for all non-working holidays, along with lodging expenses and per diem for the holiday.

2.3 Overtime premium applies to all hours worked in excess of eight (8) hours per day or forty (40) hours per week. Service providers will not be requested to work more than 60 hours in any calendar week without the express written consent of the Seller.

2.4 Inefficient or idle time caused by any cause outside Seller's control (e.g., force majeure, Purchaser delays) shall be the responsibility of Purchaser, and any time scheduled or reasonably anticipated to be utilized shall be billed at the appropriate rate(s).

2.5 Time spent traveling four (4) hours or more shall be charged at the Normal rate for a full day, with no overtime charged. Travel time is comprised of the time for the service provider to travel from and to his home base of employment. Should circumstances require that Service providers be lodged at a location that is more than thirty (30) minutes from the work site, the additional time shall be charged as hours worked.

2.6 Seller reserves the right to adjust its rates as of January 1, 2016, and the first of each year thereafter; the rates charged will be those in effect as of the date that the services are provided.

**3. LIVING EXPENSE**

Living expenses shall be borne by the Purchaser on a cost basis plus 5% to cover overhead. Lodging expenses will be charged at cost (see item 4 below).

## FIELD SERVICE TERMS AND CONDITIONS

### 4. TRAVEL EXPENSES

Travel expenses shall be borne by Purchaser on a cost basis plus 5% to cover overhead. Travel expenses shall be understood to include air fare, cost of work visas and other authorizations, and cost of transporting personal effects, tools, and instruments required to perform the work.

### 5. TAXES

The above-mentioned rates for remuneration, allowance and travel expenses do not include any sales or use taxes, which, if required, are for customer's account.

### 6. INVOICING AND PAYMENT

Seller will submit its invoice monthly and upon completion of the services. Purchaser shall check all service reports and invoices without delay; any such reports shall be deemed approved unless any discrepancies are noted within thirty (30) days after submission. Payment is due thirty (30) days after invoice, without setoff or reduction.

### 7. OBLIGATIONS OF PURCHASER

7.1 Unless otherwise agreed in any instance, Customer shall provide PAUL WURTH a minimum of thirty (30) days' notice prior to the start of field services.

7.2 Customer shall ensure that PAUL WURTH shall have a copy of any local laws, rules and regulations applicable to the services.

7.3 Customer shall ensure that PAUL WURTH employees have the necessary access to the worksite. Customer shall advise PAUL WURTH in advance of any certifications, training, pre-testing, drug screening, protective equipment, or other necessities that would prevent prompt access to the areas in which the services shall be conducted. Time spent completing Customer-required pre-access training shall be billed as hours worked.

7.4 Customer shall timely provide any special tools, instrumentation and any necessary site preparation for the start of PAUL WURTH's site work.

7.5 Customer shall take all necessary and legally required measures for accident prevention. The Customer shall notify PAUL WURTH of safety regulations which the customer imposes on its own employees, and PAUL WURTH shall ensure the observance of such safety regulations by its own personnel. PW personnel shall also follow all safety regulations outlined in the PW Corporate Safety Manual. If breaches of these regulations by PAUL WURTH's personnel come to the notice of the Customer, it must inform PAUL WURTH in writing promptly. The Customer may take such measures as are necessary for the avoidance of danger resulting from such breaches, and may, in particular, forbid persons guilty thereof entry to the site.

7.6 Customer shall not refuse emergency medical treatment of PAUL WURTH personnel solely due to non-employee status, but there shall be no affirmative obligation on the part of Customer to offer or provide such treatment.

7.7 PAUL WURTH personnel shall have free access to Customer's communication facilities such as phone, facsimile, and electronic mail, for purposes relating to carrying out the work.

### 8. INTERRUPTION OF WORK

If the work is substantially interrupted for a cause for which PAUL WURTH is not responsible;

- a) The customer is entitled to request PAUL WURTH to withdraw his personnel, in which case the customer shall pay the expenses of their withdrawal and return to the site.
- b) PAUL WURTH is entitled to recall his personnel if the interruption exceeds a reasonable period, in which case also the customer shall pay the expenses under 8.a.

## **FIELD SERVICE TERMS AND CONDITIONS**

If the personnel of PAUL WURTH are withdrawn or recalled, the contract is not thereby terminated and its performance is merely suspended until the customer has required the return of PAUL WURTH's personnel to the site by giving at least one (1) month's notice.

Should the suspension be of so long duration that the basis of the contract becomes substantially altered, either party shall be entitled to terminate the same without prejudice to the rights of either party accrued up to time of termination.

### **9. WORK OUTSIDE THE CONTRACT**

Purchaser shall not request, and PAUL WURTH shall not be required to provide, any work outside the Seller's contractual scope of work. Any additional or changed work shall be handled in accordance with the existing contractual provisions (e.g., the Changes clause of the general terms and conditions).

### **10. ADDITIONAL LABOR**

Purchaser shall make available to Seller any plant personnel as may be reasonably required to carry out any assembly, adjustment, operation or maintenance tasks that may be associated with Seller's scope of work. Seller shall exert reasonable commercial efforts to abide by Purchaser's work rules and customary practices, so as to avoid conflicts with Purchaser's employees.

### **11. LIABILITY OF PAULWURTH**

Under no circumstances shall Seller's aggregate liability exceed the amount received by Seller in respect of the services. Seller shall not be liable for any indirect, incidental, special, punitive or consequential damages of any kind.

### **12. JURISDICTION**

Any dispute arising from this contract, and the execution of this contract, whatever the nature and cause, will be settled in accordance with the Construction Industry rules of the American Arbitration Association, unless otherwise mutually agreed. Should the underlying contract for equipment stipulate a controlling jurisdiction, those laws shall similarly control disputes arising under this contract. Otherwise, this contract shall be governed by the laws of the Commonwealth of Pennsylvania, excepting only its laws governing choice of law.

### **13. NATURE OF THE SERVICES**

Seller's site services are in the nature of technical consultation and advice to Purchaser. Notwithstanding any written or oral descriptions of Seller's services to the contrary, Seller's representatives may not supervise or direct any personnel of Purchaser or other third parties working on site, and Seller shall not be construed as having supervised or directed any activities other than those of its own forces, under any circumstances.

### **14. WARRANTY OF SERVICES**

Seller warrants the work done by its representatives for a period of 90 days after the work is performed. If a portion of the work proves to be defective and prompt notification is made in writing, Seller will, at its own expense, supply the necessary technical direction or consultation to correct the defect. The foregoing shall constitute the sole remedy of the Purchaser and the sole liability of the Seller whether in warranty or otherwise.

### **15. POINT OF CONTACT**

For all services that need to be scheduled, please contact our Field Service Manager, Dave Schoolcraft on his cell at 724-825-0091. Or contact our main line at 219-850-1290

**Customer** : Tenova CORE - USA Project  
**Project:** : One 100 TPH Single Strand Pig Casters  
**PW Reference** : ZQ-70558 REV 0

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## **1 PROJECT DESCRIPTION**

### **1.1 The Paul Wurth® Pig Casting Machine**

The Paul Wurth Pig Casting Machine is used for casting molten metal into uniformly sized pigs. For iron producing facilities the advantages of the Paul Wurth Pig Casting machines include:

- The ability to turn excess iron producing capacity into a salable product.
- The ability to take excess iron from over run heats and turn it into a scrap substitute for in house use or a salable product.
- The ability to take excess iron during periods of upset in the downstream processes allowing more uniform operations of the iron producing facilities and generating a salable product.

Compared to other methods for handling excess iron, i.e.: "beaching" or pouring the iron on prepared ground beds, and allowing it to solidify then breaking it up into pieces, the pigging operation results in reduced overall costs and provides a more valuable product. The Paul Wurth Pig Casting Machine provides uniform size pigs which are easily handled, stored, and identified.

The Pig Casting Machine is an inclined, endless chain of molds traveling around two (2) sprocket assemblies. The sprocket assembly near the top of the machine is driven and is called the head sprocket assembly, while the other is the tail sprocket assembly.

The molten metal is poured into the molds just forward of the tail sprocket and cools as the strand travels up an incline, then onto a discharge cooling conveyor. This cooling is enhanced by water sprays. As the chain rounds the head sprocket, the solidified pigs drop off onto the discharge cooling conveyor while the empty molds continue traveling down the incline where they can be automatically coated and dried. During startup, the pig caster should be run for approximately 20 minutes for drying of the molds prior to coating.

This pig casting operation is essentially a one-man operation; however, an additional man may be required for incidentals.

All Paul Wurth® Pig Casting Machines are designed and built for the utmost in simplicity, ruggedness and low maintenance operation.

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## 1.2 Project Information

For the Tenova CORE project, a pig casting facility will be laid out according Paul Wurth Drawing ZQ-70558-01. This pig casting machine will be fed by an existing 156 t ladle which will pour onto an inclined launder system.

For this project, Paul Wurth is proposing one (1) single strand Pig Casting Machine, with a capacity of 100 t/h. This pig caster offer is complete with the launder system, the fume hood, pig strand conveyor, steam exhaust system, discharge cooling conveyor and the control and electrical equipment as described in the scope of supply of this technical specification. This offer is for engineering and equipment supply only.

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## 2 DESIGN PARAMETERS

The design data here below applies for one (1) pig casting machine:

<b>Operating Parameters Considered for Design</b>		
Daily Production, maximum	1.400	mt HM/d
Pig Iron Temperature	1,348 - 1,450	Of
Si Content	< 1.2	%
Density Pig Iron	7,208	Kg/m <sup>3</sup>
Liquid Iron Content Ladle	156.4	mt HM
Nominal Casting Performance of the Machine	100	mtlh
Number of Ladles per Day	8.76	
Nominal Pouring Time for 1 Ladle	94	mln
Total Nominal Pouring Time per Day	13.7	h
Time Between Nominal Casts for Ladle Handling	70.5	min

<b>Pig Caster Design Parameters</b>		
Number of Strands	1	
Single Pig Weight	12	kg
Number of Pigs in Each Mold	3	
Total Weight of Pigs in a Mold	36	kg
Residence Time of Pigs on the Machine	300	sec
Chain Pitch (Link Length)	762	mm
Molds per Link	4	
Chain Velocity at Nominal Production	9.25	m/min.
Molds (Total Single Strand)	496	
Fixed Wheels per Strand	226	
Machine Inclination	13	deg.
Height Difference Between Center Sprocket Wheels	6.88	m
Horizontal Length	47.3	m
Drive Performance (running)	32.5	Kw

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### **3 DESCRIPTION OF THE PIG CASTER INSTALLATION**

The offer consists of one (1) pouring area with one (1) fume hood, one (1) pig casting machine and an electric/automation system that will be installed in the common control/electric room that will be supplied by the customer.

Reference Drawing: ZQ-70558-01

#### **3.1 Pouring Area and Hot Metal Handling**

##### **3.1.1 Ladle and Ladle Tilter**

The pouring area and hot metal handling as described below is for one (1) pig casting machine. This pig casting machine is fed by a 156 t ladle. The 156 t ladle is placed by an electrical overhead traveling crane into the ladle tilter supplied by Paul Wurth. The ladle tilter is a steel fabrication with hydraulic controls to lock the ladle into position on the tilter then tilt the ladle to pour the molten iron into the pig machine. For an illustration, see Detail A below. The ladle pivot point is located close to the pour point to minimize changes in elevation when pouring metal into the launder system. The tilter is designed to tilt the ladle more than 90°.

The ladle tilt system will be controlled with feedback from weighing systems supporting the tilter so that the molten iron will be poured at the required continuous flow rate corresponding to the production capacity of the pig machines. This will insure properly filled pig molds, and provide an accurate measure of production.

The ladle will be modified to add a slag dam at the pouring lip. The slag dam will consist of a refractory lined plate across the pouring lip allowing an opening of approximately 150 mm x 300 mm. During pouring the slag dam will hold back the slag floating on the surface while allowing the molten iron to flow into the launder system.

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## PAULWUR1H LADLE TILTING



Detail A

### 3.1.2 Launder

The launder system will be designed in such a way that the feeding of the single strand is done with one (1) ladle pouring system.

The flow path of the launder to pig casting machine will be split in five (5) flow paths in order to provide the molten metal to each of the mold pockets. Splash guards are supplied at both ends of the launder exit end to protect the chain link assembly movement.

Note: Launder refractory and refractory installation will be supplied by the customer.



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### **3.1.3 Casting Area**

A working platform is foreseen at the launder in the tail end elevation. This platform can be accessed from the ground floor by access stairs at both sides of the machine. For proposed arrangement refer to Paul Wurth Drawing ZQ-70558-01. This platform will be accessible from the common control room located between the two pig machines.

### **3.1.4 Dedusting System**

Paul Wurth is including the supply of a hood in the pouring area of the ladle. This hood will evacuate the emissions from the ladle, launder, and pig molds when pouring from the ladle. The hood will be removable for maintenance purposes.

The estimated required suction capacity is 50,000 scfm, which shall be confirmed in the basic engineering phase.

The dedusting capacity should be connected to the existing plant dedusting system. The connection between the hood and the dedusting system including ducts, duct support, dampers etc. or connection to a dedicated baghouse is not included in Paul Wurth scope of supply.

## **3.2 Pig Casting Machine Proper**

One (1) pig casting machine, consisting of a single strand will be supplied, consisting of the following main components supplied by Paul Wurth. The details are as follows:

### **3.2.1 Steel Structure**

The pig casting machine will be supplied complete with walkways and access platforms. There are walkways on each side of the strand; at the advancing chain elevation and at the returning chain elevation. There is also a working platform at the pouring area and at the head sprocket and at the discharge cooling conveyor. For details, refer to Paul Wurth Drawing ZQ-70558-01.

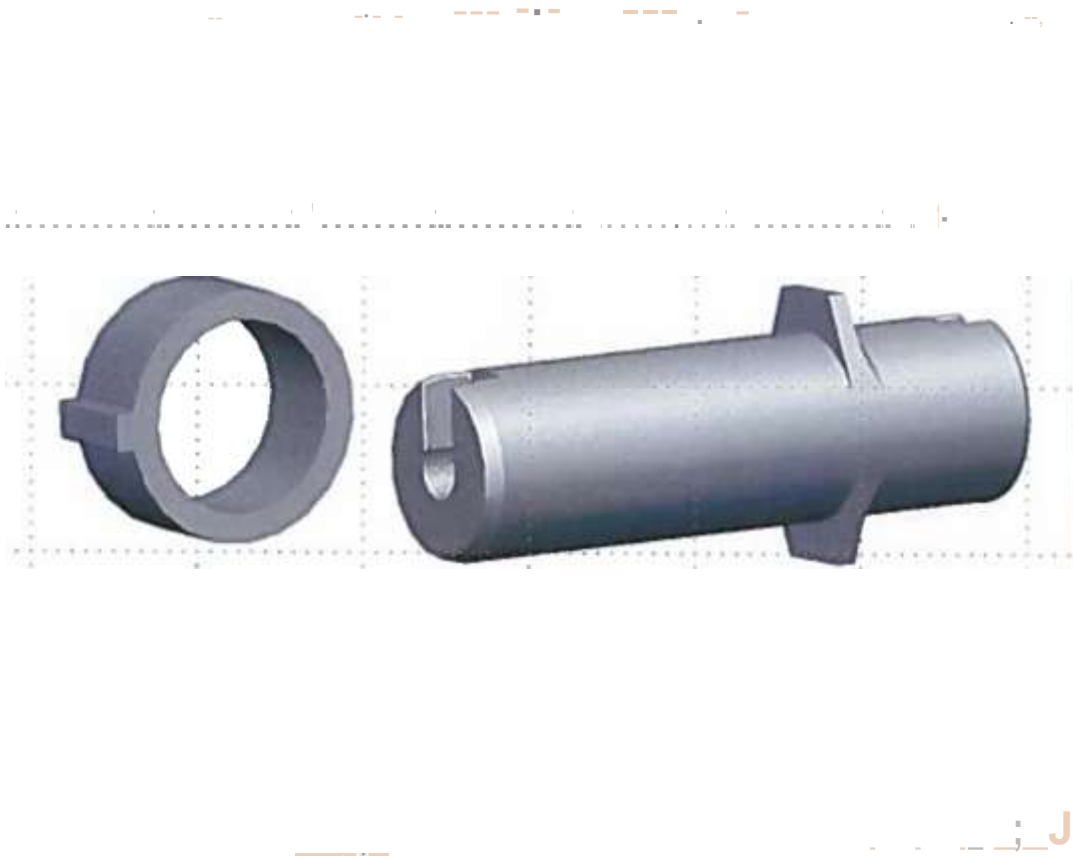
The supporting steel structure, access stairs, from the ground level to the machine, and platforms for the common control room will be by the customer.

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### 3.2.2 Chain

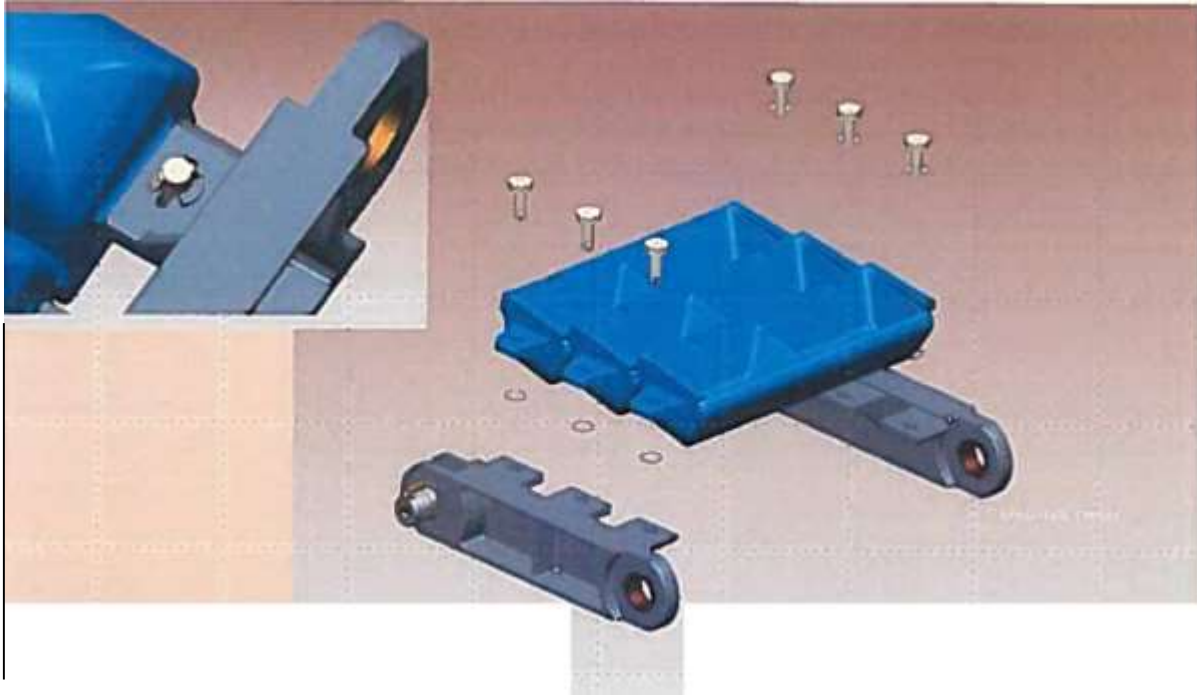
The link connections on the Pig Casting Machine are made with a keyed bushing, which restricts all link wear to the area riding on the wheels. This is minimal since this is rolling friction, not sliding. The bushing isolates all contact between mating links so that the chain wear is confined to the easily and inexpensively replaced bushings. For details on the pin and bushing, see Detail 1 below.



**Detail 1 - Pins and Bushings**

For long life and wear resistance, the chain components are made of high strength steel castings. For details on the chain link assembly components, see Detail 2 below.

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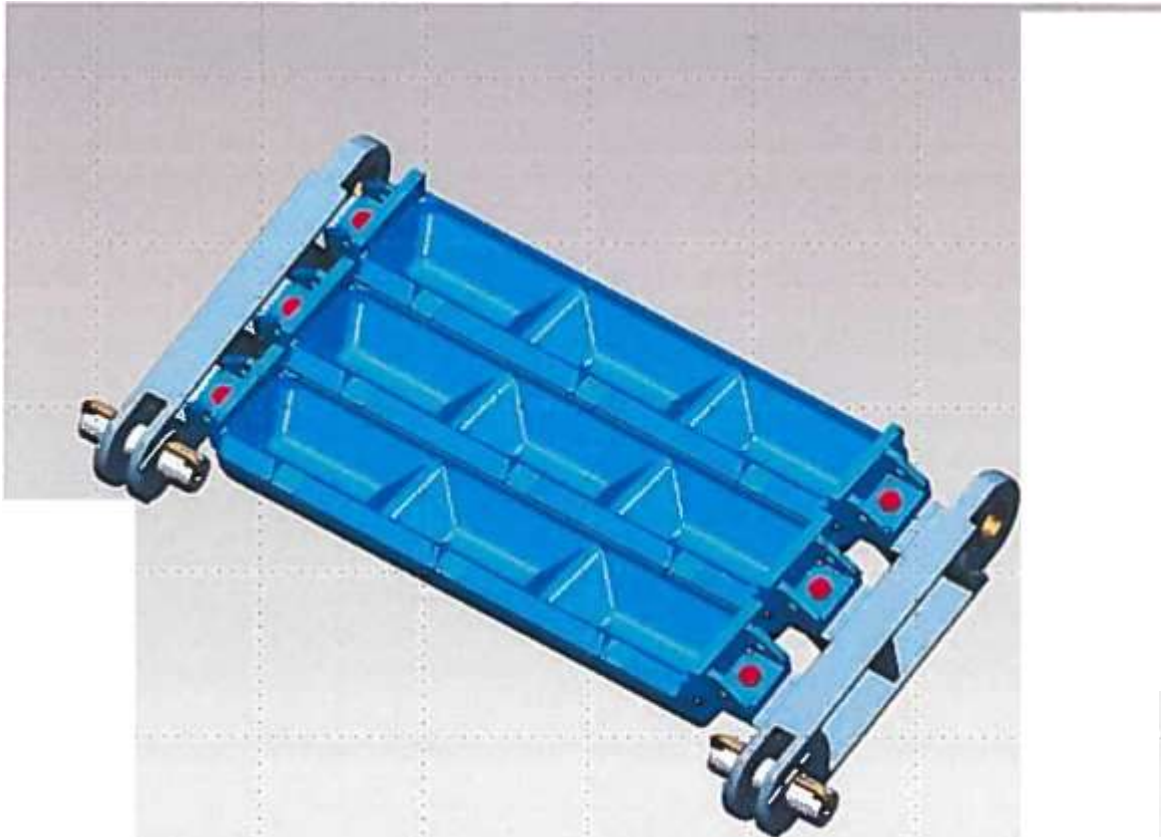


**Detail 2 • Chain Link Assembly - General Concept View**

### 3.2.3 Molds

Our three (3) pocket molds are manufactured of cast steel. High emphasis has been placed on the design criteria of maximum thermal conductivity and ease of pig release. Each mold has run-off troughs cast into it on the trailing edge to guide excess metal into the following pig, not over the machine structure. For details on the molds, see Detail 3 below.

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**Detail 3 - 3.Pocket Molds**

### **3.2.4 Stationary Wheels**

Traveling wheel Pig Casting Machines have the inherent disadvantage of many moving parts. The Paul Wurth Pig Casting Machines uses stationary large diameter wheels (10m) bolted to the machine structure. Unlike the travelling wheel strands the larger diameter fixed wheels keep the hot molds at a further distance from the axle bearings and gives a greater surface for heat dissipation. Sealed bearings are used, however a central grease lubrication system can be supplied as an option. For details on the Wheel Assembly, see Detail 4 below.

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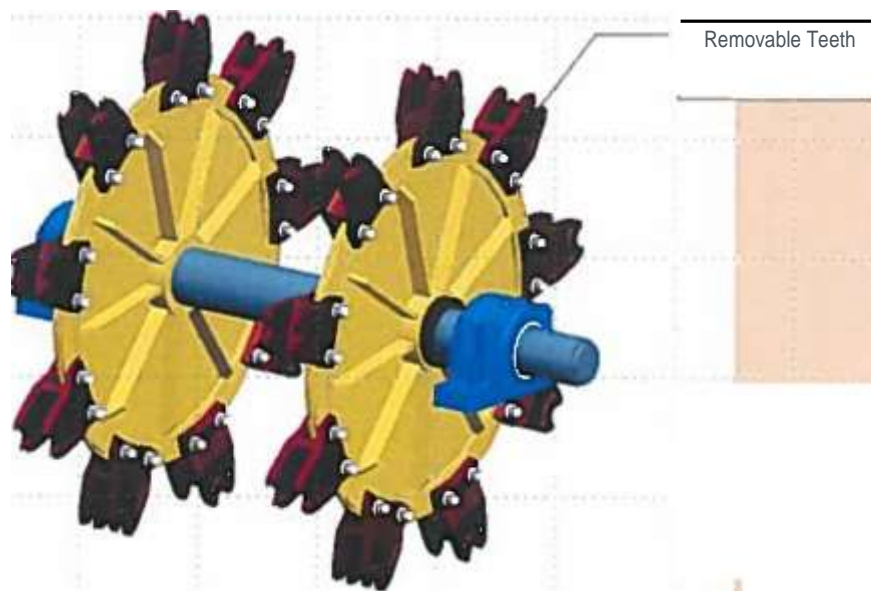
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**Detail 4-Wheel Assembly**

### 3.2.5 Sprocket Wheels

The sprockets are heavy duty cast steel with flame-hardened, replaceable teeth to reduce wear. The sprockets are of a large diameter to reduce RPM's. For details on the Sprockets, see Detail 5 below.



**Detail 5 - Sprocket**

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### 3.2.6 Drive Unit

This single pig caster strand is powered by an independent planetary motor reducer drive unit. This drive unit is controlled by variable speed controllers capable of varying the machines required capacity from 90-115 t/h of iron pigged.

### 3.2.7 Sticker Rails

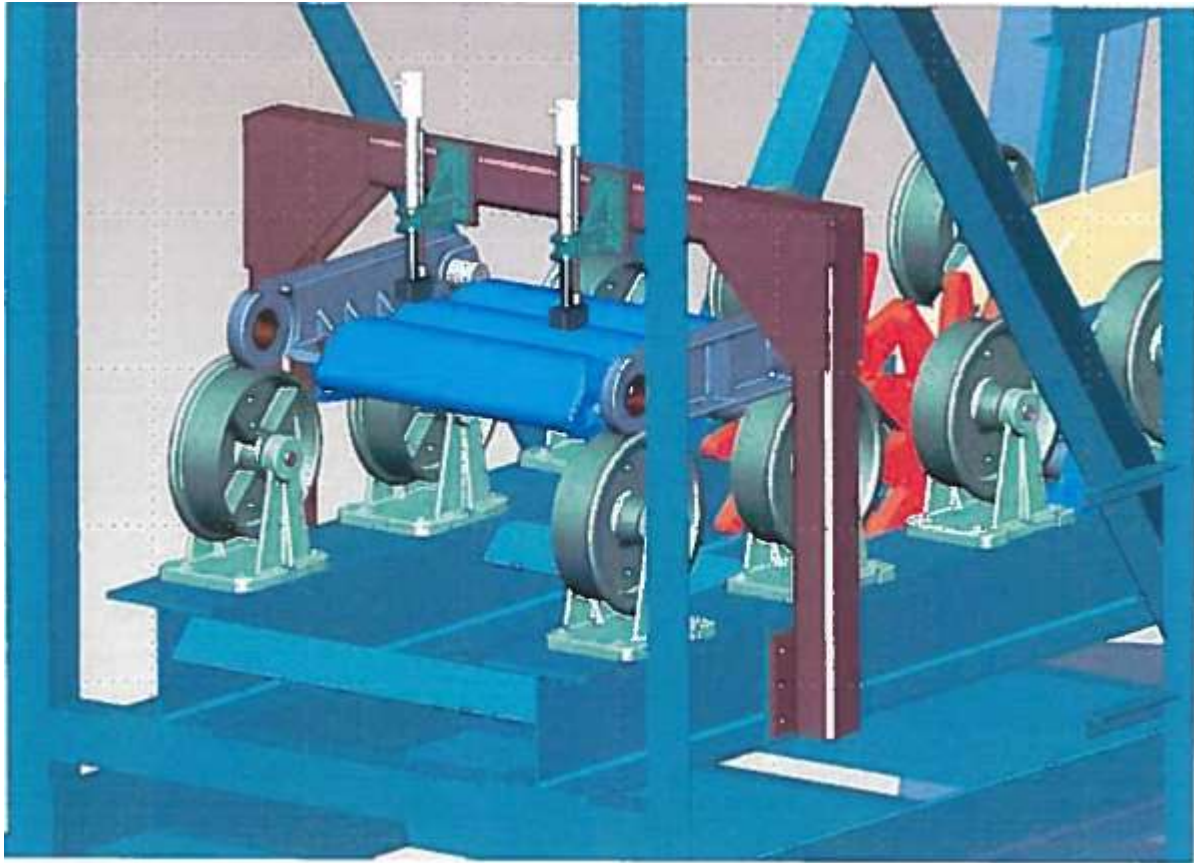
These rails are parallel bars that run underneath the returning strand. They prevent any unreleased pigs from falling onto equipment or personnel. The bars end at the sticker chute, a designated drop-off area where the falling pigs will do no harm and be collected in a tote box or by other means.

### 3.2.8 Automatic Pig Knocker

Two (2) sets of "Automatic Pig Knockers" are provided. Sensors are provided to identify "stickers" (pigs which do not release normally) when identified an air impact pig "knocker" is actuated to remove "stubborn" stickers. This will eliminate "knocking" every mold unnecessarily. For details, see Detail 6 below. A third set of sensors will monitor the final results of the pig knockers and can provide key information on mold performance.



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Detail 6 • Pig Knocker

### 3.2.9 Discharge and Sticker Chute

A pivot-type rocker discharge chute will be provided at the head end to direct the cooled pigs into gondola cars. The chute will be fabricated out of A36 steel and be lined with AIR plate. The rocker chute will be pneumatic operated to divert the pigs to the railroad tracks on either side of the pig casting machine.

Two (2) parallel tracks will be provided by the customer with adequate space for four (4) 100 ton capacity gondola cars on each side of each strand. A railroad car puller will be provided by the customer to move the gondola cars during filling to provide a uniform filling of the cars. Any pigs not released at this area will be pig knocked and released onto the sticker chute and fall onto a collection pan which will also direct the pigs into a parked gondola car. Both of these chutes are open feed and will have hard-faced liners to protect them from wear.

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### **3.2.10 Dry Shot Plate System**

In the pouring region, the hot metal splashes are collected by a dry shot system comprised of the following:

- Track
- One (1) carriage/ transfer car
- Two (2) collecting boxes (packed sand)
- Electrical winch with cables, return pulley and accessories
- Support structure

The traversing of the carriage with each collecting box is a manual operation controlled by a local pushbutton setup provided by Paul Wurth. The collecting boxes will be removed and emptied utilizing a fork lift that will be supplied by the Customer.

### **3.2.11 Head End Pig Discharge System**

The head end of the pig cast machine is where the pigs are discharged from the molds when turning over at the sprocket wheel and will be guided through a fixed chute to diverter chute.

Note: This chute is shown on general arrangement Drawing ZQ-70558-01.

At the discharge area of the machine, the building crane will be used for maintenance of the sprocket wheel and for mold exchange.

### **3.2.12 Mold Spray System**

The purpose of this mold spray system is to coat the returning molds with an anti-stick slurry. This coating eases release of the pig, and in addition, affords some heat protection to the molds. The strand of the pig caster will be serviced by a mold spray system consisting of the following:

- One (1) pre-mix tank with agitator
- Transfer pumps, from pre-mix to mix tank
- One (1) mix tank with agitator
- Emulsion delivery pumps



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- Piping, valving and accessories

The control of the density of the coating emulsion has to be done manually.

The premix and mix tank equipment will be located on grade as shown on drawing ZQ-70558-01. Also, Super Sacks of the coating material can be stored at this level as well.

Note: Paul Wurth recommends a commercial available pre-mixed material called "Densco" be used. This material is more environmentally friendly and requires less maintenance than older lime slurry coatings. If lime is to be used it must be supplied in 2,000 lb Super Sacks and of proper consistency for mixing with water.

The emulsion preparation consists of the following elements:

- Big bag discharge system for 2,000 lb. Super Sacks
- One (1) screw conveyor dispensing into pre-mix tank

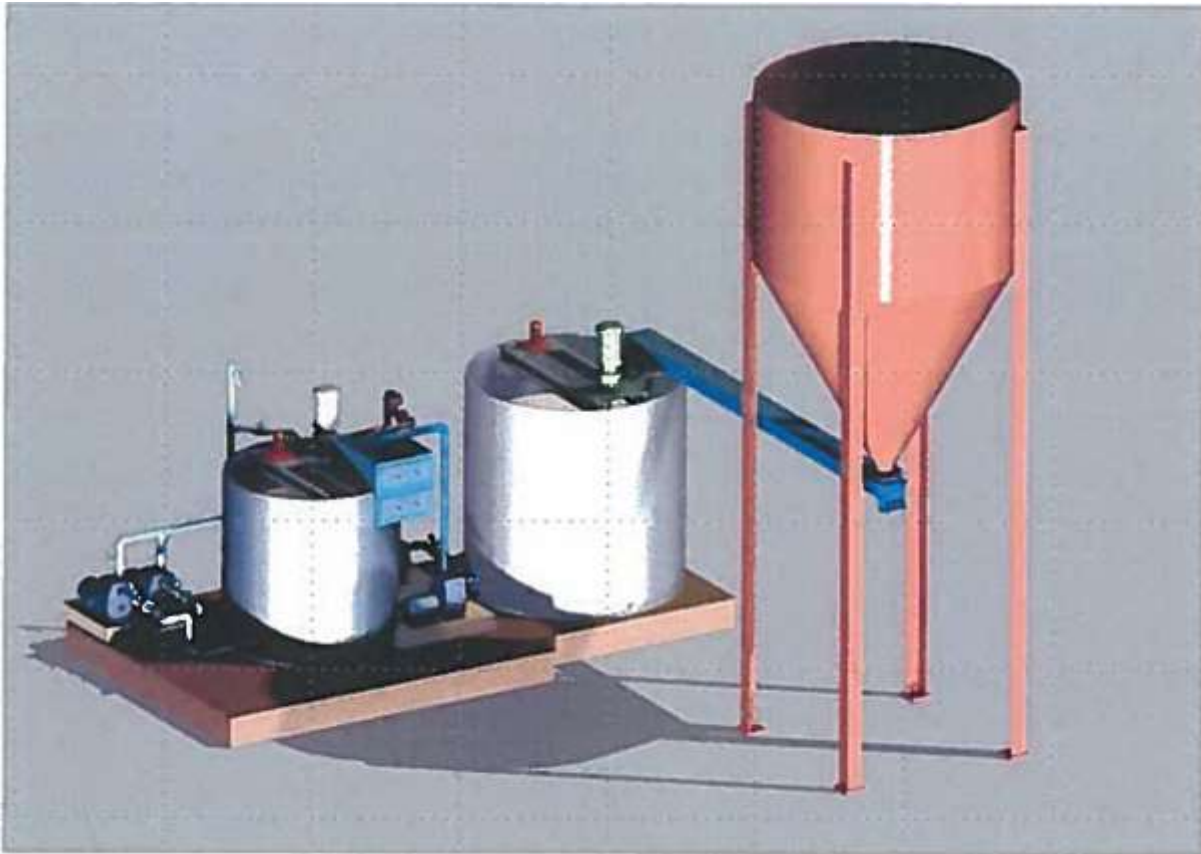
The control of the emulsion preparation facility is an automatic operation controlled by a local pushbutton station. The sack charging will be done by an overhead crane (customer supplied).

After operation, the system has to be cleaned with fresh water and the remaining material needs to be removed to prevent clogging in the installation.

The consumption of the coating material is approximately four (4) pounds per ton of hot metal. The capacity of one (1) sack is about 500 t of cast pig iron. For details on the Mold Spray System layout, see Detail 7 below.

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**Detail 7 - Mold Spray System**

### **3.2.13 Mold Drying System**

The mold drying heaters are used to eliminate humidity and water from the mold coating prior to casting. The system will be comprised of the following independent elements:

- control system for drying (automatic ignition and flame detecting)
- burners with associated valving and piping

The burners have a capacity of approximately 70 kW. In case of natural gas feed with a calorific value of 54 kJ/g, this corresponds to a consumption of 6.8 cu m/hr. at a required minimum pressure of 2 Bar.

### **3.2.14 Water Cooling System - Pig Machine Proper**

The water cooling system expedites the pig cooling. They consist of spray headers with off-takes for the sprays.

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For the most efficient cooling of the pigs, we utilize an air/water atomizing nozzle spray system similar to the equipment found on continuous casters. This nozzle arrangement requires a filtered water system.

Each air/water header is equipped with a solenoid valve that will be controlled by the PLC to sequence on and off as the molds enter the water cooling spray area. The small percentage of the water not evaporated will return through an overflow basin to a water return tank to separate particulates and then be filtered and pumped back through the spray nozzles.

The amount of water required for the water/air spray system is approximately 1,675 Lpm at 5.0 Bar and 800 scfm of Compressed air at 3.0 Bar.

The conveyor strand will have approximately 55 air/water nozzles.

Water spray nozzles are also placed underneath the molds to cool the molds and provide a more uniform thermal distribution in the molds, improving mold life. Approximately 24 hydraulic spray nozzles will be used to cool the molds. The amount of water required is approximately 110 Lpm at 3.0 Bar.

The water from the sprays that does not evaporate will be captured by the water trough below the upper strand of the pig caster and be directed to the catch basin.

In normal conditions the cooling system will have no overflow.

The water supply system will have to be monitored in regular intervals by the customer.

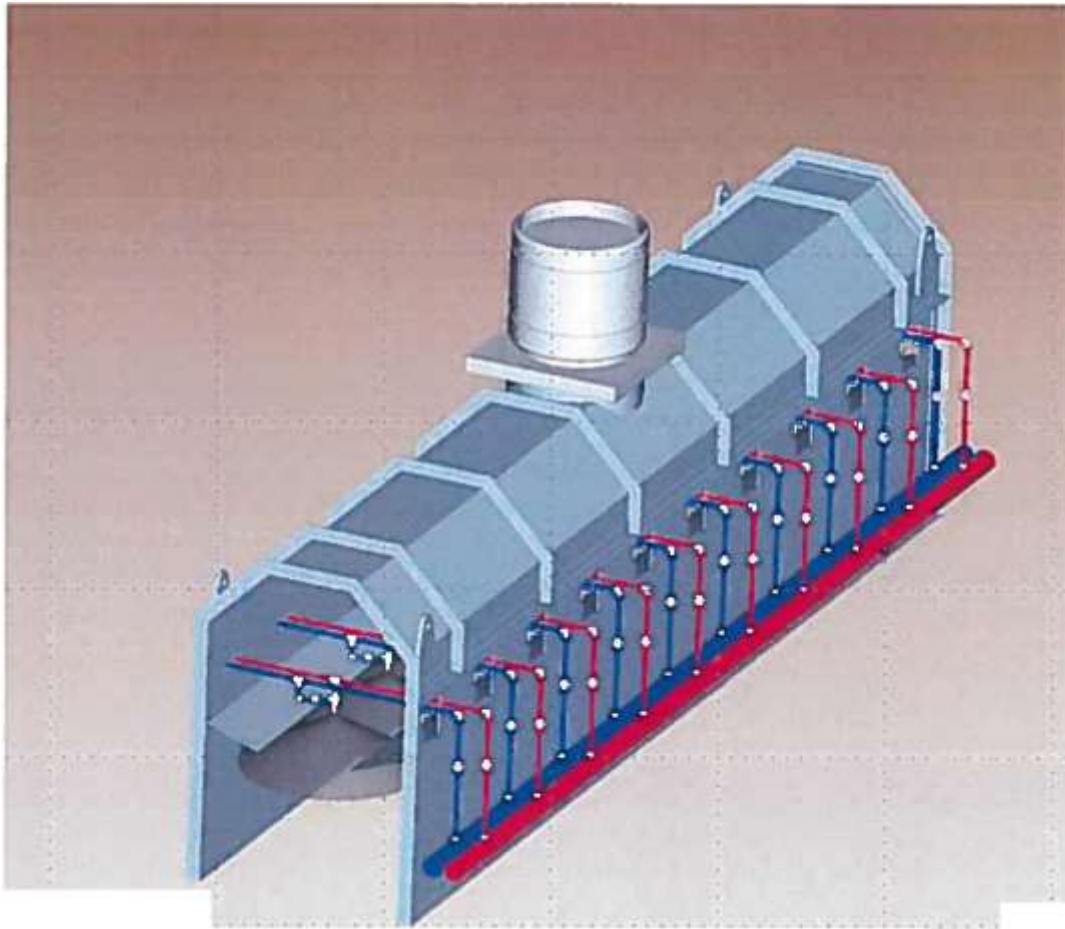
### **3.2.15 Steam Hoods and Blowers**

The exhausting of steam from water cooling will be provided over the pig machine proper. Hoods over these areas (approximately 5) will be supplied to efficiently exhaust steam from the cooling pigs and pig molds. For details on the hoods, see Detail 8 below.



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Detail 8 - Steam Hoods

### 3.2.16 Walkways and Platforms

Walking and platforms on and around the machine are located here:

- 1) There are 42" wide walkways on each side of the strand; one (1) at the advancing chain elevation and one (1) at the returning chain elevation
- 2) There is a working platform at the head sprocket and a working platform at the tail end lauder elevation with removable sections to access the tail sprocket
- 3) There are also intermediate maintenance walkways between the strands at both advancing and returning chain elevations, furnished by customer.

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- 4) Walkways and platforms in the center of both strands they will house the control station and mold spray system, will be furnished by customer.

### 3.2.17 Piping and Instruments

All of the on board piping, including air and water, will be provided and installed as much as possible on the machine in the assembly shop. Any piping and hose connections required to the machine between sections will have to be made by the installation contractor. NOTE: The same will be true for the instrumentation; any instruments (on board) that can be mounted prior to shipment will be and all others will be shipped loose.

The interconnecting pipe supply runs for water, air and mold spray system will not be provided by Paul Wurth. It will be the responsibility of others.

In summary, Paul Wurth's battery limits are limited to the physical boundaries of the machine; anything outside of that box will be the responsibility of others.

### 3.2.18 Recirculation Water system

A recirculation type water system is provided to recycle the cooling water spray system. There will be excess water that does not evaporate and will be collected by a series of water pans under the machine proper. The water collected will then be drained by gravity to a concrete sump area. The sump area will separate out the large particles by a weir where it can be cleaned out at a later time. The overflow area of the sump will have a single sump pump where it will pump that water out to a holding tank . The water level in the tank will be maintained by using make-up water (city water only). From the tank two (2) in- line pumps will be provided with media strainers upstream to ensure clean water reaches the spray headers. Note: Plant water should not be used in this application.

## 3.3 Control Room (By Customer)

Paul Wurth is proposing an electrical/control room in the position as shown on the layout drawing. The electrical and MCC building to be provided by the Customer. Paul Wurth will foresee a platform to the strand area of the machine, accessible from the control room. From this platform it is possible to observe the molten metal flow to the strand from an optimum position.

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- Higher operator comfort because the available space allows a bigger control room
- Less heat radiation to the control room is also increasing the comfort of the operator
- The cabling does not need to pass the hot metal pouring area and thus diminishes the risk of cable burning
- Area of lower risk being further from the molten iron
- Emergency exit is escaping directly away from the machine

### 3.4 Electrical System

#### 3.4.1 Automation Overview

The automation system for control and operator interface will be based upon a Siemens automation platform.

The automation system will be based upon the Siemens S7-315 PLC processor. To minimize wiring cost, ET200S RIO architecture will be used for the Main Control Panel (PLC) and Local Control Desk (LCD). The ET200S modules will eliminate the need for terminal blocks as devices can be wired directly to the ET200S modules except where interposing relays are used on ET200S outputs.

To further reduce I/O, an intelligent MCC, furnished by customer, has been incorporated in our design.

The operator will be able to control the equipment from the following locations:

- Local Control Desk (LCD) - Via Siemens MP277, 10" HMI and with limited control via operator devices. From the HMI mounted in the console, the operator will be able to start/stop mold conveyor, water system, coating system, and burners. The HMI will be programmed with WinCC Flexible to display the following general screens:
  - a Supervisory screen
  - o Control selections screen
  - o Equipment status screen
  - a Alarming screens (active and historical)
- Local Control Panel (LCP1) - Via operator devices. LCP1 will allow local control of;
  - a Coating Pumps

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- o Mixing Device
- o Screw Conveyor
- Local Control Panel (LCP2) - Via operator devices. LCP2 will allow local control of;
  - o Recirculation Pumps
- Local Push Button Station (LPB 1-10) - Via operator devices. LPB will allow local control of;
  - o Local motor control

The list of electrical and control components that Paul Wurth will furnish as part of this proposal is a preliminary list and some quantities may change based on final design considerations.

### 3.4.2 1/0 Count

#### 3.4.2.1 General Parameters

The following general parameters were used in the calculation for 1/0 count.

<b>General Parameters</b>			
Percent of Spare 1/0 points required	15%		
Percent of Contingency 1/0 points required	5%		
1/0 points per DI Card	8		ET 200S
1/0 points per DO Card	8		ET 200S
1/0 points per AI Card	4		ET200S
1/0 points per AO Card	2		ET 200S
1/0 points per RTD Card	4		ET 200S
1/0 points per TC Card	2		ET 200S
Max FB points per Network	64		Profibus

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The following I/O count has been tabulated based upon: field Instruments, MCC, control desk and local control panels;

	01	DO	AI	AO	RTD	TC	FB	Total I/O
MCC Feeders and Mains	10							10
Main PLC Panel Aux power monitoring	30							30
Control desk	16	10					1	27
(10) LCP's	20	10						30
Recirc Pump LCP	8	4						12
Coating Pump LCP	22	6						28
Field Instruments	40	160	8	2				210
MCC							1	1
<b>Sub-Total Calculated I/O points</b>	<b>146</b>	<b>190</b>	<b>8</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>348</b>
5% Contingency	8	10	1	1	0	0	1	
15% Spares	22	29	2	1	0	0	1	
<b>Total Required I/O points</b>	<b>176</b>	<b>229</b>	<b>11</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>424</b>
Number of Modules	22	29	3	2	0	0	1	
<b>Installed I/O points</b>	<b>176</b>	<b>232</b>	<b>12</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>425</b>

### 3.4.3 Electrical and Control Equipment

#### 3.4.3.1 Quantity (1) Main Control Panel (PLC)

Free standing steel panel housing the following components installed, wired and tested;

- Siemens S7-315 PLC processor (non-duplex) complete with, rack, power supply, Profibus & Ethernet communication
- ET200S RIO Rack complete with; rack, power supply, Profibus communication



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- Ethernet switch
- Ancillary control devices such as; circuit breakers, fuses, relays, terminal strips

The PLC program will be fully documented, with electrical reference annotations. The PLC equipment will include 15% spare memory and 1/0.

#### 3.4.3.2 Quantity (1) Local Control Desk (LCD)

Carbon steel console enclosure which will come with approximately 24 operator devices such as pushbuttons and pilot lamps be wired to the RIO block inside of the console and one (1) industrial HMI.

#### 3.4.3.3 Quantity (1) Local Control Panel (LCP1)

Carbon steel, wall mount enclosure, approximately 30" x 36", which will house approximately 30 operator devices such as pushbuttons, selector switches and pilot lamps. These operator devices are to be hardwired back to the RIO block inside of the LCD console or PLC control panel to be determined during detailed design based on shortest cable distance.

#### 3.4.3.4 Quantity (1) Local Control Panel (LCP2)

Carbon steel, wall mount enclosure, approximately 12" x 16", which will house approximately 12 operator devices such as pushbuttons, selector switches and pilot lamps. These operator devices are to be hardwired back to the RIO block inside of the LCD console or PLC control panel to be determined during detailed design based on shortest cable distance.

#### 3.4.3.5 Quantity (10) Local Push Button Stations (LPB 1-10)

Carbon steel, 3-button enclosure, which will house 3 operator devices such as pushbuttons and a selector switch. These operator devices are to be hardwired back to the RIO block inside of the LCD Control Panel or PLC control panel to be determined during detailed design based on shortest cable distance.

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#### 3.4.3.6 Quantity (1) Engineering Workstation

One (1) desktop computer will be supplied for engineering purposes. The computer will allow engineering to modify and test changes made to the PLC and HMI programs. The computer will come with the following major components

- Desktop computer complete with 22" monitor, keyboard, mouse
- Development licenses for
  - Operating System - Windows
  - PLC - Step 7 Professional
  - HMI - WinCC Flexible

#### 3.4.3.7 Quantity (1) Intelligent Motor Control Center (MCC), (furnished by customer)

The Intelligent MCC will be a free standing steel cabinets, to be installed inside an electrical room. The following items will be housed in the MCC: variable frequency drivers, circuit breakers, contactors, power distribution block and terminal strips. A remote I/O inside the MCC will also be provided.

The TOP for the 600 V voltage will be at the panel main inlet circuit breaker. Customer will supply one (1) wall mounted air conditioner to be installed in the common control/electrical room.

#### 3.4.3.8 Quantity (1) Transformer, by customer

100 kW light transformer (one (1) transformer for the pig machine and the cast area) and a 15 kW control transformer are foreseen.

#### 3.4.3.9 Quantity (1) Light Distribution Panel, by customer

The distribution panel will come with; eight (8) different light circuit breakers will cover the requirement of both machines and the cast area.

#### 3.4.3.10 Quantity (1 lot) Local Disconnects

The offer also includes a local disconnect for each motor for maintenance purposes including main strand motor drives and mold spray operation panel for pumps and screw conveyor.

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#### 3.4.3.11 Quantity (1 lot) Instrumentation

The instrumentation includes level transmitters for the tanks and speed transmitters for the strands; natural gas ignition system and flame detection for the drying system; flow switches and pressure switches for the water and coating system will also assist in the monitoring of the plant operation.

### 3.5 Documentation

Paul Wurth will supply the following documentation:

#### **Equipment Manuals**

Paul Wurth will furnish an operating and maintenance manual that will consist of a description of the machine and its components in a step-by-step description for the operation on how to operate the pig caster and how the maintenance should be performed.

#### **Electrical Drawings**

##### Type of Drawings

- Digital 1/0 schematics
- Arrangement drawings with bill of material
  - o **Main** Control Panel (PLC)
  - o Local Control Desk (LCD)
  - o Local Control Panel (LCP1)
  - o Local Control Panel (LCP2)
  - o Local Push Button Stations (LPB 1-10)
  - o Engineering Workstation
- Main control panel layout drawing with bill of material
- Single line drawing
- Power schematics (3 Line)
- 440/120/24 volt power and control schematics
- Equipment location drawings

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**Process Drawings:**

Type of Drawings

- Flowsheet of the water cooling system
- Flowsheet of the coating system
- Flowsheet of the mold drying system

**Mechanical Drawings:**

Type of Drawings

- Layout and general arrangement drawings
- Assembly and Sub assembly drawings with material lists
- Arrangement and section drawings of the piping
- Erection drawings for the steel structure and roofing
- Drawings and specifications of components from sub suppliers according to sub supplier standard

**Civil Drawings:**

Type of Drawings

- Basic design drawings for civil works
- Foundation loads drawings

**Drawings of Wear Parts:**

- Detail drawing of pfg discharge chute lining
- Detail drawings of splash and heat protections
- Detailed drawing of the pig iron launder
- Detail drawing of the tilting tundish
- Detailed drawing of the shot box

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### 3.6 Civil

All civil works including engineering will be supplied and executed by the client based on the basic engineering details supplied from Paul Wurth. Basic engineering design of anchor bolts and metallic inserts will be provided by Paul Wurth.

The civil work includes following items

- Foundations
- Common control and electrical room including supporting structure and access stairs
- Water tanks of the cooling water circuit and sumps
- Pig discharge bunkers (if required)

### 3.7 Electro-Mechanical Erection

The civil works are not included in the scope of the mechanical-electrical erection works and have to be done by the customer. This includes foundations, concrete structures and rooms, concrete tanks, protection of steel structures and refractory material and erection.

#### 3.7.1 Estimated Quantities

The estimated quantities for each machine are as follows:

The weight for the runner system with its access platforms and stairs in the cast building is approximately 45 t.

The weight of the steel structure and mechanical supply for the pig caster installation proper is 185 t ( including the pouring area and head end and tail end stairwells and all intermediate steel platform structure).

The following steel structure around the caster will be the responsibility of the customer. The details are as follows:

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A) Pour End Structure

1. Steel Structure	11,350 kg.
2. Grating	60 Sq.m
3. Handrail	10 m

8) Pour End Stair Tower

1. Steel Structure	6,500 kg.
2. Stair Treads	26 total
3. Tie-In Grating	12 Sq. m
4. Handrail	42 m

C) Intermediate Platform Stairs and Structure

1. Steel Structure	7,400 kg.
2. Stair Treads	24 total
3. Grating	65 Sq. m
4. Handrail	48 m

D) Head End Structure

1. Steel Structure	15,500 kg.
2. Grating	32 Sq. m
3. Handrail	24 m

E) Head End Stair Tower

1. Steel Structure	11,150 kg.
2. Stair Treads	48 total
3. Tie-in Grating	18 Sq.m.
4. Handrail	64 m

F) Piping and electric cabling is estimated to following quantities per machine:

- piping approximately 8 t
- electric cables approximately 12 m/ per machine

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G) Plant/Equipment & Power Requirements

<b>ELECTRICITY</b>		
Main Drive Motor	Kw	32.5
Ladle Tilter Hydraulic Drive Motor	Kw	35
<b>Standard components</b>		
Mold Coating Powder Screw Conveyor	Kw	1.5
Coating Premix Tank Pump Motor	Kw	1.5
Coating Premix Tank Mixer Motor	Kw	0.5
Coating Mix Tank Pump 1 Motor	Kw	1.5
Coating Mix Tank Pump 2 Motor	Kw	1.5
Coating Mix Tank Mixer Motor	Kw	0.5
Pig cooling Spray water Pump 1 Motor	Kw	20
Pig cooling Spray water Pump 2 Motor	Kw	20
Mold Heating Burner Air Fan Motor	Kw	0.5
Mold Cleaning Air knife Motor	Kw	1
Shot Box Mover Motor	Kw	2.5
Operating Power Required =	Kw	96.99
<b>WATER</b>		
Water for Pig Cooling & Mold Coating Mixing		
General Evaporation factor	%	10%
Flow	LPM	3181
Pressure	psig	55.00
<b>COMPRESSED AIR</b>		
Compressed air for Pig Cooling and Mold Coating		
General air loss factor	%	10%
Flow	scfm	1591.7
Pressure	psig	30

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H) List of consumables and consumption rates

Electricity	kw-hr/t	0.970
Price of Electricity	\$/Kw-h	\$0.08
Operating cost Electricity	\$/t	\$0.08
Mold Spray Coating Material	lbs/t	4
Mold Spray Coating Material Cost	\$/tm	\$400.00
Mold Spray Coating Material cost	\$/t	\$0.80
Water	L/t	1909
Cost of Water	\$/L	\$0.0020
Total Water Cost	\$/t	\$3.82
Compressed Air	scf/t	955
Compressed Air Cost	\$/Ksd	\$0.20
Compressed AIR Cost	\$/t	\$0.19
Grease (main Bearings only)	cm <sup>3</sup> /t	0.0125
Grease Cost	\$/ cm <sup>3</sup>	\$5.00
Grease Cost Main Bearings	\$/t	\$0.0625
Grease Stationary Wheels	cm <sup>3</sup> / t	0.000941667
Grease Cost	\$/ cm <sup>3</sup>	\$5.00
Grease Cost Stationary Wheels	\$/t	\$0.0047
Mold Consumption	Kg/t	0.080
Mold Cost	\$/Kg	2.50
Mold Scrap Credit	\$/kg	0.25
Mold Operating Costs	\$/t	\$0.18
<b>Personnel</b>		
Machine Operator	m-hr/t	0.02
Assistance Machine Operator	m-hr/t	0.02
Maintenance Personnel	m-hr/t	0.02
Cost per man -hour	\$/m-hr	\$100.00
Personnel	\$/t	\$5.26
Total Operating Costs	\$/t	\$10.39



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### **3.7.2 Client's Responsibility**

- To indicate the existing topographical boundaries for the execution of the services, when necessary
- To supply the civil works for the installation of the pig casting machine, including electrical building and control room and electrical grounding
- To present a copy of the topography reports and soils report for foundation design
- Disassemble/demolish construction that is in the future area of the plant and construction area
- Electric power (600 V), water and natural gas take-over points to be incorporated in the various utility drawings
- Supply all engineering and material related to site drawings
- The customer is responsible for all construction and erection of Paul Wurth-supplied equipment.

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## **4 TRAINING**

Training shall be provided at an additional cost. Training is normally foreseen as classroom training for operation and maintenance of the equipment. Time duration of training to be determined once customer input is provided.

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## **5 SITE ASSISTANCE**

Site assistance shall be provided at an additional cost. Paul Wurth recommends that one (1) man will be needed for four (4) weeks, ten (10) hours per day, one (1) shift per day, six (6) days per week.

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## 6 COMMISSIONING ASSISTANCE

Commissioning assistance shall be provided at an additional cost. Paul Wurth recommends that two (2) men will be needed for two (2) weeks, ten (10) hours/day, two (2) shifts per day, six (6) days per week.

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## **7 SPARE PARTS**

Later.

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## 8 SUMMARY

Paul Wurth, including the Bailey Engineering Technology , has designed and manufactured over 123 pig casting machines, ranging from 15 ft. (4.6 m) to 230 ft. (70.1 m) in length, single and double strand.

Many of our machines have been installed worldwide and have been running for years. The Paul Wurth<sup>0</sup> machine design incorporates strength and reliability in the most demanding of applications.

Paul Wurth stands behind each installation and will assist the customer during the start-up and commissioning phase and provide maintenance support for each product and project.

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## 9 SCOPE OF SUPPLY

The scope of supply is described in the list here below:

### Legend

- BE Basic Engineering including assembly and sub-assembly drawings, excluding static calculations
- DE Detail Engineering and manufacturing drawings, including static calculations and material lists
- SU Manufacturing and Supply
- ER Erection
- C CUSTOMER
- PWA PAUL WURTH AUTOMATION, CANADA
- PWU PAUL WURTH U. S.

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SCOPE OF SUPPLY FOR ONE (1) PIG CASTING INSTALLATION (2 PIG CASTING MACHINES WILL BE SUPPLIED)							
Item	Description	Quantity	BE	DE	SU	ER	
<b>1</b>	<b>Cast Area and Hot Metal Handling</b>						
1.1	Pig Caster Building	1	C	C	C	C	
1.2	15 T Pig Caster Maintenance Crane	1	PWU	C	C	C	
1.3	240 T Ladle Tilting Device	1	PWU	PWU	PWU	C	Complete unit
1.3.1	Civil Support for Ladle Tilting Device	1	PWU	PWU	C	C	By Customer
1.4	Structural Support for ladle Tilting Device	1	PWU	PWU	PWU	C	
1.4.1	Ladle Tilter Hydraulic System	1	PWU	PWU	PWU	C	
1.4.2	Control Room	1	PWU	C	C	C	By Customer
1.4.3	Ladle Handling Building	1	C	C	C	C	
1.4.4	250 T Ladle Crane	1	C	C	C	C	
1.5	Roof and Structure at Pouring End	1	PWU	PWU IC	C	C	Part of customer building
1.6	Hot Metal Feed Launder (From Ladle Tilter to Pig Casting Machine)	1	PWU	PWU	PWU	C	Refractory not Included; by Customer - no spare
1.7	Pig Caster Launder Refractory	1	PWU	PWU	C	C	By Customer
1.8	Pouring Platform with access stairs and platforms	1	PWU	PWU	C	C	By Customer
1.9	Maintenance Overhead Crane	1	PWU	PWU	C	C	In Bldg.
1.10	Dedusting Hood (excludes duct)	1	PWU	PWU	PWU	C	At pour end
1.11	Shot Removal System (Dry)	1 Lot	PWU	PWU	PWU	C	
1.12	Stair Tower (tail end)	1	PWU	PWU	C	C	By Customer
1.14	Slag Dam (on ladle)	Lot	PWU	PWU	C	C	By Customer
<b>2</b>	<b>PIG CASTING MACHINE PROPER</b>						
2.1	Supporting Steel Structure with Walkways, Handrails and Access Stairways per module	1 Lot	PWU	PWU	PWU	C	
2.1.1	Intermediate support structure, including walkways and support steel that supports machine	1 Lot	PWU	PWU	C	C	By Customer
2.2	Chain System, Links, Bushings per strand	1 Lot	PWU	PWU	PWU	C	
2.3	Molds (per strand)	496	PWU	PWU	PWU	C	
2.4	Chain Support with fixed wheels	1 Lot	PWU	PWU	PWU	C	
2.5	Sprocket Wheels	4	PWU	PWU	PWU	C	
2.7	Shot Removal System (Ory)	1 Lot	PWU	PWU	PWU	C	
2.8	Sticker Rails	1 Lot	PWU	PWU	PWU	C	
2.9	Sticker Discharge Chute	1	PWU	PWU	PWU	C	
2.10	Water Catch Basin (Concrete basin)	1	PWU	C	C	C	By Customer
2.11	Air Knife	1	PWU	PWU	PWU	C	



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SCOPE OF SUPPLY FOR ONE (1) PIG CASTING INSTALLATION (2 PIG CASTING MACHINES WILL BE SUPPLIED)							
Item	Description	Quantity	BE	DE	SU	ER	
2.12	Splash Guards	Lot	PWU	PWU	PWU	C	Incl. AIR plate
2.13	Pig Knocker	2	PWU	PWU	PWU	C	
2.14	Pivot Type Discharge Chute {pneumatic oerated)	1	PWU	PWU	PWU	C	Includes AIR Wear Plate
2.15	AC VWF Drive and Motor	1	PWU	PWU	PWU	C	
2.16	Motor Coupling	1	PWU	PWU	PWU	C	
<b>3</b>	<b>PIG DISCHARGE AREA</b>						
3.1	Structure at Head and Tail End with access platforms and stairs for maintenance	1	PWU	PWU	C	C	
3.2	Discharge Chute without Diverter (pivot tvoe)	1	PWU	PWU	PWU	C	Includes Wear Plate
3.3	Sticker Chute / Catch Pan	1	PWU	PWU	PWU	C	Includes AIR Wear Plate
3.4	Monorail Beam and Hoist to Remove Molds and Maintain Drive Sprocket Wheel	1	PWU	PWU	C	C	1 per strand - jib crane style
3.5	Stair Tower & Structure (Head End)	1	PWU	PWU	C	C	By Customer
3.6	Gondola R/R car	5	-	-	C	C	
3.7	Railroad trackwork	lot	PWU	C	C	C	
<b>3.8</b>	Railroad car puller	1	PWU	C	C	C	
<b>4</b>	<b>MOLD COATING SYSTEM</b>						Coating Material in super sacks (supplied by Customer)
4.1	Dry Coating Powder Super Sack Discharge Svsstem with Screw Convevor	1	PWU	PWU	PWU	C	
4.2	Pre-mix Tank	1	PWU	PWU	PWU	C	
4.3	Pre-Mix Tank Mixer	1	PWU	PWU	PWU	C	
4.4	Pre-Mix Tank Transfer Pumps	2	PWU	PWU	PWU	C	
4.5	Mix Tank	1	PWU	PWU	PWU	C	
4.6	Mix Tank Pumps	2	PWU	PWU	PWU	C	
4.7	Mix Tank Mixers	1	PWU	PWU	PWU	C	
4.6	Spray Nozzles	1 Lot	PWU	PWU	PWU	C	
4.7	Dry Coating Powder Silo	1	PWU	PWU	PWU	C	
4.8	Cooling Catch Basin with Door	1	PWU	PWU	<b>PWU</b>	C	Contains overspray
4.9	Mold Coating System Platfonn	1 Lot	PWU	PWU	C	C	
4.10	Interconnecting Pipe	1 Lot	PWU	C	C	C	

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SCOPE OF SUPPLY FOR ONE (1) PIG CASTING INSTALLATION (2 PIG CASTING MACHINES WILL BE SUPPLIED)							
Item	Description	Quantity	BE	DE	SU	ER	
<b>5</b>	<b>MOLD DRYING SYSTEM</b>						
5.1	Heater - Mold Drying System	1	PWU	PWU	PWU	C	Uses natural Qas
<b>6</b>	<b>WATER-COOLING SPRAY SYSTEMS AND HOODS (MACHINE PROPER)</b>	1 system per machine					
6.1	Atomizing Nozzles	1 Lot	PWU	PWU	PWU	C	Assembled on sections
6.2	Pig Caster Spray Water Piping	1 Lot	PWU	PWU	PWR	C	Assembled on sections
6.3	Air/Water Solenoid Control Valves	1 Lot	PWU	PWU	PWR	C	Assembled on sections
6.4	Water Recirculation Tank and Overflow Tank in Concrete	1 Lot	PWU	PWU IC	C	C	Tanks in concrete
6.5	Water recirculation System Pumps	2	PWU	PWU	C	C	
6.6	Spray Hoods with Exhaust Duct Connection Spool	12	PWU	PWU	PWU	C	Assembled on sections
6.7	Air/Water Piping (on board PW Equipment only)	Lot	PWU	PWU	PWU	C	Assembled on sections
<b>7</b>	<b>PIG CASTING MACHINE DEDUSTING &amp; STEAM EXHAUST SYSTEM</b>	1 common system					
7.1	Fume Extraction Hood with supporting structure	1	PWU	PWU	PWU	C	At pour end
7.2	Connection of Hood to Building, Ducts, Suooorts, Dampers, Control...	1	PWU	C	C	C	
7.3	Steam Exhaust Fan w/damper	5	PWU	PWU	PWU	C	
7.4	Steam Exhaust Ductwork	Lot	PWU	PWU IC	C	C	
7.5	Steam Exhaust Duct and Fan support steel	Lot	PWU	PWU	C	C	
<b>8</b>	<b>ELECTRICAL EQUIPMENT (Within Batterv Limits of Machine)</b>	Common for both machines					
8.1	Incoming Power Distribution	1	PWA	PWA	C	C	
8.2	Intelligent Motor Control Center (MCC)	1	PWA	PWA	C	C	
8.3	VVVF Motors and Drives	1	PWA	PWA	PWA	C	
8.4	Transformer	1	PWA	C	C	C	
8.5	Main Control Panel (PLC)	1	PWA	PWA	PWA	C	
8.6	Local Control Desk (LCD)	1	PWA	PWA	PWA	C	
8.7	Local Control Panel (LCP1)	1	PWA	PWA	PWA	C	
8.8	Local Control Panel (LCP2)	1	PWA	PWA	PWA	C	
8.9	Local Push Button Stations (LPB 1-10)	10	PWA	PWA	PWA	C	
8.10	Engineering Workstation	1	PWA	PWA	PWA	C	

Customer : Tenova CORE - USA Project  
 Project: : One 100 TPH Single Strand Pig Casters  
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SCOPE OF SUPPLY FOR ONE (1) PIG CASTING INSTALLATION (2 PIG CASTING MACHINES WILL BE SUPPLIED)							
Item	Description	Quantity	BE	DE	SU	ER	
8.11	Field Instrumentation	1 Lot	PWU	PWA	PWA	C	
8.12	Light Distribution Panel	1	PWU	PWA	C	C	
8.13	Local Disconnects for Motors	1 Lot	PWA	PWA	C	C	
8.14	Cabling and Installation Material	1 Lot	PWA	PWA	C	C	
8.15	Central Control Room	1	PWA	PWA	C	C	
8.16	On Machine Wiring	Lot	PWA	PWA	PWA	C	
<b>9 CIVILS</b>							
9.1	Foundations	1 Lot	PWU	C	C	C	By Customer
9.2	Water recirculation tank for pig cooling system	1 Lot	PWU	C	C	C	By Customer
9.3	Control, Electric and Sanitary Room with Access Stair and Suooorting Structure	1	PWU	C	C	C	By Customer
9.4	Metal Inserts and Anchor Bolts	1 lot	PWU	C	C	C	By Customer
9.5	Walkways and Handrails	1 Lot	PWU	C	C	C	
9.6	Lubrication and Inspection Work Platforms	1 Lot	PWU	C	C	C	
9.7	Pouring Platform	1	PWU	C	C	C	
9.8	Access Stairways	1 Lot	PWU	C	C	C	
9.9	Automatic Lubrication System (Optional)	1 Lot	PWU	C	C	C	Not included in base
<b>10 PLANT AIR SUPPLY</b>							
10.1	Complete Plant Air System and Piping for maintenance points		PWU	C	C	C	By Customer
10.2	Pig Machine Air Pipe on Machine up to T.O.P. close Pig Machine		PWU	PWU	PWU	C	
10.3	Preparation of dry air suitable for valve actuation		PWU	C	C	C	By Customer
10.4	Instrumentation	Lot	PWU	PWU	PWU	C	Limited to on-board suoolv
<b>11 WATER SUPPLY</b>							
11.1	Complete Water Supply System including Water Filtration up to T.O.P. close Pig Machine and piping for maintenance points		PWU	C	C	C	By Customer
11.2	Water Interconnecting Pipe		PWU	C	C	C	
11.3	Slurry Pipe		PWU	C	C	C	Interconnecting
<b>12 NATURAL GAS SUPPLY</b>							
12.1	Complete Gas Supply System and Piping for maintenance points uo to machine	1 Lot	PWU	C	C	C	By Customer
12.2	Pig Machine Gas Pipe on Machine up to T.O.P.	1 Lot	PWU	PWU	PWU	PWU	

Customer : Tenova CORE- USA Project  
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SCOPE OF SUPPLY FOR ONE (1) PIG CASTING INSTALLATION (2 PIG CASTING MACHINES WILL BE SUPPLIED)							
Item	Description	Quantity	BE	DE	SU	ER	
<b>13</b>	<b>MANUALS</b>						
13.1	Erection Manual	1	PWU	PWU	PWU	-	
13.2	Operation Manual	1	PWU	PWU	PWU	--	
13.3	Maintenance and Repair Manual	1	PWU	PWU	PWU	-	
13.4	As-build Drawings	Lot	PWU	PWU	PWU	-	
<b>14</b>	<b>WATER SUPPLY &amp; RECIRCULATION SYSTEM</b>						
14.1	Water Sump (made of concrete)	1	PWU	C	C	C	
14.2	Sump Pump	1	PWU	PWU	C	C	
14.3	Interconnecting Water Piping	1 Lot	PWU	C	C	C	
14.4	Water Recirculation tank	1	PWU	PWU	PWU	C	
14.5	Water Recirculation Pumps and Filters	2 ea.	PWU	PWU	PWU	C	Interconnecting Only
<b>15</b>	<b>CONSTRUCTION ENGINEERING</b>						By Customer
<b>16</b>	<b>INSTALLATION</b>						By Customer
<b>17</b>	<b>ERECTION SUPERVISION/ STARTUP/ COMMISSIONING</b>						Not included in base offer

Customer : Tenova CORE - USA Project  
Project: : One 100 TPH Single Strand Pig Casters  
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## **10 PROJECT PLANNING**

Paul Wurth will require drawings of the ladle, building and overhead crane span in order to finalize the engineering details.

Customer : Tenova CORE - USA Project  
Project : One 100 TPH Single Strand Pig Casters  
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## 11 BATTERY LIMITS

Excluded from the Seller's scope of services and supplies are:

- Grease Lubrication system
- Ladle(s) and all overhead cranes, gondola cars
- Switchgear, Motor Control Center (MCC), cable trays and interconnection wiring that is not on-board the equipment in the Scope of supply. The supply of VSD packages to be installed in **MCCs**.
- Piping supports
- Ducting outside of the Pig Casting Machine enclosure and gas handling equipment, including baghouse, scrubber, etc.
- Foundation and steel support
- Control room
- All utilities, water, sewer, gases and incoming electrical power
- Civil Works
- Excavation and foundations
- Electrical building and control room
- Electrical power and water supply during erection
- Compressed air supply
- Refractory and refractory installation
- Heat tracing and insulation of pipes
- Field surveying
- Building permits
- Building services
- First oil and lubrication fill
- Mold coating material
- Commissioning spares
- Operational spares
- Steam exhaust duct detail engineering and supply
- Environmental permits
- Dedusting System supply including dedusting hood

Customer : **Tenova CORE - USA Project**  
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- Fork Lift
- All environmental control
- Detailed drawings of equipment other as specified in this document and technical calculations
- As built, updating of technical documentation of any components, equipment or facilities that have not been affected directly by the Pig Casting Machine installation
- Power supply and all and any necessary inputs for execution of cold and hot tests, start up, operation/ performance tests, and assembly
- Topographical marks
- Any service, software or material that comes to be necessary for adaptation, updating, equipment compatibility, systems or existing facilities to receive equipment or systems from the new installation
- Removal of interferences with equipment and facilities not shown in the drawings, hidden materials
- Fire extinguishers and fire fighting installation
- Monitoring center and processing of fire alarms
- Furniture for control/electrical rooms
- Slag to be used for paving roads
- Lubricants, greases and hydraulic oils
- Any services and/or supplies not described in this proposal
- Modifications and/or revisions in the drawings of areas or existing facilities (Blast Furnaces, Steel Plant, etc.) for inclusion of equipment materials related to the new installation
- Conduit or cable schedules
- Cable installation drawings
- Cable routing
- Risk Assessment/Safety audit
- Motor Control Center (MCC)
- Transformer
- Light Distribution Panel
- Local Disconnect
- Instrumentation

**Customer** : Tenova CORE - USA Project  
**Project:** : One 100 TPH Single Strand Pig Casters  
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- Cabling and Installation Material



**Customer** : Tenova CORE- USA Project  
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## 12 GUARANTEE

Paul Wurth will guarantee the nominal production rate of 100 t/h for the pig casting machine.

The daily performance test will be carried out pouring four (4) ladles on not having any outside interferences.

Precondition for the performance test is that the pig iron composition and temperature is in accordance with the specification given in this document, please refer to chapter 2.0 Design Parameters.

In case that during the performance test the guaranteed production rate can not be accomplished for one (1) ladle the performance test will be interrupted for a common analysis of the problem. In case that the problem is attributable to Paul Wurth, Tenova CORE will allow Paul Wurth to adjust the machine. In case the problem is attributable to Tenova CORE, Tenova CORE will fix the problem. After interruption the performance test will be continued in common agreement until reaching the required number of ladles to be poured for the performance test.

If during five (5) days of performance test, not counting the interruptions, Tenova CORE is not capable of supplying the 20 ladles with the pig iron characteristics as specified in this technical specification, the performance test will be considered as concluded.

Customer : Tenova CORE - USA Project  
Project: : One 100 TPH Single Strand Pig Casters  
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## **13 APPENDIX**

- 13.1 Drawings
- 13.2 Reference List

**Customer** : Tenova CORE - USA Project  
**Project** : One 100 TPH Single Strand Pig Casters  
**PW Reference** : ZQ-70558 REV O

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## 13.1 Drawings

Drawing ZQ-70558-01 - Pig Casting Machine - General Arrangement



Customer : Tenova CORE-USA Project  
Project: : One 100 TPH Single Strand Pig Casters  
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## 13.2 Reference List

See attached.

Reference List					
BAILEY PIG CASTING MACHINES					
No.	Customer Location	Qty.	Contract Year	Density Pig Weight	Type
1.	Acme Pig Iron & Centrifugal Colaba, India	1	1962	25/40#	SS
2.	Air Products & Chemical Co. Greenville, PA	1	1960		SS
3.	Air Products & Chemical Co. Greenville, PA	1	1967		SS
4.	Air Products & Chemical Co. Greenville, PA	1	1964	40/60#	SS
5.	<b>A.I.S.</b> Kwinana	1			OS
6.	A.1.S. Kwinana	1			OS
7.	Acme Pig Iron & Centrifugal Colaba, India	1			SS
8.	African Metals Corporation	1			DS
9.	African Metals Corporation	1			SS
10.	African Metals Corporation	1			SS
11.	Ajax Magnethemiic (Remington-Rand), Shreveport, LA	1			SS
12.	Allegheny-Ludlum Steel Natrona Heights, PA	1	1966	40/60#	SS
13.	Alloy Metal Products Davenport, IA	1	1977	<b>0.255</b> (45#)	SS
14.	Altos Homos De Vizcaya Spain	1			OS
15.	American Cast Iron Pipe Co. Birmingham, AL	1	1959	25/40#	SS
16.	Anderson Electric Corp. Leeds, AL	1	1966	Double	SS
17.	Appleby-Frodingham Steel Co.	1			DS
<b>18.</b>	Appleby-Frodingham Steel Co.	1			DS
19.	Amico Steel Corp. Ashland, KY	1	1961		DS
20.	Amico Steel Corp. Houston, TX	1	1942		DS
21.	Amico Steel Corp. Ashland, KY	1	1975		SS

PAUL WURTH

Reference List					
BAILEY PIG CASTING MACHINES					
No.	Customer Location	Qty.	Contract Year	Density Pig Weight	Type
22.	Armco Steel Corp. Middletown, OH	1			SS
23.	Avco Corp.-Electronics/Ordin. Div. Richmond, IN	1			SS
24.	B.H.P Newcastle	1			DS
25.	B.S.C. Teesside & Workington	1			DS
26.	B.S.C. Teesside & Workington	1			DS
27.	Bairds & Scottish Steel, Ltd.	1			DS
28.	Barrow Iron Works, Ltd.	1			DS
29.	Barrow Iron Works, Ltd.	1			DS
30.	Bendix Corporation St. Joseph, MI	1	1966	25/40#	SS
31.	British Columbia Tube Works Vancouver, B.C.	1	1946	35/50#	SS
32.	Campbell, Wyant & Cannon Muskegon, MI	1	1947	35/50#	SS
33.	Canadian Furnace Co. Port Colborne, Canada	1			DS
34.	Caterpillar Tractor Co. Mapleton, JL	1	1976	0.266@2800° 93#	SS
35.	Chevrolet-Saginaw Foundry Saginaw, MI	1	1961	25/40#	SS
36.	Chevrolet-Sagnaw Foundry Saginaw, MI	1	1962	40/60#	SS
37.	Chevrolet-Sagnaw Foundry Saginaw, MI	4	1965	40/70#	SS
38.	Chevrolet-Tonawanda Tonawanda, NY	1	1954	34/40#	SS
39.	Chevrolet-Tonawanda Tonawanda, NY	1			SS
40.	Clow Corp. Tarrant, AL	1	1969		SS
41.	Clow, J.B. & Sons Coshocton, OH	1	1954	35/40#	SS
42.	Colvilles, Ltd. (Clyde)	1			DS
43.	Colvilles, Ltd. (Clyde)	1			DS

## PAUL WURTH

Reference List					
BAILEY PIG CASTING MACHINES					
No.	Customer Location	Qty.	Contract Year	Density Pig Weight	Type
44.	Consett Iron Co.	1			OS
45.	Crouse-Hinds Company Syracuse, NY	1			SS
46.	John Deere Tractor Works Waterloo IA	1	1947	50I15#	SS
47.	John Deere Tractor Works East Moline, IN	1	1961	25/40#	SS
48.	Delco-Remy Div., GMC Anderson, IN	1	1961	25/40#	SS
49.	Dorman Long, Ltd.	1			DS
50.	Empire - Detroit Steel Div. Portsmouth, OH	2	1976 1978	2-30# (Mold Only)	
51.	Exomet Conneaut, OH	1	1956	35/50#	SS
52.	Exomet Dayton, OH	1	1965	40/60#	SS
53.	Farrel-Birmingham Co. Ansonia, CT	1	1945	35/50#	SS
54.	Ford Motor Co. Dearborn, MI	1	1960	25/40#	SS
<b>55.</b>	Ford Motor Co. Dearborn, MI	1	1951	100#	DS
56.	Ford Motor Co. Dearborn, MI	1	1952	35/50#	SS
57.	G.H.R. Foundry Dayton, OH	1			SS
58.	General Electric Co. Elmira, NY	1	1962	25/40#	SS
59.	Gould Inc. Frisco, TX	1	1977	0.23@1950° 45#	
60.	Great Lakes Foundry Sound Bend, IN	1	1948	35/50#	SS
61.	Griffin Pipe Products Co. Council Bluffs, IA	1	1962	40/60#	SS
62.	Guest Keen Baldwins, Ltd.	1			DS
63.	Huron Valley Steel Belleville, MI	1	1949	60 (Triple)	SS



Reference List					
BAILEY PIG CASTING MACHINES					
No.	Customer Location	Qty.	Contract Year	Density Pig Weight	Type
64.	Inland Steel Indiana Harbor Works, IN	1	1942	100/50#	DS
65.	Inmetco Ellwood City, PA	1	1977	0.28@2900° 50#	OS
66.	Inmetco Ellwood City, PA	1	<b>2005</b>	(24 ton/hr)	SS
67.	International Harvester Co. Rock Island, IL	1	1952	<b>35/50#</b>	SS
68.	International Harvester Co. Memphis, TN	1	<b>1953</b>	35/50#	SS
69.	International Nickel Co. Huntington, WV	1	1941	35/50#	SS
70.	John Lysaght, Ltd.	1			DS
71.	John Summers & Sons, Ltd.	1			OS
72.	Karabuck Steelworks Turkey	1			OS
73.	Kelsey-Hayes Company Detroit, MI	1	1961	<b>25/40#</b>	SS
74.	Koninklijke Nederlandsche	1			OS
75.	Kopper Co. (Bartlett-Hayward Div) Baltimore, MD	1			SS
76.	Latrobe Steel Company Latrobe, PA	1	1952	35/50#	SS
77.	Lebanon Steel Company Lebanon, PA	1	1961	25/40#	SS
<b>78.</b>	Lynchburg Foundry Lynchburg, VA	1	<b>1948</b>	35/50#	SS
79.	Majestic Iron & Steel Middlesex Co., NJ	1			SS
80.	McKinnon Industries St. Catherines, Ontario	1	1964	40/60#	SS
<b>81.</b>	McKinnon Industries St. Catherines, Ontario	1	1964	40/60#	SS
<b>82.</b>	McKinnon Industries St. Catherines, Ontario	1	1956		SS
<b>83.</b>	Mercer-Alloys Corp. Greenville, PA	1			SS

Reference List					
BAILEY PIG CASTING MACHINES					
No.	Customer Location	Qty.	Contract Year	Density Pig Weight	Type
84.	Metropolitan Metals Detroit, MI	1	1969	20#	SS
85.	Michael Schiavone & Sons, Ltd. New Haven, CT	1	1972	0.28/0.33 40/50#	SS
86.	Millam and Askam, Ltd.	1			DS
87.	Mysore Iron and Steel Works	1			SS
88.	Norvex Mining Company St. Jerome, Quebec	1	1958	25/40TPH	SS
89.	Penna Smelting & Refining Co. Philadelphia, PA	1	1948		SS
90.	Penna Smelting & Refining Co. Philadelphia, PA	1	1946		SS
91.	Parkgate Iron & Steel, Ltd.	1			SS
92.	Pease & Partners, Ltd.	1			SS
93.	Phoenix Iron & Steel Co. Chester, PA	1	1948		SS
94.	Plant & Facilities Corp. (Aerojet) Downey, CA	1	1961	25/40#	SS
95.	Primorec Differdange, Luxembourg	1		15TPH	SS
96.	Quebec Iron & Titanium Corp. Sorel, Quebec	1	1955		DS
97.	Quebec Iron & Titanium Corp. Sorel, Quebec	1	1951	100#	DS
98.	Quebec Iron & Titanium Corp. Sorel, Quebec	1	1973	0.275@2500° 46#	SS
99.	Remington Rand Shreveport, LA	1	1962	25/40#	SS
100.	Republic Steel Corp. South Chicago, IL	1	1942	Double 40#	SS
101.	Richards Bay Iron & Titanium Co. Natal, South Africa	1	1975	0.275@2750° 46#	DS
102.	Richard Thomas & Baldwins	1			DS
103.	Richard Thomas & Baldwins	1			DS
104.	Rock Island Arsenal Rock Island, IL	1	1969		SS
105.	Russian Purchasing Commission USSR	2	1943	110#	DS

Reference List					
BAILEY PIG CASTING MACHINES					
No.	Customer Location	Qty.	Contract Year	Density Pig Weight	Type
106.	Sheepbridge Co., Ltd	1			DS
107.	Shelton Iron & Steel, Ltd.	1			SS
108.	SICARTSA Las Truchas, MX	1	1978	0.28@2500° 35# (Triple)	OS
109.	South Africa Iron & Steel Corp.	1			DS
110.	South Africa Iron & Steel Corp.	1			DS
111.	Stainless & Alloy Corp. Greenville, PA	1			SS
112.	Stanton Ironworks Co., Ltd.	1			DS
113.	Staveley Iron & Chem. Co., Ltd.	1			DS
114.	Steel Company of Wales Corp	1			OS
115.	Stewarts & Lloyds, Ltd.	1			OS
116.	TRW, Inc. Minerva, OH	1	1980	0.28/0.32@3000° 32#	DS
117.	Union Carbide Corp. Marietta, OH	1	1967		SS
118.	Union Carbide Metals Corp. Alloy, WV	1	1955		SS
119.	Union Carbide Metals Corp. Alloy, WV	1	1953		SS
120.	Union Carbide Metals Corp. Welland, Ontario	1	1958		SS
121.	Union Carbide Nuclear Co. Oak Ridge, TN	1	1959	AR25/Pb100	SS
122.	United States Metal & Ref. Carteret, NY	1			SS
123.	US Steel Corp. Braddock, PA	1	1947	100#	OS
124.	US Steel Corp. Duquesne, PA	1	1961	100#	DS
125.	US Steel Corp. Duluth, MN	1	1942	30/50#	OS
126.	US Steel Corp. South Chicago, IL	2	1942	100# & 50#	OS
127.	US Steel Corp. Universal, PA	1	1960	25/40#	SS
128.	Vanadium Corp. of America Niagara, NY	1	1950	50#	SS

Reference List					
BAILEY PIG CASTING MACHINES					
No.	Customer Location	Qty.	Contract Year	Density Pig Weight	Type
129.	Virginia-Carolina Chemical Charleston, SC	1	1949		SS
130.	JP Ward Foundry Blossburg, PA	1	1961	25/40#	SS
131.	Warner & Company	1			OS
132.	Weirton Steel Corp. Weirton, WV	1	1941		OS
133.	Wilson Foundry & Machine Pontiac, MI	1	1944	35/50#	SS
134.	Wisconsin Centrifugal Waukesha, WI	1	1979	0.28@2700° 2@20	SS
135.	Wisconsin Centrifugal Waukesha, WI	1	1970		SS
136.	Wisconsin Smelting Waukesha, WI	1	1943	35/50#	SS
137.	Workington Iron & Steel Co.	1			OS

## 10.3.6 Ancillary to Process Equipment

### 10.3.6.1 Control Room

PURE FONTE LTÉE plant is characterized by having a single point of control, situated in the center of the main EAF bay, from where the operators can see each process equipment. The personnel do not need to move outside the control cabin to perform any activity relevant to the process. All the process operation can be carried out from the control room thanks to the automation, cameras and robots located throughout the plant.

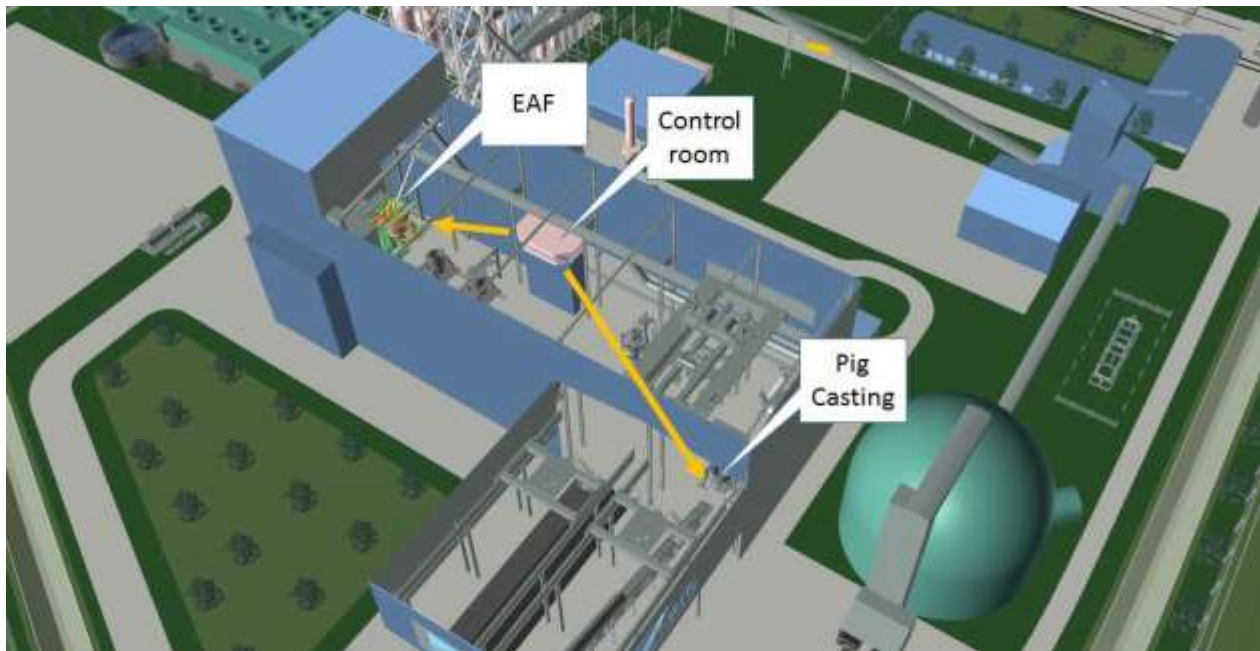


Figure 10.3-52.: position of the control room in the main building bay, overlooking EAF and Pig Caster

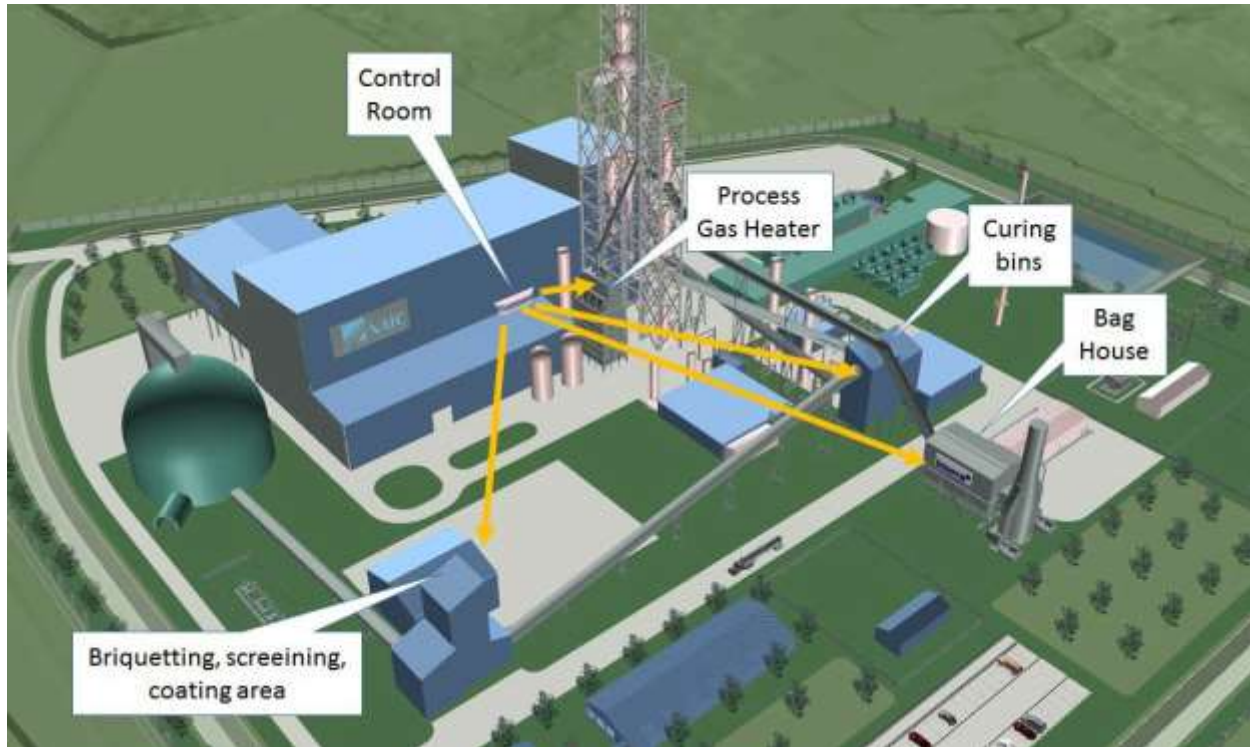


Figure 10.3-53.: position of the Control room, overlooking the exterior of the plant

Another very important feature of the Control room is the fact that it is in part open to the exterior of the building, as a sort of balcony overlooking the outside of the plant.

This feature is of particular importance for the ergonomics of the room. Natural light will be present during daylight hours, for a more comfortable operation. The personnel will also be in condition to see the various parts of the process equipment as the IO pellets screening and coating area, the main Bag House, the curing bins and the process gas heater. This equipment does normally not require to be under the direct visual supervision of the operators, as it is fully automates, but it is important, for safety reasons, that the plant operators can directly see these areas.

Tenova Core will design and supply one (1) EAF all-welded tubular structure control pulpit as follows:



Figure 10.3-54.: Typical Exterior and Interior of similarly designed pulpits.

- Exterior Sheeting will be cleaned, primed and painted and is designed for site environments that are abusive and could see some impact
- Exterior Roof will be cleaned, primed and painted and is designed for a 70psf live load and will be welded to form a water proof barrier and is designed for areas where objects may fall onto the roof
- Interior Sheeting will be FRP liner panels which are durable, easy to maintain and non-conductive. In addition, FRP has better insulating qualities than steel and is rustproof and corrosion proof
- Interior Ceiling has a fire rated steel grid system and acoustical lay in tiles. This allows for access to the ceiling plenum and wall cavities which allows for additional wiring in the future.
- Insulation (R-14) will be mineral wool rated at 4 lbs/cu. Ft. for thermal and sound deadening in the walls, floor and roof.
- Flooring will be 4 inches deep consisting of structural grade tubing, angle and channel and be fully welded to form a unitized frame. Carbon steel will be welded to the frame to form a waterproof base. The interior floor will be steel plate with industrial vinyl tile attached to the steel subfloor after it has been cleaned and primed to allow for optimal adhesion. Wiring and conduit will be run above floor. The flooring will either be designed with one (1) wire way under the smooth plate floor that can go from the control desk to a terminal box or other area in the pulpit

or one (1) 6 inch high raised access floor in the control room area. Air locks will still be included with the smooth plate flooring.

- Doors offered will be quantity of four (4) that are galvanized steel, approximately 36" wide x 84" high with weather stripping, thermal break of header, panel and jambs to prevent ice and frost build-up in interior of the building, insulated tempered glass window, panic hardware with lever handle and automatic door closer. Door system isn't compatible with keypad entry systems.
- Windows will be fixed type, tempered safety glass and insulated and sealed and caulked prior to shipment. There will be one (1) approximately 8'-0" wide x 3'-6" high and one (1) approximately 6'-0" wide x 3'-6" high.
- Electrical Equipment will consist of:
  - One (1) Circuit Load Center w/breaker
  - Two (2) 3-way light switches
  - Four (4) 125V, 20amp duplex receptacles
  - One (1) telephone jack computer terminal
  - Four (4) recessed fluorescent lights
  - One (1) lighted exit sign w/emergency lights
  - One (1) lighted exit sign w/o emergency lights
  - Two (2) emergency lights
  - One (1) conduit penetration into load center for power plant
  - Three (3) incandescent light recessed over the control desk on dimming switch
  - Two (2) exterior light fixture wired to switch in air lock
  - Two (2) ground/terminal lugs, bronze cast with high copper content, consisting of one (1) cable each and four (4) silicone bolts/nuts and lock washers each with standard NEMA drilled tongue and will be located on opposite sides of the pulpit enclosure
- Fire Detection will consist of one (1) dry chemical fire extinguisher
- Safety and PPE will consist of one (1) first aid kit for up to 125 people, wall mounted, painted steel and installed and one (1) ear plug dispenser with 250 pairs of earplugs, sealed, sanitary, foam roll-up barrel style
- HVAC will be commercial duty, wall mounted with preliminary - 24,000BTU cooling, 5 kW heat, 208/230VAC, 1PH, 60Hz and internal disconnect switch. In addition two (2) framed openings for the HVAC supply and return will be included.
- Additional Equipment will consist of lifting lugs rated 11,000lbs capacity minimum.



### 10.3.6.2 EAF Shell Lifting Beam

For EAF shell refractory purposes, the EAF shell must be retrieved from the tilting platform and set onto the maintenance platform. An EAF shell lifting beam is needed to lift the EAF shell and move it with the main overhead crane.

Lifting beam assembly is shown below in a typical drawing.

- Quantity:one (1)
- Design standards:DIN 15407
- Hooking points (by E.O.T. crane):according to crane hooks
- Hooking points to shell:4
- Lifting members design:articulated to allow load repartition
- Lifting beam weight:~22 short tons (20 metric tonnes)

The shell lifting beam is composed of the following parts:

- One (1) main girder welded box type equipped with top hooking system designed according to EOT crane main hooks, and box connections to the transversal girders
- Two (2) transversal girders box type each provided at both ends of connecting structures to the articulated members
- Four (4) articulated lifting members designed for the main hooking structures of the shell welded to the shell lower part

The lifting beam can also be used to handle the upper shell only in case splitting is required: for initial separation from the lower shell, the hydraulic jacks have to be used.

Four (4) lifting lugs will be welded to the ring structure of the top shell: these lifting lugs are designed for the weight of the top part only and must not be used for lifting the complete shell. In case of shell splitting, the separation of the upper shell from the lower one shall be done by hydraulic jacks located in the relevant support boxes.

The lifting beam design takes into account the position center of gravity of the lined shell in order to ensure shell level during lifting and handling.

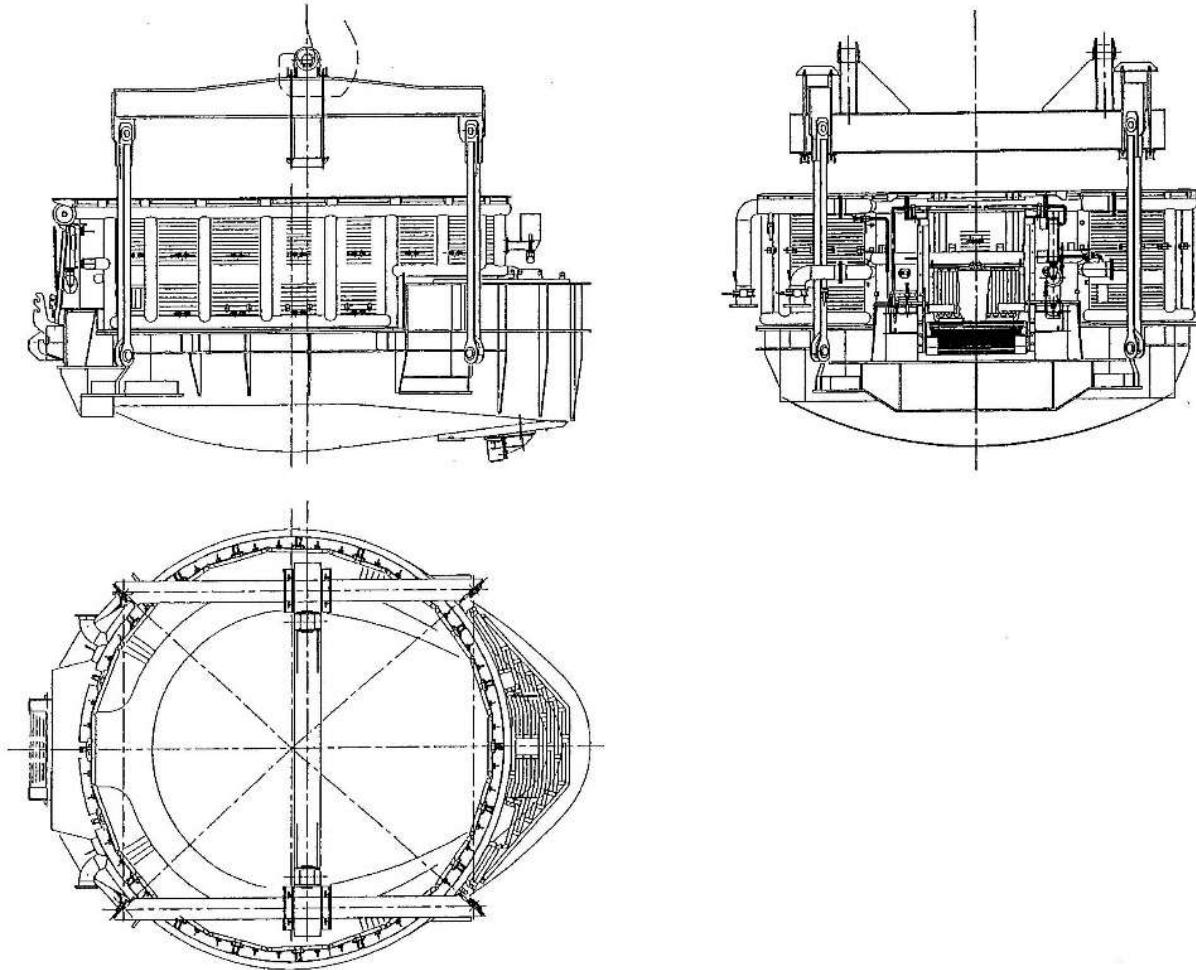


Figure 10.3-55.: Shell Lifting Beam






### 10.3.6.3 EAF Shell Transfer Car



Figure 10.3-56.: position of the EAF shell transfer car at the north end of the main building

In the plant there will be two EAF shells: one in operation and one under refractory relining. Once the EAF campaign is over (2 to 4 weeks), the shells have to be switched. The relined one is set from the transfer car on the ground in the EAF bay and the one on the tilting platform is moved by the overhead crane onto the transfer car. At that point the relined one can be positioned on the tilting platform and the shell transfer car moves the used shell sideways in the service building for the shell maintenance.

The transfer car is composed with following main parts:

-  Main carrying structure
-  Wheels groups
-  Driving equipment
-  Controls
-  Festoon and/or drums for electric feeding, signals and gases supply

### Technical data

- Quantity: 1
- Number of wheels: 8 double-flange type
- Number of motorized wheels: 2
- Wheels type/diameter: carbon steel C4TF–UNI2954/800 mm
- Wheels surface: hardened by treatment
- Wheels supports: with bearings grease lubricated
- Main carrying structure: from welded steel plate
- Car driving system: nr.1 gear reducer group driven by electrical motor
- Type of motor: AC
- Electric supply: 480 V – 60 Hz
- Speed control: by inverter
- Electric supply: by festoon and/or drum
- Rail type: Burbach A 120

### Main carrying structure

The main carrying beams and the secondary cross beams are from welded steel plate structure. All elements composing the main structure will be stress relieved after construction.

### Wheels group

Wheels will be manufactured in carbon steel. Surface will be hardened by adequate treatment. Support will be equipped with rolling bearings grease lubricated.

### Car driving equipment

The driving system basically consists of two motor-reducer groups driven by electrical motors. The car will be delivered complete with the items described above, as well as the electrical wiring up to the terminals in the terminal box fitted on the car itself.

### Electrical equipment

The electric supply will be of V.V.V.F. type. Electrical equipment will be installed in a vertical board to be located into L.V. room.

Electrical equipment includes:

- Electronic inverter for speed control
- Contactors, fuses and circuit breakers
- Auxiliary relays for sequences

### Cable Lines

Festoon and/or drum will be used for power, signal cables and inert gas hose. Suitable position detectors will be installed, on the line to provide signals of car positions.

Proximity limit switches are suitably installed along the car way and will detect car positions.

### Controls

Car control manipulator will be located into the tapping pulpit.

A second manipulator will be located at ground level, at the pick-up area of the shell.

#### 10.3.6.4 EAF Shell Maintenance Platform

The mechanical maintenance to the shell as well as the refractory demolishing and reconstruction will be done in a dedicated area via one working platform.

The working platform is provided, half fixed - half removable, to allow easy access to the shell and to support the demolishing machine during refractory maintenance.

The area is provided with the following facilities:






-  Cooling water supply and return to complete the shell cooling
-  Electric feed for welding machine, electric tools, lighting, etc.
-  Compressed air, oxygen, natural gas
-  Hydraulic and pressure test facilities
-  Jib crane or other material handling equipment



Figure 10.3-57.: Shell Maintenance Platform Area- For reference only



One section of the access platform will be designed to carry the demolishing machine during the refractory demolition and refractory removal from the used shell.

One section of the platform will be made removable (by the EOT crane) to allow shell transfer to/from the relining position.

The remaining part of the access platform will be fixed type.

Hoses with quick connections will be provided to feed the water to the shell once transfer car is at the shell maintenance platform.

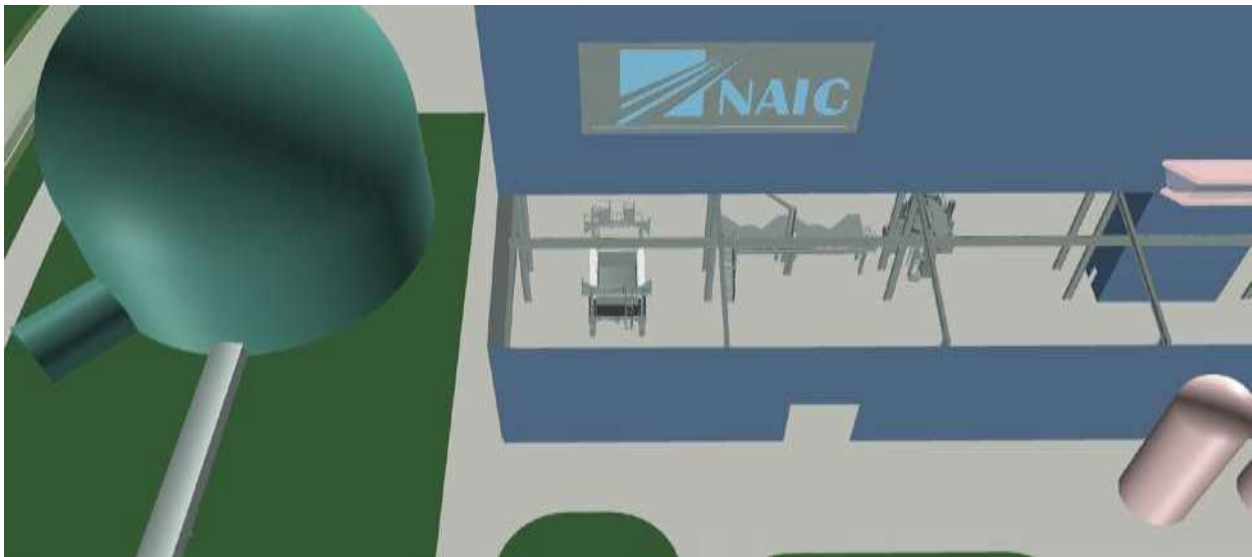


Figure 10.3-58.: 3D view of the maintenance building next to the main building bay

### 10.3.6.5 Electrode Storage and Piccardi Machine

#### Storage and make-up station

One (1) electrode storage and make-up stand is provided with the following main characteristics:

- Unit length: up to 94.5 in (2400 mm) max
- Storage stands: four (4)
- Make-up stand complete with hydraulic clamp: one (1)
- Hydraulic unit: one (1)
- Pump: 0.5 gallons/minute (2 liters/minutes)
- Working pressure: 11,600 psi (80,000 kPa)
- Motor: 3.3 hp (2.5 kW) - 480 V - 60 Hz
- Tank: 6.6 gallons (25 liters)

The make-up stand is provided with one hydraulic clamp to hold the electrode column during make-up (screwing of new unit). Electrode clamping is spring held with hydraulic release. Release of the electrode is made by a hydraulic cylinder.

The storage stand is provided with four (4) stands to prevent oxidation of the electrode column during storage.

The storage stands are made out of steel tubes with removable bottom in order to allow extraction of electrode tips in case of need.

Electrode storage stands and make up unit will be provided with supporting structure to be anchored to the furnace working platform.

#### Hydraulic Unit

The hydraulic unit feeds the oil to the holding and clamping mechanism.

#### Electrode Jointer for Electrodes

The electrode make-up will be performed by means of a remotely-operated device, designed to join the electrode unit to the electrode column without the need of taking the electrode column down to the make-up stand.

The main equipment for direct electrode screwing is composed of:



- No. 1 automatic electrode jointer to screw graphite electrodes units directly on the furnace by means of a hydraulic power unit. The jointer is complete with electric motor, hydraulic motor, cylinders, hydraulic and pneumatic valves and top rotating device.
- No. 1 control pulpit located in EAF control room
- No. 1 deposit stand for 3 electrodes units and for vertical overturning of one unit, to be inserted into the jointer. The tilting operation is obtained by a hydraulic unit through a cylinder at controlled and firm speed.

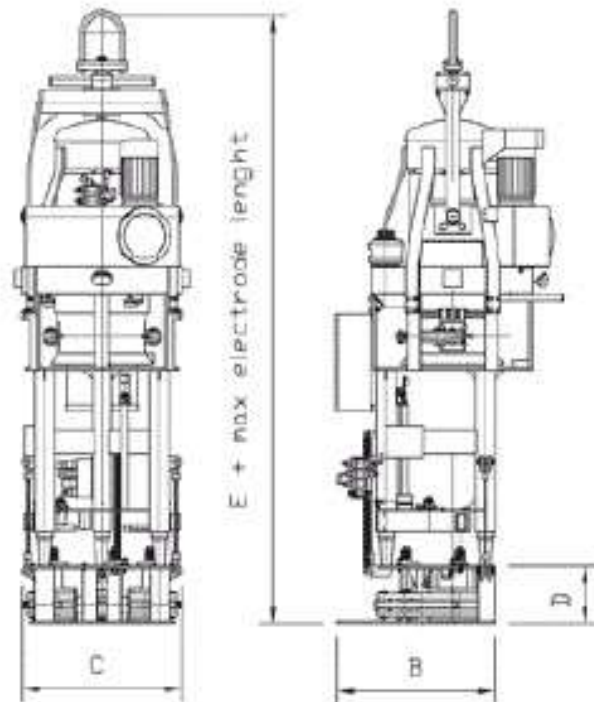
The hydraulic machine clamps the electrodes and moves them to the vertical position as it is useful to avoid stresses to the electrode while lifting from the horizontal position. The electrode is hydraulically hoisted to the vertical position, while manually locked in place.

Once the screwing of the electrode unit is completed, the jointer is used to slip the complete electrode column through the clamp by suspending the complete electrode column while the arm is raised.



Figure 10.3-59.: photo of the electrode storage equipment and the electrode jointer machine

# AUTOMATIC ELECTRODE JOINTER with top rotating device



No special requirements nor structural alterations are needed with respect to the height of the crane's hook, overall furnace dimensions electrode holder or for storage of the root.

In addition to the standard robot, this unit features an upper hydraulic device enabling the jointer to rotate 180° while hanging from the crane hook.

This allows the unit to be easily used on two opposing furnaces.

Electrode diameter mm	Electric power KW	Weight Kg	Order No	A mm	B mm	C mm	D mm
400	5.5	1800	1659	1550	880	863	260
450	5.5	1900	1660	1550	930	924	260
500	7.5	2300	1661	1650	1000	975	340
550	9.2	2350	1662	1700	1080	1050	340
600	11	2650	1663	1700	1140	1100	340
650	15	3000	1664	1950	1300	1275	440
700	15	4300	1665	2000	1360	1325	480
750	15	4450	1666	2100	1430	1375	515
800	15	4800	1667	2200	1500	1425	555

All above data are not binding. "Piccardi" reserves the right to introduce changes whenever needed for a technical and functional updating. 30/11/200

Figure 10.3-60.: Typical Electrode Jointer Information



#### **10.3.6.6 Furnace Transformer 55 MVA**

See attached the technical specification for the 55 MVA transformer from Tamini Tes

OFF16-0052-MV-rev.1

TENOVA S.p.a.  
Via Monte Rosa, 93  
20149 - Milano - Italia

Att. Purchase dept.

Ospitaletto, 27/05/2016

SUBJECT: EAF Transformer and dry type Transformers.

Dear Sirs

with reference to your inquiry, we are pleased to submit our offer for the possible supply of the following equipment:

Item	Description	Q.ty	Unit price [€]
A	EAF Transformer 55 MVA, OFWF 2x100%, 60 Hz, with OLTC, 34500/660÷550÷496 V, and other characteristics as per your technical specification. <b>EXW TES, oil included.</b>	1	
B	Dry type Transformer 2500 kVA, AN, 4160/600 V, 60 Hz, Vcc%=6% with IP23 box and other characteristics as per our standard.	5	
C	Dry type Transformer 1250 kVA, AN, 4160/600 V, 60 Hz, Vcc%=6% with IP23 box and other characteristics as per our standard.	1	
D	Dry type Transformer 200 kVA, AN, 4160/600 V, 60 Hz, Vcc%=6% with IP23 box and other characteristics as per our standard.	2	
E	Dry type Transformer 630 kVA, AN, 4160/600 V, 60 Hz, Vcc%=6% with IP23 box and other characteristics as per our standard.	3	
F	Dry type Transformer 500 kVA, AN, 4160/600 V, 60 Hz, Vcc%=6% with IP23 box and other characteristics as per our standard.	3	

The above prices are VAT excluded and valid for the quoted quantities.  
Changes in the technical parameters listed in the offer, could cause prices and delivery terms modification.  
Everything not listed in our offer is not included in the quoted scope of supply.

LIMIT OF SUPPLY (Included in the scope)

To be consider:

- Bidirectional wheels.
- HV and LV bushing terminals.
- Auxiliary terminal board.

The connections to the HV and LV systems and to the automation system of the plant are therefore excluded from the scope supply.

## TERMS OF SUPPLY

- Payment conditions: 20% at the order at 30 days date of invoice.  
80% to be agreed.
- Delivery time: To be agreed, approx. 8 months after the receiving of the P.O. and the advance payment.  
The preliminary documentation will be submitted 2 months after the P.O.
- Delivery terms: EXW our plant, loaded on truck, custom cleared. (Incoterms® 2010)
- Packing: Excluded.
- Storage: In case of a delay in the goods delivery for reasons not attributable to Tamini Trasformatori S.r.l., the Purchaser shall pay Tamini Trasformatori S.r.l. an amount of 1% of the good value, for each month or fraction in which the good will remain stored c/o Tamini Trasformatori S.r.l.; the applicable grace period will be one month from the contractual delivery date.
- Warranty: 12 months after delivery, but not later than 18 months from the successful factory testing date. The guarantee cover all the necessary costs for repair or replace of components due to a defect of our supply; the warranty terms are intended at the contractual delivery point.
- Assistance: Assistance of accessories erection and assistance of commissioning: at balance based on Euro 950,00/day/man; travel, board and lodging expenses excluded.  
Tools, cranes and oil treatment equipment are at customer charge.
- Adjustment of the price: The calculated price displayed, is valid for a delivery taking place not later than 12 months from the P.O. date and it is based on the quotations of the grain oriented magnetic steel, of the copper and of the insulating oils now in force; the price could then be updated when the actual delivery take place and/or during the final negotiation.
- Bid validity: 30 days

### LIMITATION OF LIABILITY

Tamini Trasformatori S.r.l. shall not be liable for loss of profit and/or loss of production and/or consequential/indirect cost damages.

In any case the Vendor aggregate liability (for delays, extra costs, damages, expenses, indemnifications, etc) shall not exceed the 100% of the total contract price.

It is intended that the receipt of an order, will be considered as full acceptance of the above liability limitation clause in favour of Tamini Trasformatori S.r.l..

For matters not covered elsewhere in this quotation, the "General Conditions for the Supply of Mechanical, Electrical and Electronic Products", Brussels, August 2000 (ORGALIME S 2000) shall apply.

**Tamini Trasformatori S.r.l.**

**ITEM A TECHNICAL SPECIFICATION**

Three-phase oil immersed EAF transformer, oil-water cooled (OFWF) by means of n° 2x100% coolers single wall type, with OLTC with 11 taps for LV regulation.

**CHARACTERISTICS**

Rated power at taps 660 to 550 V	MVA	55
Rated current at taps 550 to 496 V	kA	57,7
No load ratio	V	34500 / 660-639-619-601-583-566-550-536-522-509-496
Rated frequency	Hz	60
Windings connections		Star / open delta
Water inlet temperature	°C	35
Windings temperature rise	K	55
Reference standards		ANSI/IEEE
Installation		indoor

**INSULATION LEVELS**

HV windings	kV	LI 200 AC 70
LV windings	kV	AC 8

**GUARANTEE VALUES**

Reference rating	MVA	55
Reference voltage ratio	V	34500/660
No load losses	kW	40
Load losses at 85°C	kW	310
Short circuit impedance at 85°C	%	8

**INDICATIVE MASS AND OVERALL DIMENSIONS**

Core & coils assembly	kg	33000
Oil	kg	15000
Total in service condition	kg	61000
Overall dimensions (L x W x H)	mm	5500 x 3000 x 5400



## TERMINALS

- n°3 HV porcelain bushings 52 kV 1000 A on the cover.
- n°3 set of LV copper double tubes on the side wall.

## COOLING EQUIPMENT OFWF

- n°2x100% oil forced-water forced coolers single wall type, designed to dissipate the 100% of the total losses in overload, suitable for industrial type water (max inlet temp. 35°C) complete with oil and water pressure gauges, oil and water thermometers, oil and water flow indicators with electric contacts and oil/water leakage indicator.
- n°2 oil circulation pumps.
- n°2 set of shut-off valves for water and oil circuits.

## ON LOAD TAP CHANGER (VACUTAP®)

Manufacturer	MR (Germany)
N° of operating positions	11 (10 steps)
Type	Three-phase - VACUTAP® (*)

The OLTC is arranged for assembling inside the transformer tank with the diverter switch in a separate oil tight compartment, and it is equipped with a motor drive unit with possibility of manual operation, if necessary. Motor or hand operations are interlocked each other.

In the tap changer control cubicle are included two sets of contacts for signalling the tap changer position for electrode control.

OLTC Accessories:

- n° 1 oil surge protection relay type RS 2001.

(\*) VACUTAP® technology allows 300.000 operations without maintenance and no need for oil filter unit.



## **ACCESSORIES**

N°1 oil conservator with two compartments (transformer and tap changer diverter switch) each complete with:

- Oil level indicator readable at floor level;
- Dehydrating breather;
- Oil filling and discharge valves.

N°1 gas and oil actuated relay with double float type Buchholz for transformer tank;

N°1 oil temperature indicator (dial type thermometer) with contacts for alarm and trip;

N°1 winding temperature indicator with contacts;

N°1 pressure relief device for the transformer;

N°2 earthing terminals for tank;

N°2 thermometer pockets placed in the top cover of the tank;

N°1 rating and diagram plate;

N°1 set of valves for oil sampling, filling, draining, filtering;

N°1 set of wheels, bi-directional type;

N°1 set of lifting and jacking facilities;

N°1 set of CT's.

N°1 control cabinet with motor starters, cooling equipment controls and terminal boards;

N°1 ladder for maintenance , welded on the transformer.

## **FIRST OIL FILLING**

The insulating oil for first filling is included in the scope of supply and will be compliant to the standard IEC 60296. All parts of the transformer which are or may be in contact with the oil, will be compatible with the above mentioned type of oil.

## **PAINTING**

Final colour RAL 7033.

## **TESTING**

Routine tests according to IEC 60076 standards are included, type tests and special tests could be quoted as option if needed.

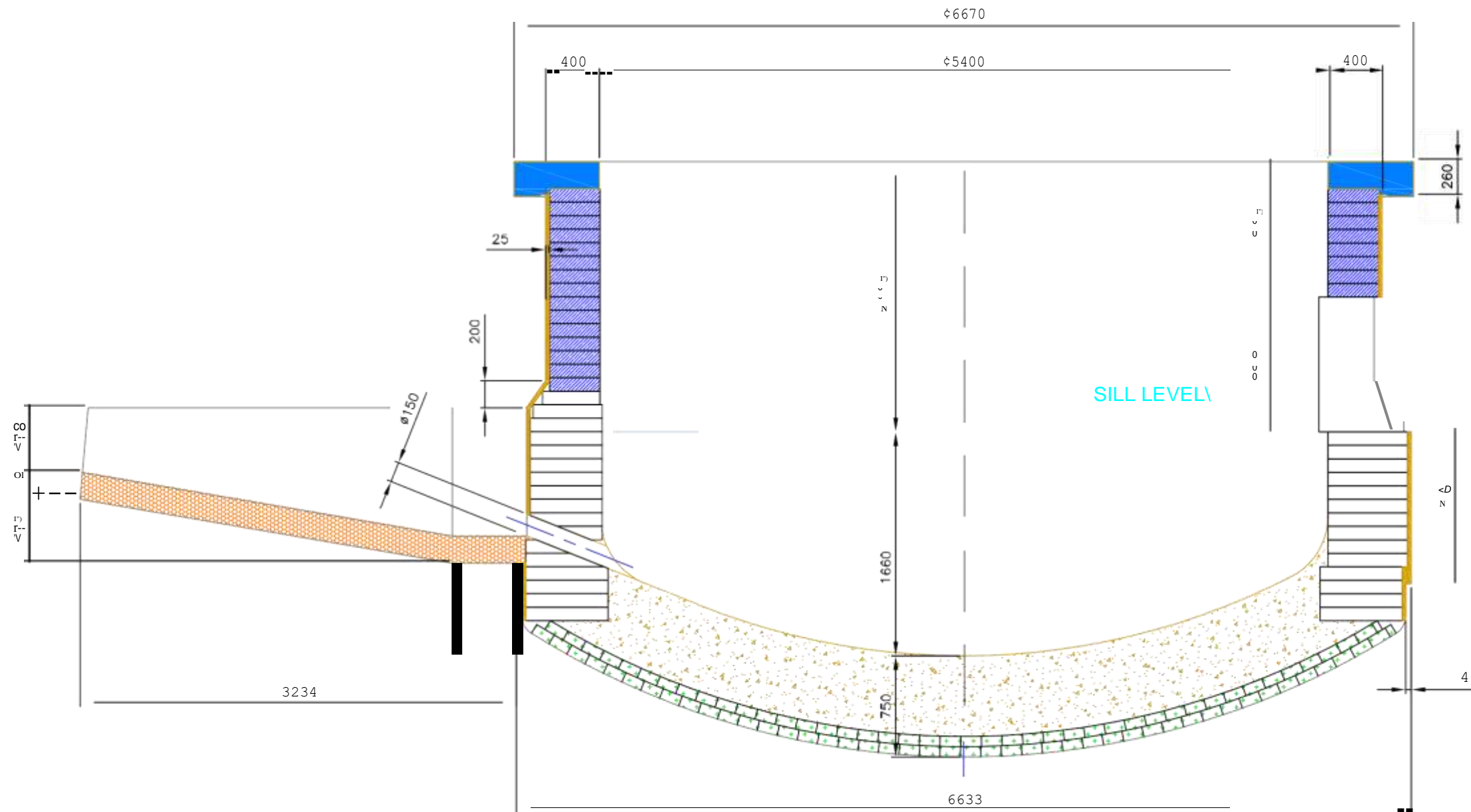
## **TRANSPORT**






The transformer will be transported partially dismantled, with oil inside.



### **10.3.6.7 Refractory**

Tenova has evaluated two different vendors for EAF refractory material. Please see the attached information.



-  GMAG-EAF-13-D
-  GMAG-EAF-F5
-  DOLA-BBOFS
-  JEBFIL-MRB
-  BASIMAG-30-D

**NOTE:**

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**CUSTOMER:**

**TENOVA  
QUEBEC, CANADA  
EAF**

**DRWG No.  
T031-F1-R0  
JOB REQUEST  
514815**

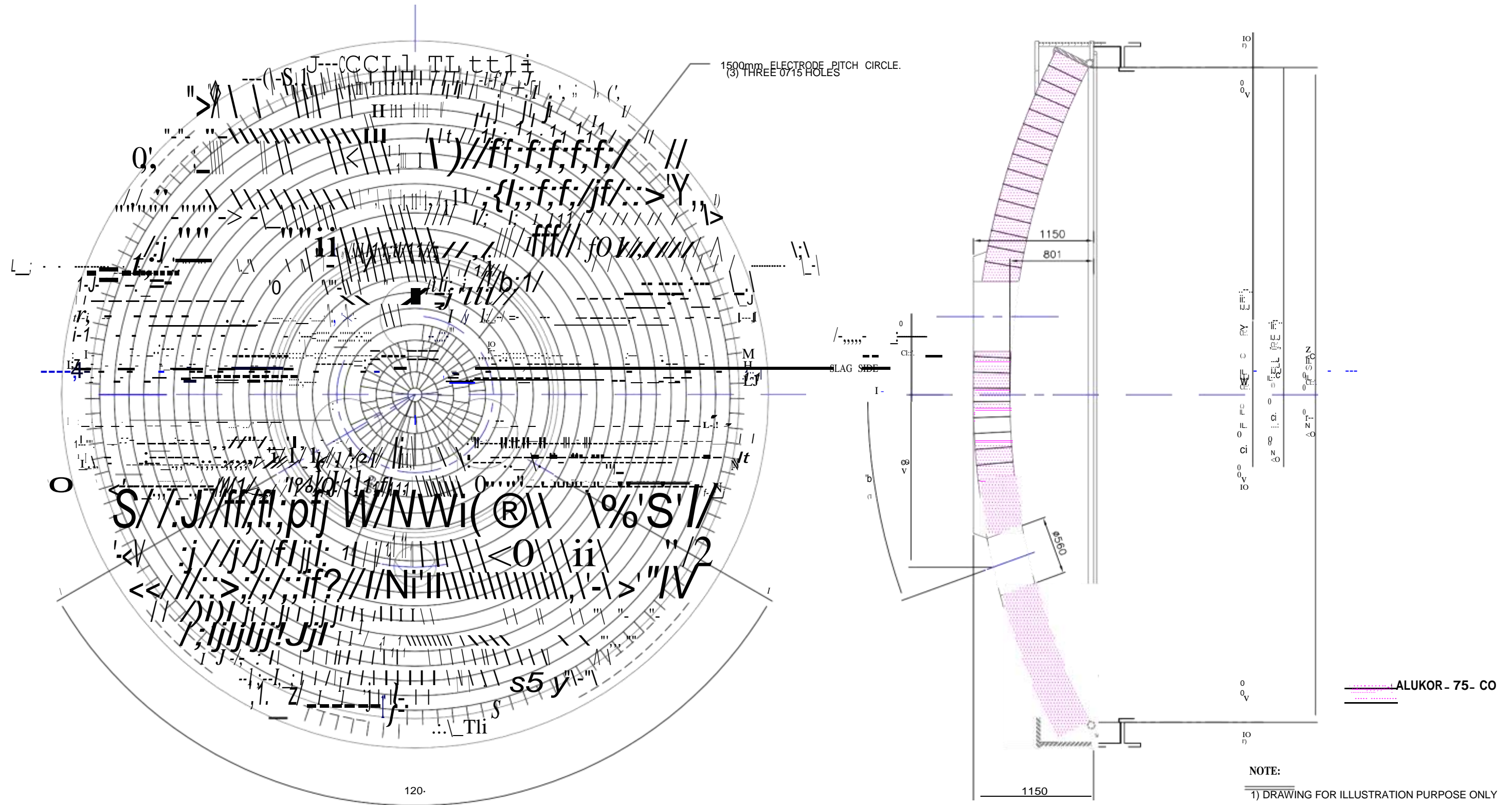
Date: 09 JUN 16

Drawn by: JPC

Chkd. by: VLB

Scale: 1 40

Sheet no. 1 OF 2



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**CUSTOMER:**

**TENOVA  
QUEBEC, CANADA  
EAF ROOF**

Date: 08 JUN 16

Drawn by:

JPC

Chkd. by:

VLB

Scale:

40

**DRWG No.  
T031-RF1 -RO  
JOB REQUEST  
514815**

Sheet no. 2 OF 2



**EB-FIL MRB**

A dust-free MgO dry vibrating material for use as a backfill behind the working lining of the Electric Arc Furnace. Jeb-Fil MRB offers superior resistance to basic slags.

**Method of Application** Pour behind the working lining brick every other course as they are laid. A ½" to 1" gap is suggested as a backfill. Compact by tamping with trowels, small rammers or pencil vibrators.

**Chemical Analysis** Typical Calcined Chemical Analysis (%)

MgO	92.4
CaO	1.6
SiO <sub>2</sub>	1.3
Al <sub>2</sub> O <sub>3</sub>	0.2
Fe <sub>2</sub> O <sub>3</sub>	0.8
Others	3.7

**Physical Characteristics** Typical Screen Analysis

	<u>Size US Sieve</u>	<u>% Through</u>
	4 (4.8mm)	93

Loose Bulk Density	141	(lbs./ft. <sup>3</sup> )
	2.26	(g/cc)
Installed Bulk Density	155	(lbs./ft. <sup>3</sup> )
	2.49	(g/cc)

**Packaging and Storage** Available in polyethylene lined 55 pound (25 kg) bags, 2000 pound and 4000 pound coated fabric super sacks. Also available in 25 kg, 1000 kg and 2000 kg. Products are shipped ready to use. Keep packaging tightly sealed until used. Store in cool, dry area and use within six months.

## TECHNICAL DATA SHEET

### GMAG-EAF-F5

Revision: 0

Date: 21 May 2013

<b>Description</b>	Resin bonded refractory brick, tempered, based on fused and sintered magnesia
<b>Main raw material component</b>	Fused magnesia
<b>Type of bond</b>	Resin bonded
<b>Main application</b>	Lining of electric arc furnace

<b>Chemical composition</b> (Loss on ignition - free)	<b>Typical</b>	<b>Unit</b>	<b>Test standard</b>			
MgO	96.0	%	ISO 12677			
Total Carbon	9.5	%	Internal Procedure			
<b>Physical properties</b> (as delivered)	<b>Typical</b>	<b>Unit</b>	<b>Test standard</b>			
Bulk density	3.02	g/cm <sup>3</sup>	EN 993-1 / ABNT-6220			
Apparent porosity	3.5	%	EN 993-1 / ABNT-6220			
Cold crushing strength	60	MPa	EN 993-5 / ABNT-6224			
	<b>800</b>	<b>1000</b>	<b>1200</b>	<b>1400</b>	<b>°C</b>	<b>Test standard</b>
Bulk density	-	-	-	3.00	g/cm <sup>3</sup>	EN 993-1 / ABNT-6220
Apparent porosity	-	-	-	8.0	%	EN 993-1 / ABNT-6220
Hot modulus of rupture	-	-	-	17.0	MPa	EN 993-7 / ABNT-9642





**DOLA B- 0 FS**

Dola B-80 FS is a dry, vibratable, magnesia/doloma, electric furnace bottom material for new bottoms or major cold resurfacing. Dola B-80 FS is formulated for enhanced sinterability versus Magnesita's traditional Dola B-80 material. The low Fe<sub>2</sub>O<sub>3</sub> content and high installed density are designed for today's hottest EAF's.

Method of Application Apply directly from super sack or utilize a spreader. Manually de-air by spiking with shovels, followed by surface vibration.

Chemical Analysis

Typical Calcined Chemical Analysis (%)

MgO	77.5
CaO	19.1
SiO <sub>2</sub>	0.8
Al <sub>2</sub> O <sub>3</sub>	0.3
Fe <sub>2</sub> O <sub>3</sub>	2.3

Physical Characteristics

Typical Screen Analysis

<u>Sieve (mm)</u>	<u>% On</u>
+9.50	0
-9.50 +2.80	33
-2.80 +1.40	22
-1.40 +0.60	12
-0.60+0.25	8
-0.60	25

Vibrated Density	172	(lbs./ft. <sup>3</sup> )
	2.75	(g/cc)
Shoveled Density	149	(lbs./ft. <sup>3</sup> )
	2.38	(g/cc)

Packaging and Storage

Available in polyethylene lined 25 kg. bags and 500 kg., 1000 kg., and 2000 kg. coated fabric super sacks. Store in a dry area and use within six months.



**ALUKOR-75-CO**

A high purity, andalusite-enhanced alumina brick with superior resistance to thermal shock. Major applications include high-temperature blast furnace stoves and furnace walls.

**Chemical Analysis**

Typical Calcined Chemical Analysis (%)

MgO	0.1
CaO	0.1
SiO <sub>2</sub>	21.9
Al <sub>2</sub> O <sub>3</sub>	75.5
Fe <sub>2</sub> O <sub>3</sub>	0.8
TiO <sub>2</sub>	1.4
Alkalis	0.2

**Physical Characteristics**

Bulk Density	165	(lbs./ft. <sup>3</sup> )
	2.64	(g/cc)
Porosity	16.5	(%)
MOR (As received)	1395	(lbs./in. <sup>2</sup> )
	9.5	(MPa)
CCS (As received)	9,250	(lbs./in. <sup>2</sup> )
	63.5	(MPa)
Permanent Linear Change	@ 2732°F 1500°C	±1.2 (%)

**Packaging and Storage**

Shipped on pallets. Store in cool, dry place.





**C-BOND SUPER  
EAF-13D**

A premium quality magnesia-carbon electric arc furnace brick with 13% retained carbon. The brick is based on a combination of high density sintered and fused magnesias and natural flake graphite. C-Bond Super EAF-13D contains a metallic addition to enhance oxidation resistance and strength.

Chemical Analysis

By XRF-Calcined Basis

MgO	89.5
CaO	1.9
SiO <sub>2</sub>	3.2
Al <sub>2</sub> O <sub>3</sub>	4.6
Fe <sub>2</sub> O <sub>3</sub>	0.7

Aggregate Based on Minimum 97% MgO

Physical Characteristics	Bulk Density	186.0	(lbs./ft. <sup>3</sup> )
		2.98	(g/cc)
	Retained Carbon	13.0	(%)
	Porosity (Coked)	10.0	(%)
	MOR (As received)	2000	(lbs./in. <sup>2</sup> )
		13.8	(MPa)
	Thermal Conductivity	@ 1472°F	56.0 (BTU•in/ft. <sup>2</sup> •hr.°F)
		800°C	8.1 (W/m•K)

Packaging and Storage

Shipped shrink wrapped on pallets. Use within two years if unopened and store in cool, dry area.

## TECHNICAL DATA SHEET

### BASIMAG-30

ISSUED ON: November/29<sup>th</sup>/2011

#### BRAND CODE 2222

**PRODUCT DESCRIPTION** Refractory bricks based on sintered magnesita, fired.

**MAIN APPLICATIONS** Hot-metal mixer, electric furnace, LD converters, electric reduction furnace of ferronickel.

#### CHEMICAL ANALYSIS (%)

MgO	CaO	Fe <sub>2</sub> O <sub>3</sub>	Al <sub>2</sub> O <sub>3</sub>	SiO <sub>2</sub>
98.0	0.9	0.4	0.3	0.3

#### PHYSICAL PROPERTIES

	Typical Value	Unit
Bulk density	2.98	(g/cm <sup>3</sup> )
Apparent porosity	14.5	(%)
Cold crushing strength	75	(MPa)
Hot modulus of rupture at 1485 °C x 3 h	6.0	(MPa)
Thermal Shock Resistance	35	(Cycles of 950°C x 30 min)
Reversible thermal expansion up to 1200 °C	1.6	(%)
Reversible thermal expansion up to 1500 °C	2.0	(%)
Permanent linear change at 1700 °C x 5 h	- 0.1	(%)
Creep at 1450°C x 50h x 0.2MPa	0.8	(%)

#### Remarks:

- 1- The tests are performed in accordance with ABNT, ASTM, EN, DIN standards and internal procedures.
- 2- For additional information concerning security it is recommended to consult the Material Safety Data Sheet – MSDS.
- 3- Chemical analysis was performed according to Magnesita's internal procedure using calcined basis.
- 4- Chemical analysis and special tests follow the Process Management according to ISO 9001.
- 5- Technical data were obtained from specimen of this brand taken from industrial production.
- 6- Typical values were statistically calculated according to the brand database.
- 7- The information on this sheet may change without notice. When placing the order please check if this is the latest available data sheet review.

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CB004237- 01

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SECTION 8-8

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2016.05.26  
EAF

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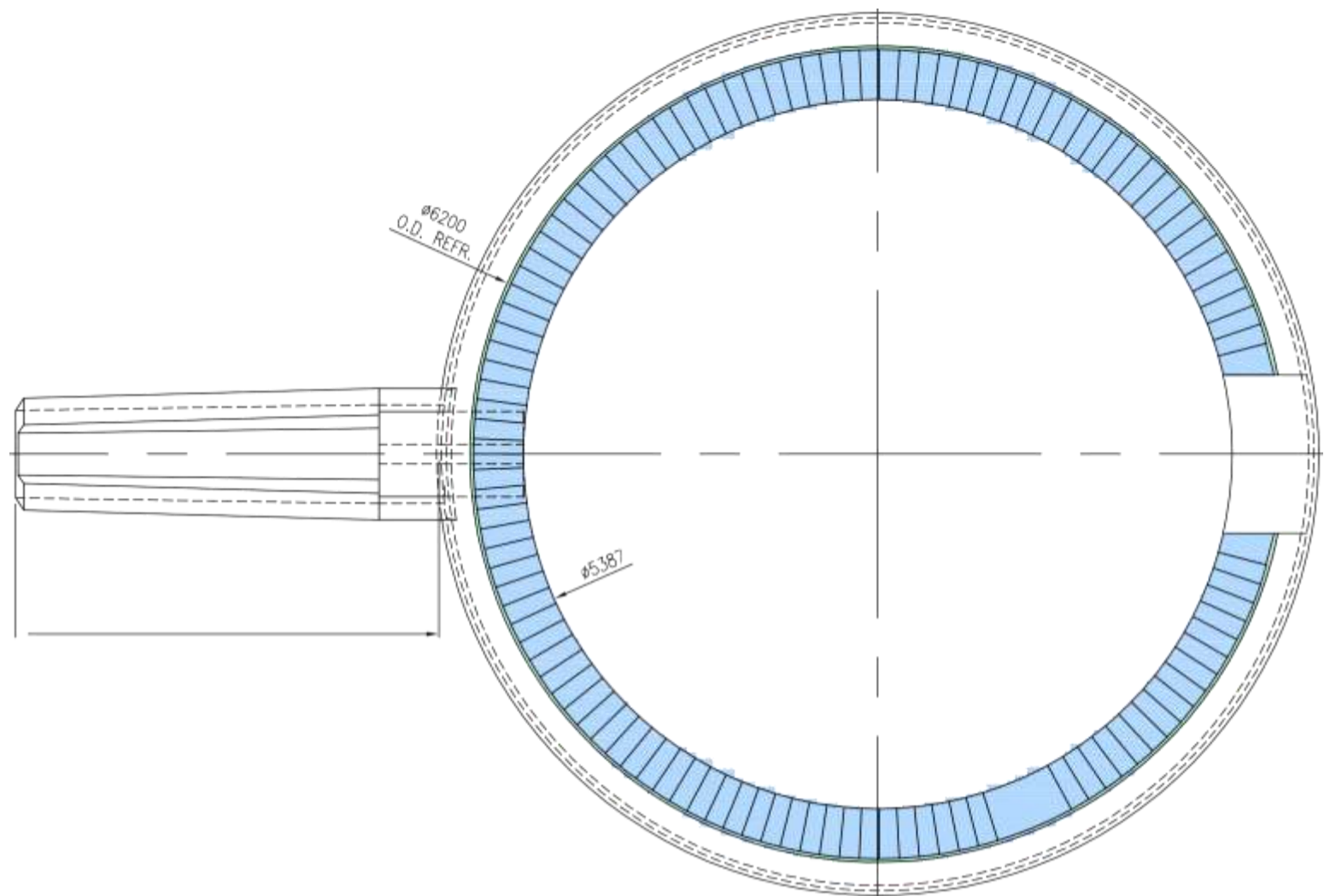
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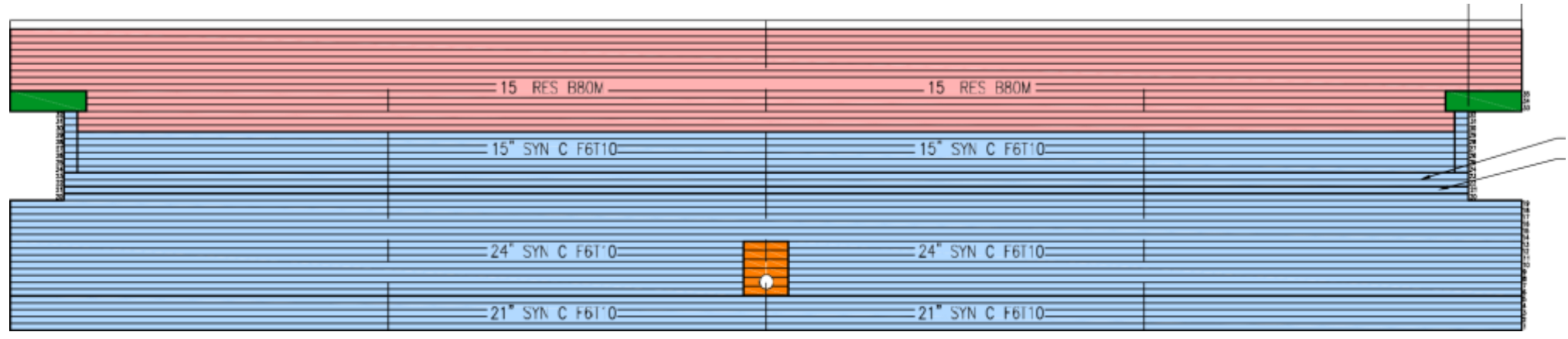
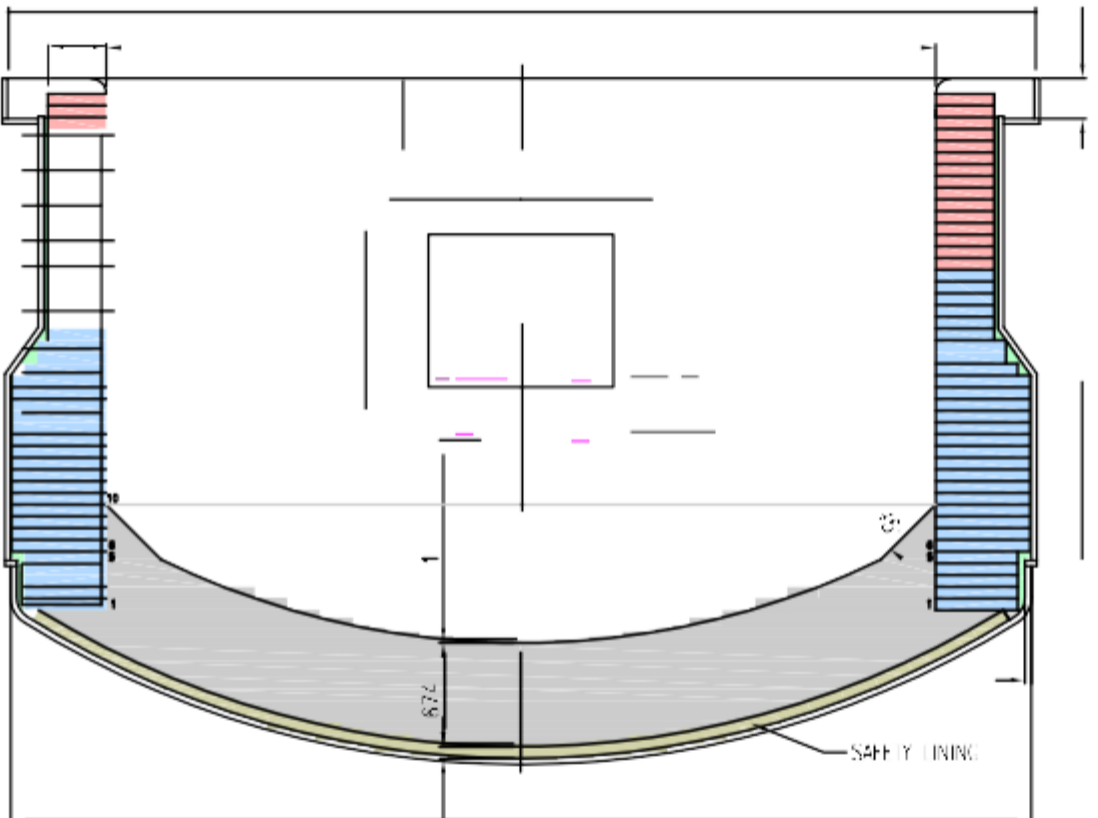
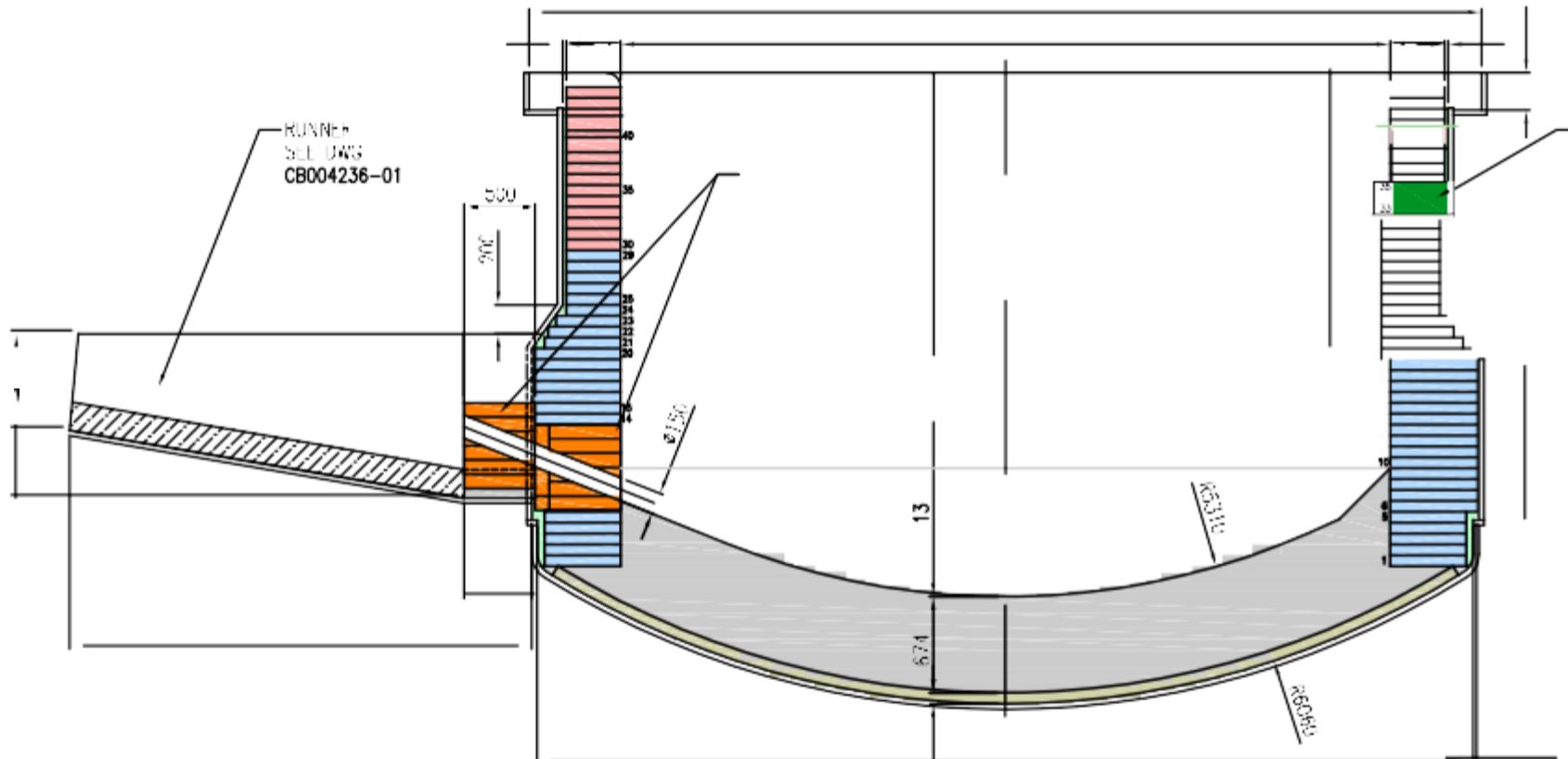
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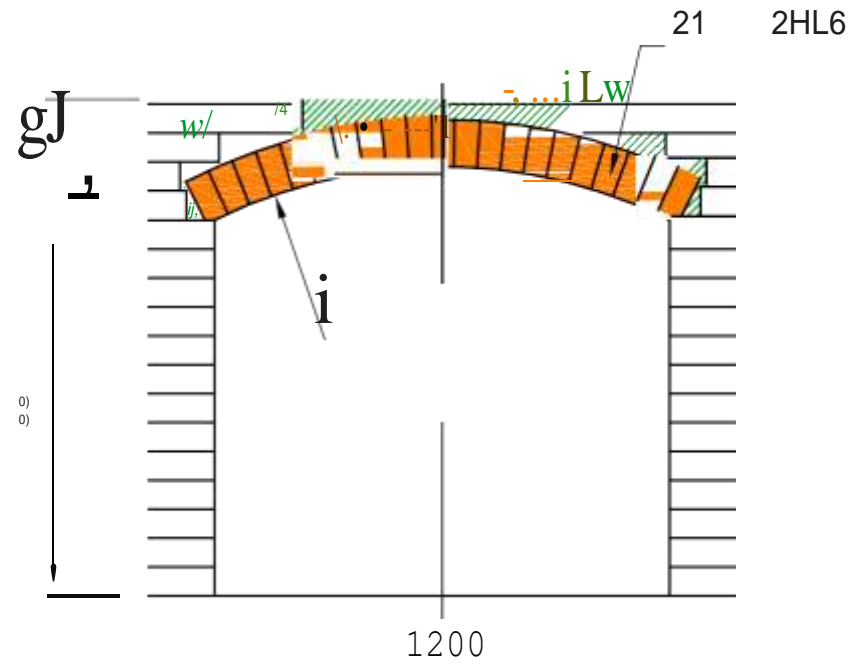
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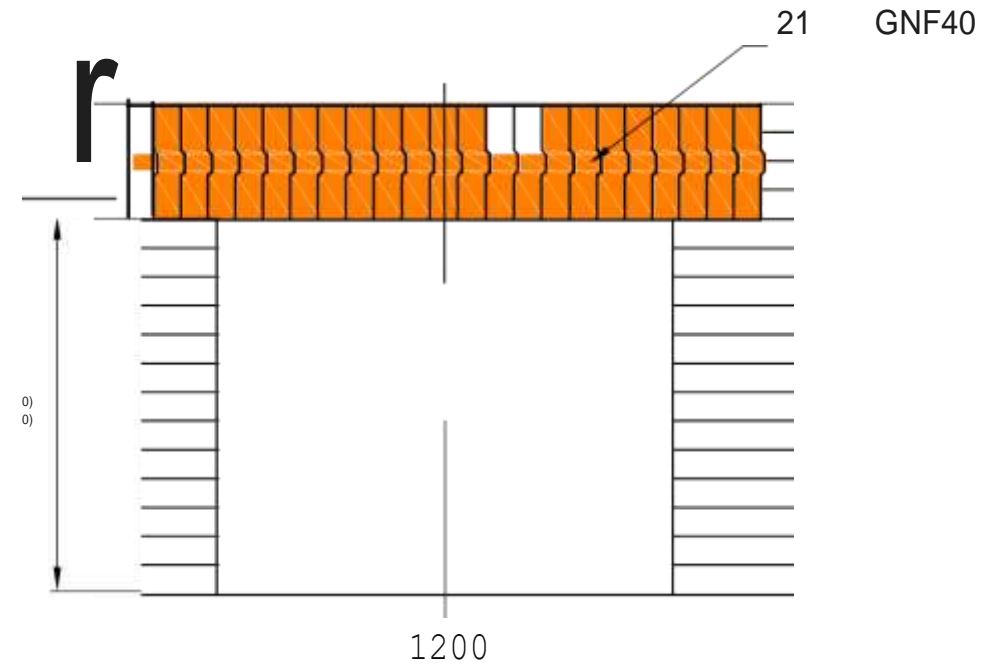
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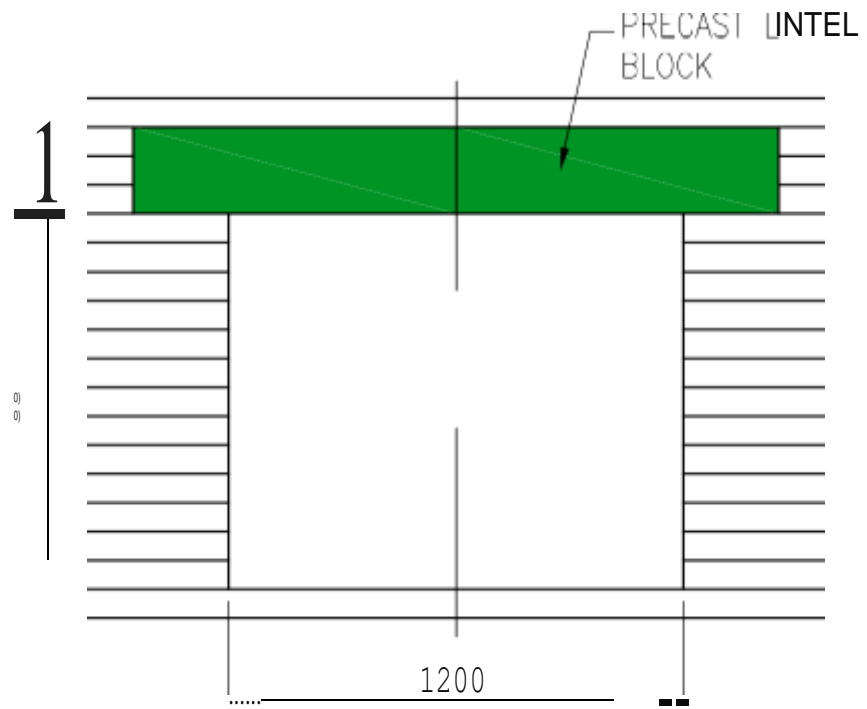
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VAR. II SPECIAL KEY SHAPES



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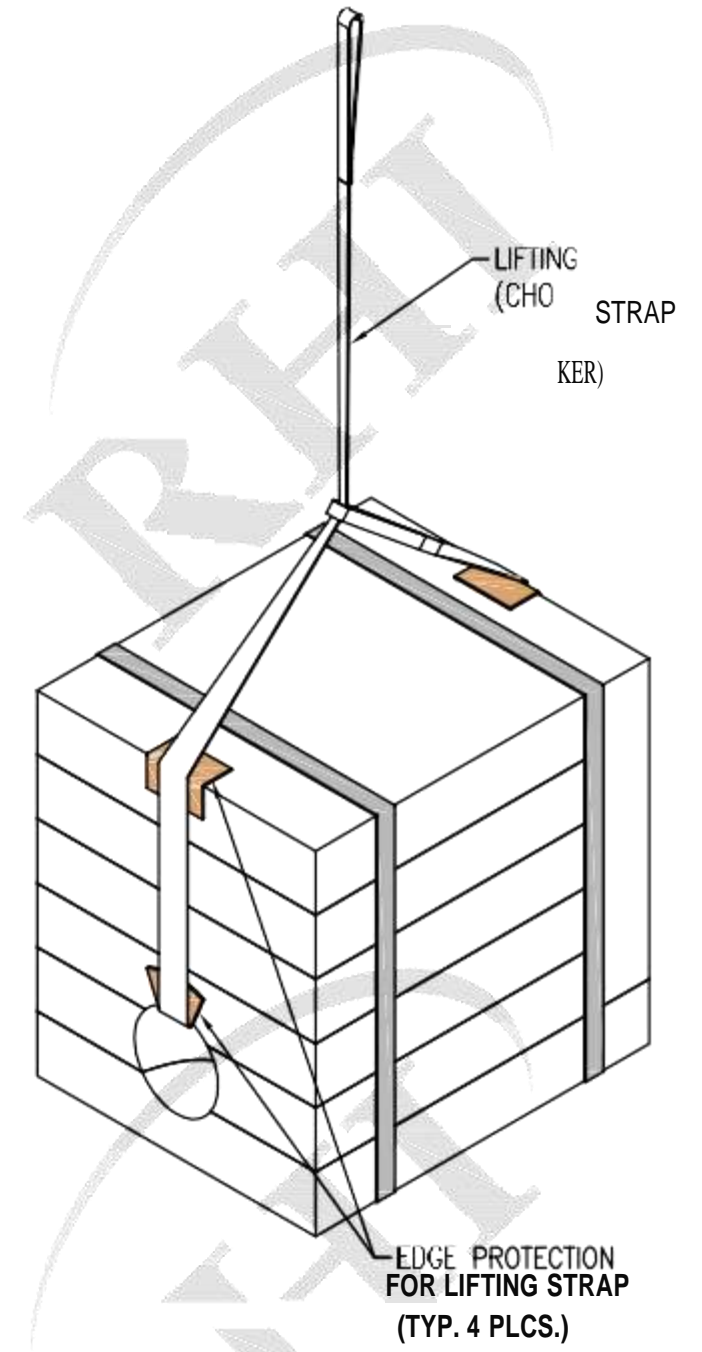
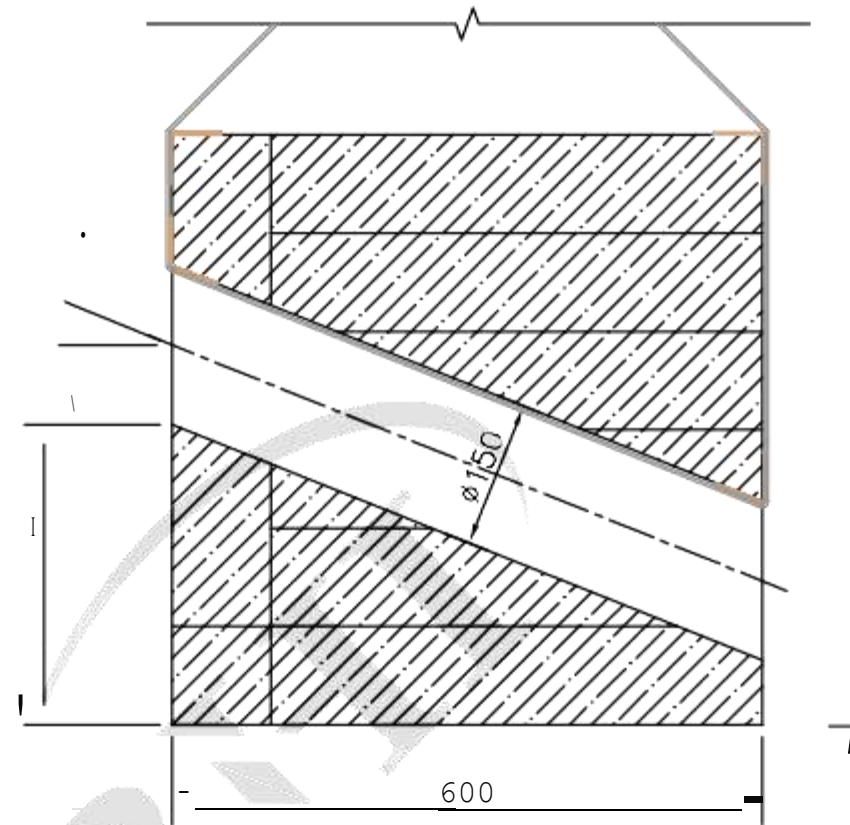
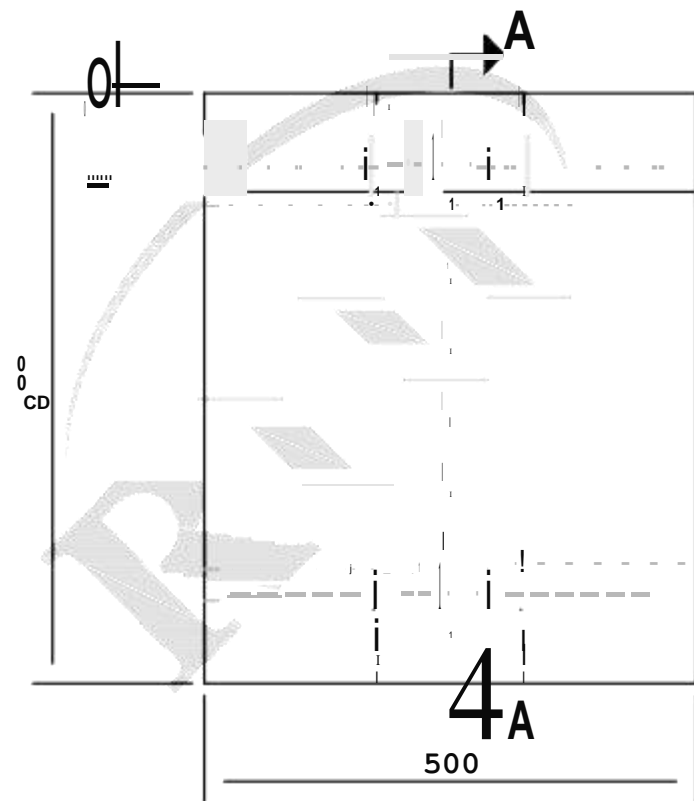
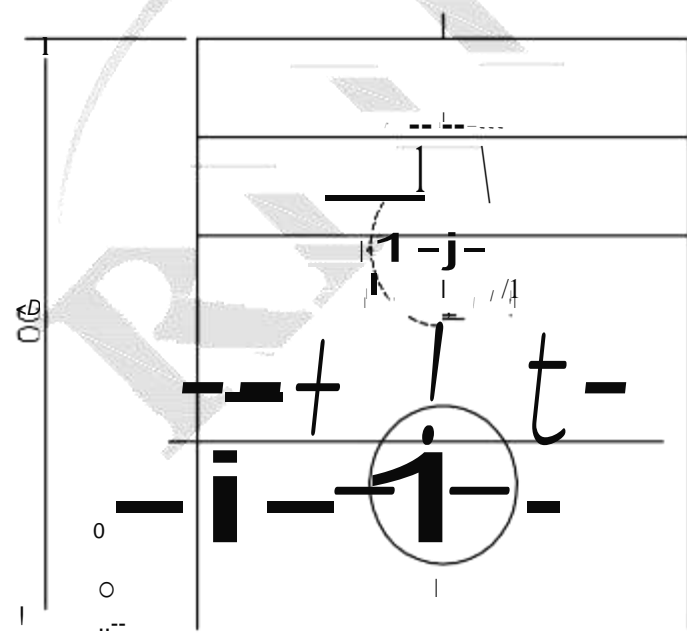
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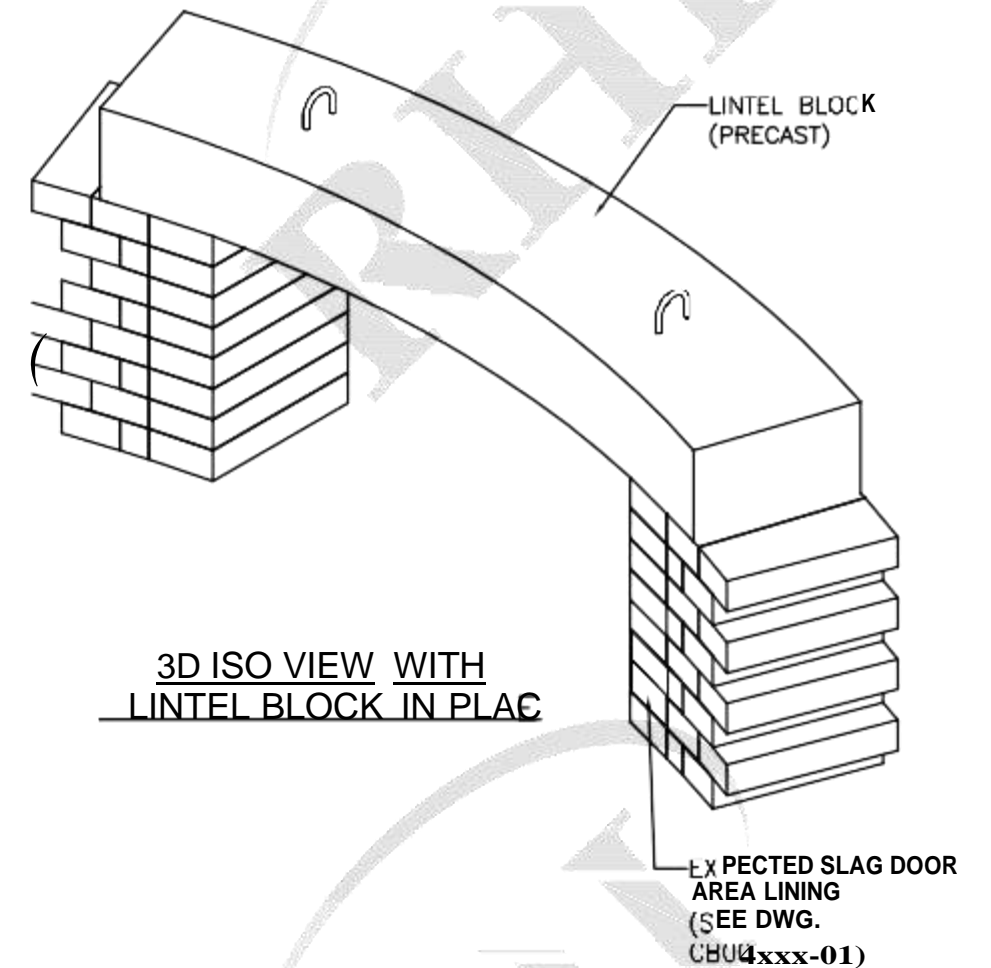
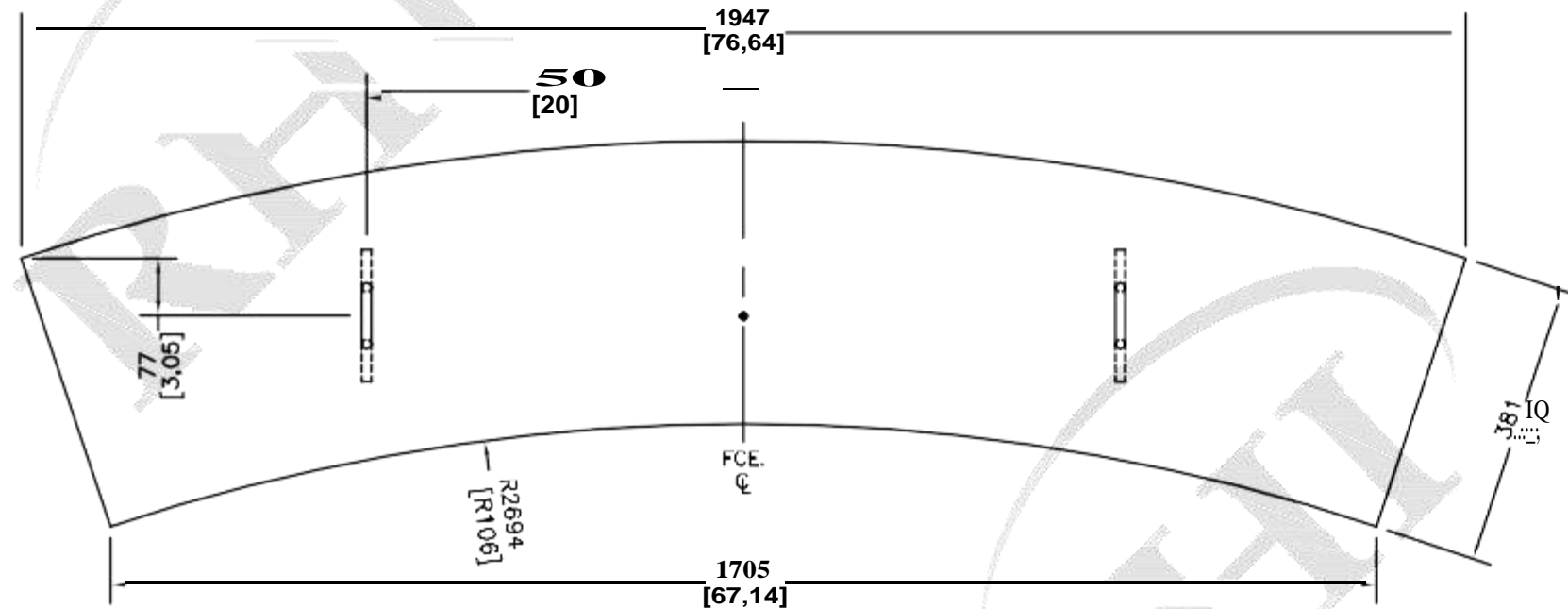
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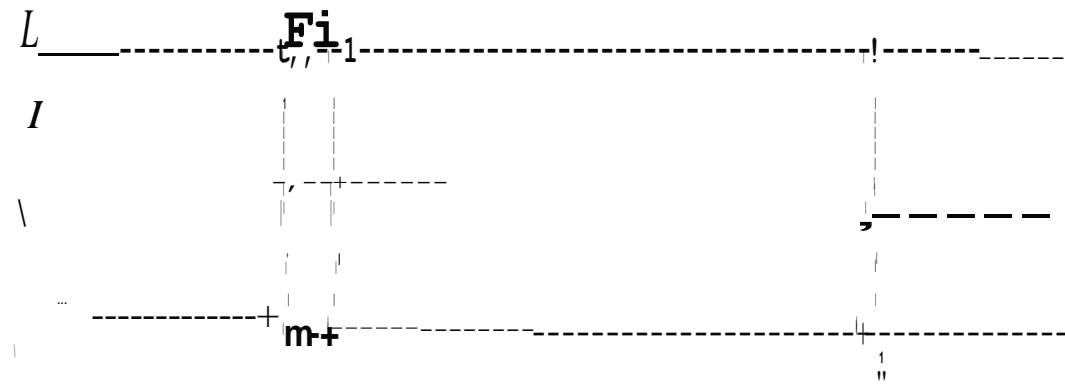
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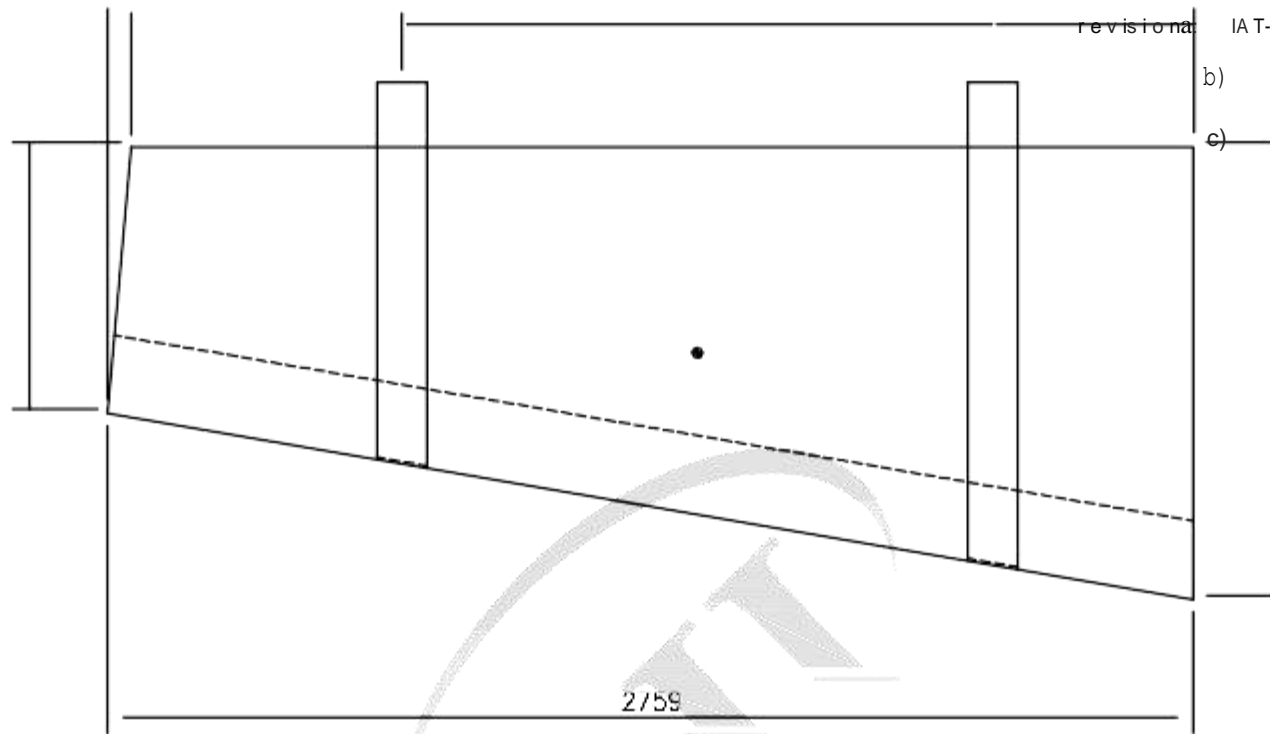
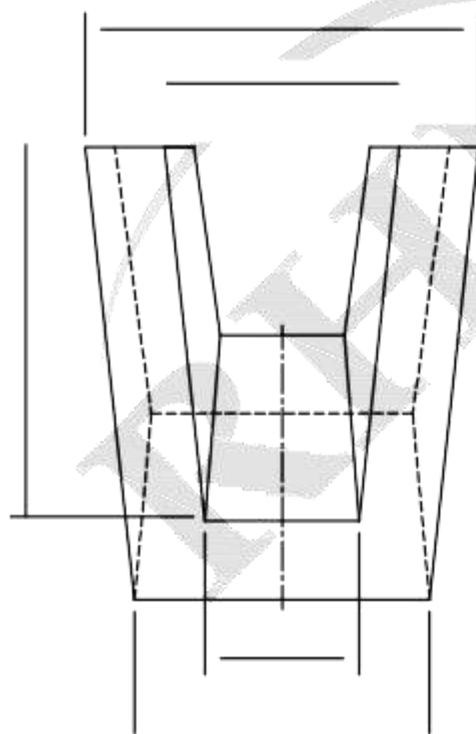
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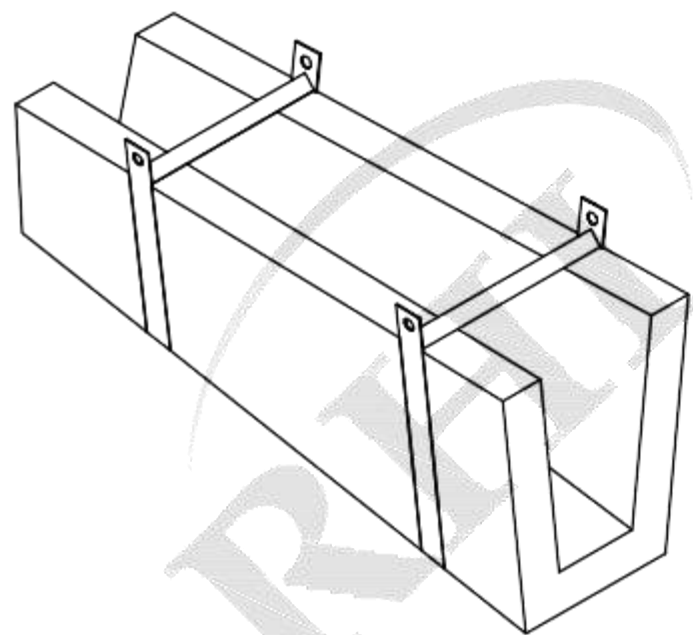
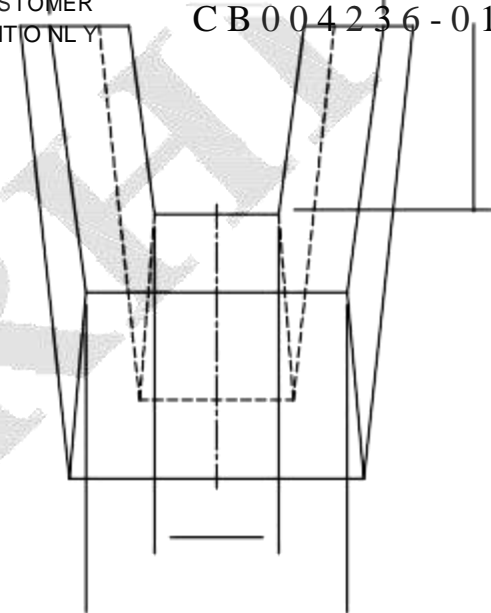
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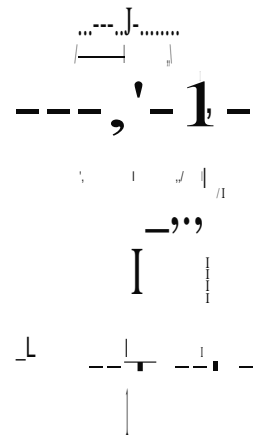


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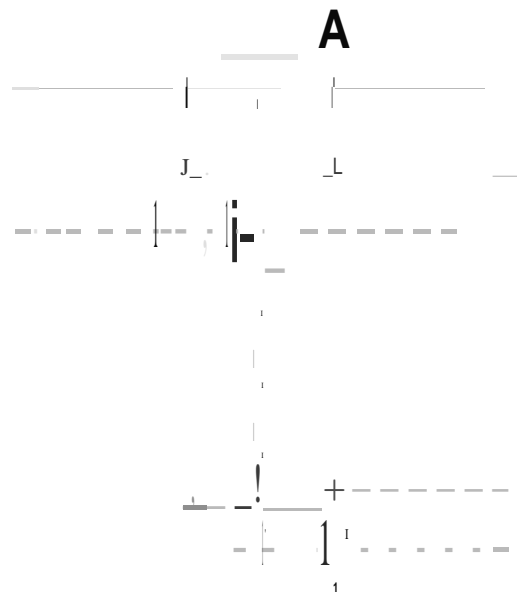
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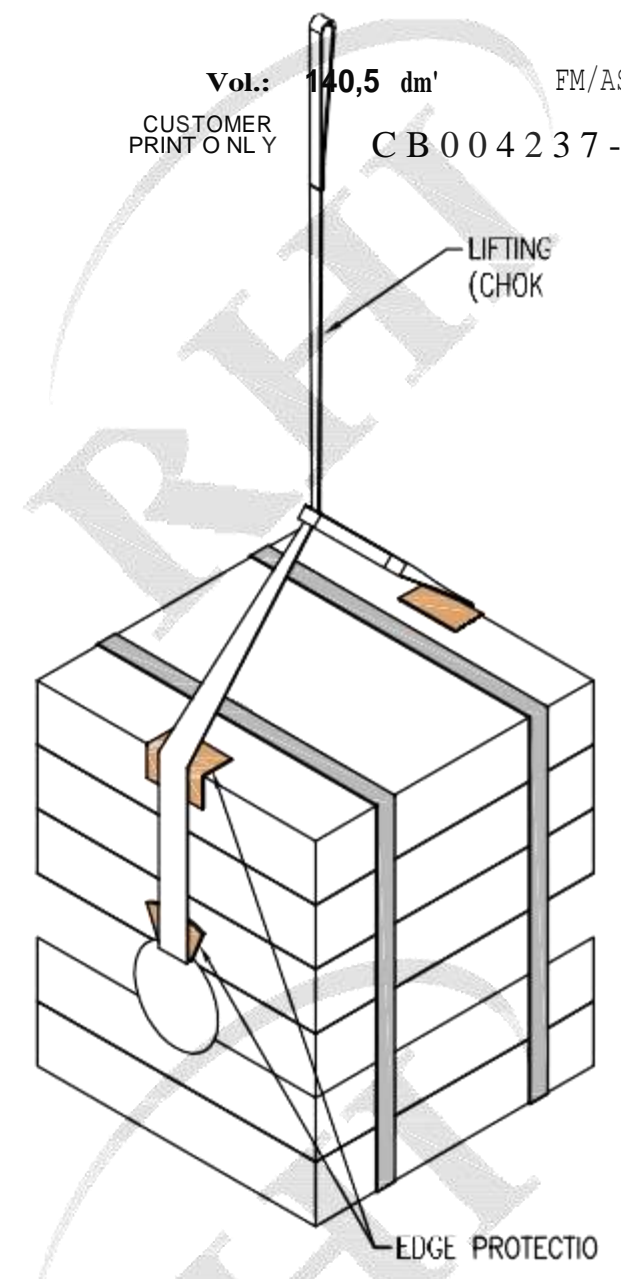
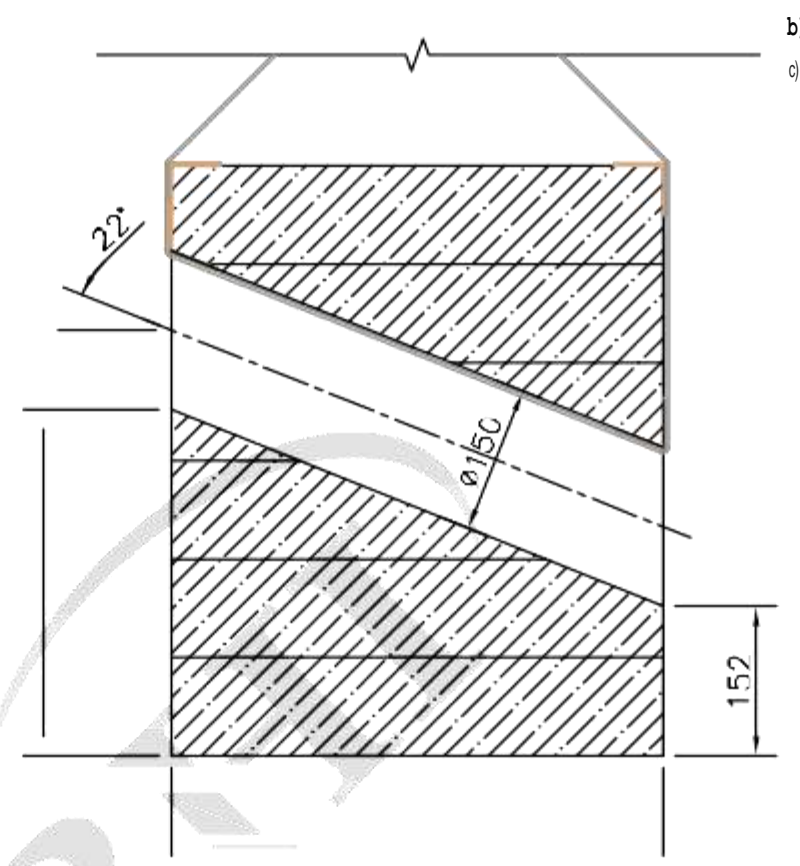
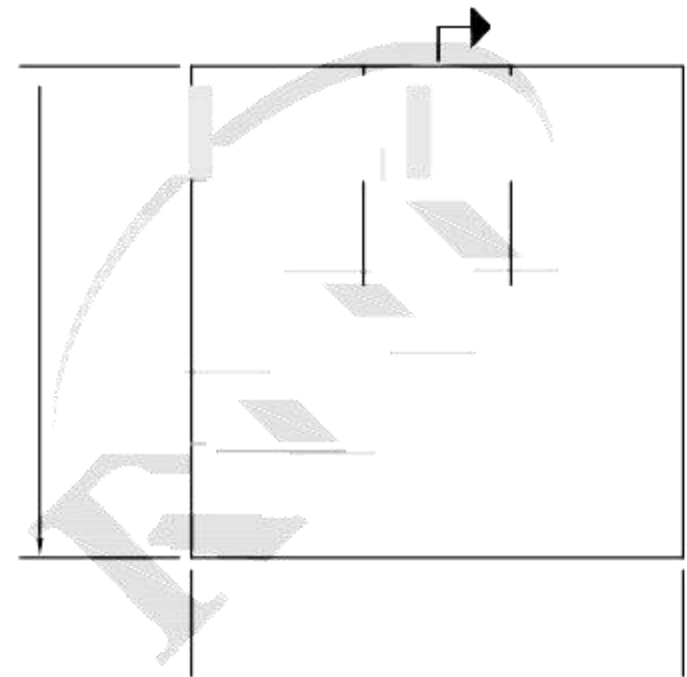
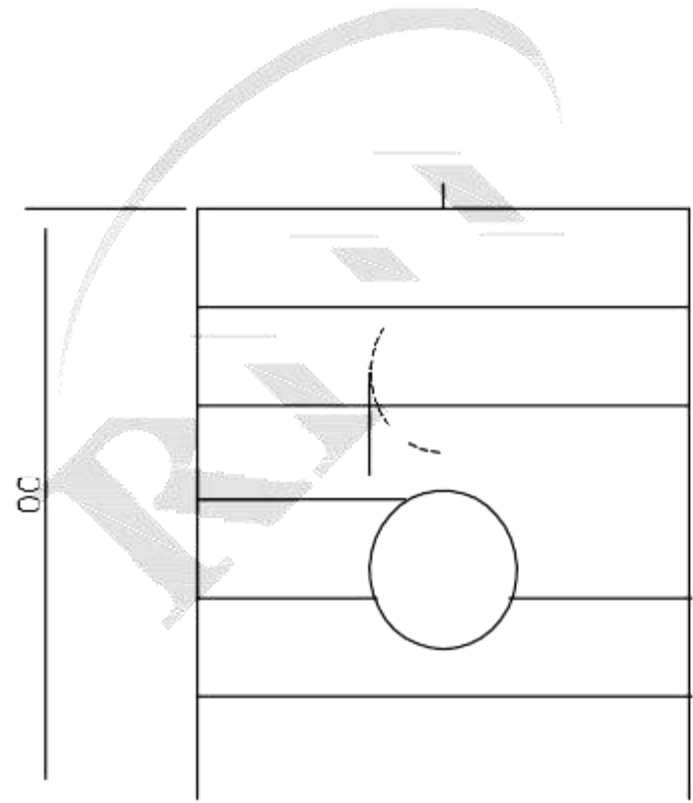
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	TENOVA TECHINT ENGINEERING & CONSTRUCTION
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## 10.4 A x ar E m

The present section includes the technical description of the auxiliary equipment, systems and plants that are required for PURE FONTE LTÉE process as:

1. Material Handling System for EAF fluxes (lime, dololime, bauxite)
2. Fumes Treatment plant
3. Ladles and ladle maintenance equipment
4. Cranes
5. Water Treatment Plant
6. Rainwater and Sanitary water plant
7. Electrical Substation and distribution
8. Fines and sludge briquetting plant
9. EAF slag processing equipment



## 10.4.1 EAF Fluxes Material Handling

### 10.4.1.1 Overview and general characteristics

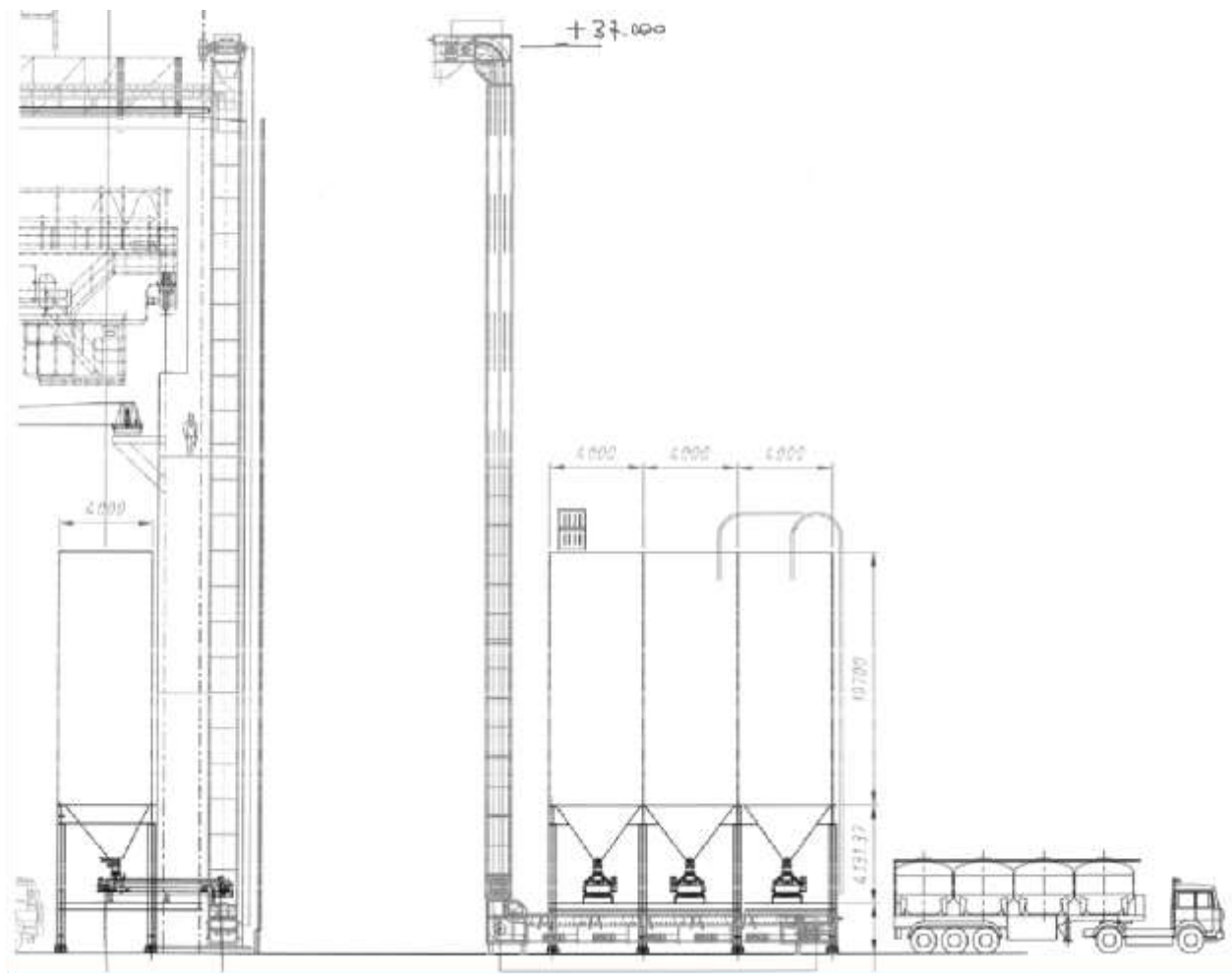


Figure 10.4-1.: elevation view of the EAF fluxes material handling system

The EAF fluxes MHS is located inside the main EAF bay, on the east side of the furnace and is equipped with three silos, one for lime, one for dololime and one spare silo that can be sued for lime or dololime or bauxite is the EAF process will require it. The material that is charged into these silos is lump material delivered by truck to the plant and charged pneumatically to the silos. From the silos the material is weighed and conveyed to the EAF by means of weigh belt feeders, trough belt conveyors, elevating conveyor and chutes.

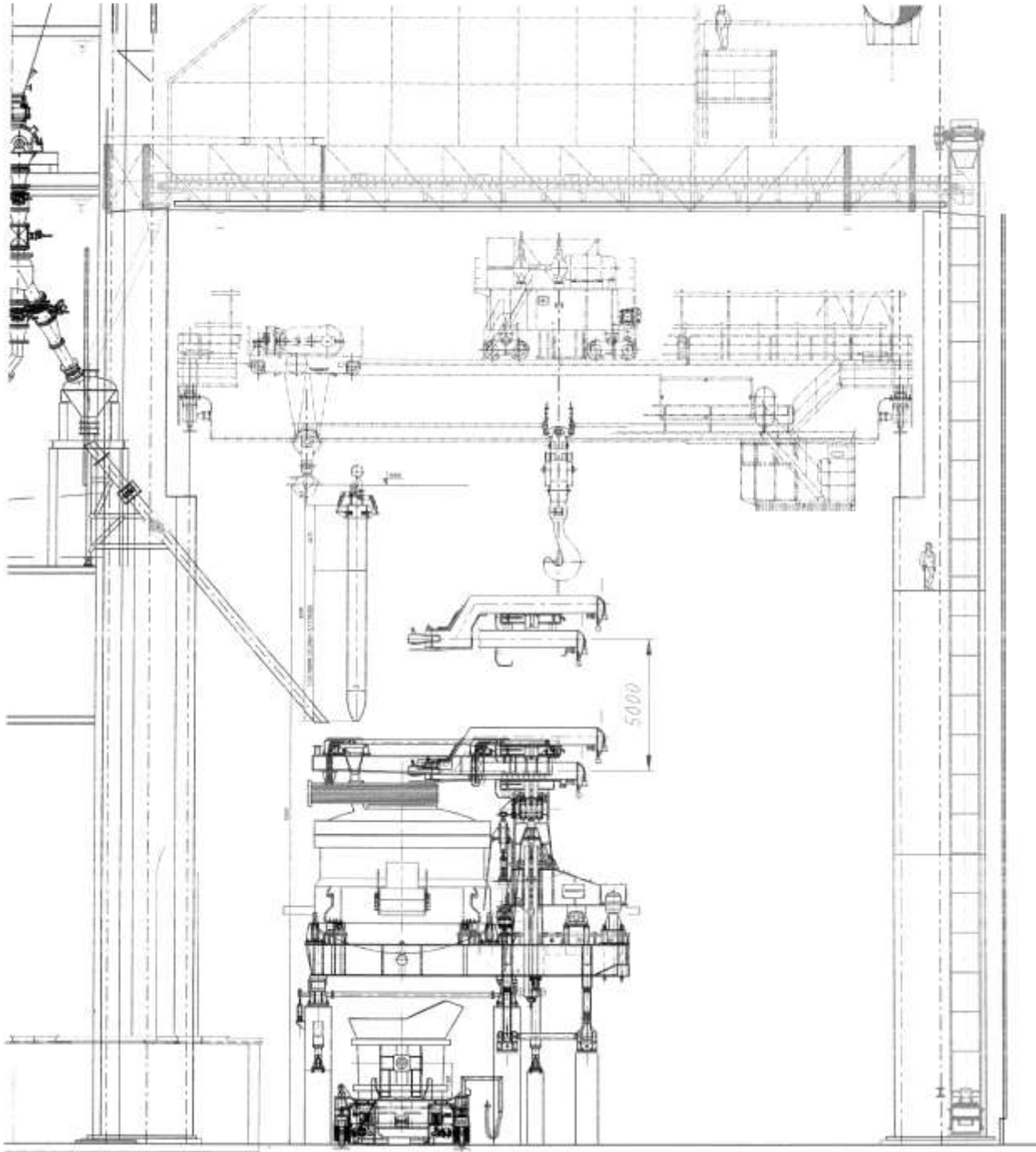


Figure 10.4-2.: cross section of the EAF fluxes material handling system

Material: Lime, Dolomitic lime, Bauxite

- Material sizes: From 0,0 to 40 mm.
- Specific weight 2,55 t/m<sup>3</sup>
- Humidity Minus 5%
- Material out size Max 5%

System:

- Max operating time: 24 hours
- Compressed air: Min 6 bar – dry
- Electric motors: 600V 60Hz – IP54 Class F Tropicalized
- Magnetic extractors: 600V 60Hz – IP65
- Magnetic extractors control panel: 600V 60Hz
- Limit switch – sensors: 120 VAC 60Hz / 24 VDC-IP55
- Solenoid valve: 24Vdc
- Installed power: ca 85,5 KW
- PipingUNI

Fluids data, compressed air:

- Type: Instruments compressed air
- Dew point: -30°C
- Oil content: Maximum 0,01 mg/m<sup>3</sup>

- Particle size: Max 0,1  $\mu\text{m}$
- Particle Concentration: Max 0,1  $\text{mg}/\text{m}^3$
- Pressure: 0,6 MPa
- Temperature: Ambient

#### 10.4.1.2 Components Description

Following we give a description of the system and main supplied components.

NOTE:

Stairs, walkways and platform shall be previewed to reach in safety conditions each inspection and maintenance area, load capacity 400  $\text{kg}/\text{m}^2$ .

Walkways (min. width 600mm) and steps in grating panels galvanized 25x76, plate 25x3;

Handrails designed as following: angular profile 50x50x5, upper pipe diameter 42x3 mm. intermediate pipe diameter 27x3 mm. foot plate guard height 150x3 mm.

Supporting structures under the belt conveyors frames will include protection to prevent material falling down (anti falling net 30x60mm.)

The electronic regulation cards for electromagnetic extractors will be supplied loose and will be installed inside the Costumer electrical panel.

All equipment will be operating in safety conditions during operation (protection, covers, shield will be foreseen) overall the lateral side of the belt conveyor frames.

All the equipment will be able to start at full load; where necessary (motor power more than 20 kW) the hydraulic joint will be included.

Gear motors will be supplied without oil for transportation (oil at Costumer charge).

Equipment will be supplied with risk assessment and safety lay-out.

- All machinery will be supplied as following:
  - Belt conveyors:
    - drive end completely assembled;
    - idle end completely assembled;
    - central bodies with length 6 meters without rollers and devices;
    - box containing: rollers, pull rope switch and other devices to be installed on belt conveyor during erection;
    - belt in open ring: junction to be done during erection;
    - belt conveyors shorter than 11 ml. will be supplied fully assembled and tested;
  - Weighing conveyor:
    - completely assembled with closed belt;
  - Belt elevator:
    - drive end completely assembled;
    - idle end completely assembled;
    - lower and upper curve completely assembled;
    - horizontal part assembled without rollers and devices;
    - vertical tubes to be assembled during erection;
    - box containing: rollers, pull rope switch and other devices to be installed on belt elevator during erection;
    - belt in open ring: junction to be done during erection;
  - Electric diverter:
    - completely assembled;
  - Vibrating feeders:
    - completely assembled;
  - Vibrating screening:
    - completely assembled;
  - Bins vibrating bottom:

- completely assembled;
- Bin discharging system
  - completely assembled;
- Filter for S2 bin:
  - completely assembled;
- Slide gate valves:
  - completely assembled;
- Mixer tank for coating system:
  - completely assembled;
- Carpentry: completely loose, with commercial parts in wooden boxes

### 10.4.1.3 Components Details

#### Nm.03 Bauxite, Lime, Dololime storage bins (S/1-2-3)

Main characteristics:

Nm. 03 storage bins capacity 120 m<sup>3</sup> each, (single discharge point);

Inspection door: nm. 01 each storage bin and a ladder inside of bin for maintenance;

Main sizes: following Tenova drawing;

Walking plan at storage bins roof;

Sheets thickness Fe: 6 mm.;

Bolted wear plate excluded.;

Charging pipe DN100, thickness 5,0 mm., with pneumatic safety valve;

Pressure control valve D.273 mm.;

#### Nm.01 Bauxite big-bag discharging hopper (S/1)

Nm. 01 Hopper capacity 600 lt., thickness 6 mm.;

Nm. 01 safety grid in carbon steel;

Big-bag cutter system (with nm. 04 INOX blade);

Nm. 01 Discharging DN300 pneumatic fly valve with position switches.

#### Nm.03 Filter for S/1-2-3 (FL/1-2-3)

Main size: mm. 800x1500 height mm H 1800

Position: bolted to S/2 bin roof;

Installed power: 7,5 Kw;

Filtration area: 54 m<sup>2</sup>;

Filtration sleeves system: comprised air;

Sleeves material: antistatic, hydro-oleo phobic;

Timer sleeves cleaning;

Filter body: AISI 304;

Support plate: Fe360;

Included devices: set of bolts, flexible hoses.

#### Nm.03 Material Storage Bins (S/1-2-3)

Nm. 03 Continuous radar level sensor, 4/20 mA;

#### Nm.03 Material Storage Bins (S/1-2-3)

Nm. 03 Maximum vibration level sensor switch, (800 mm. rope);

Nm.03 Material Storage Bins (S/1-2-3)

Nm. 03 Minimum vibration level sensor switch, (13.000 mm. rope);

Nm.03 Extractor Vibrating Cones (FB/1-2-3)

Main size: diameter 2350/406 mm.,

Flow capacity 100 m<sup>3</sup>/h;

Drive: nm. 02 vibrators RPM 1500, 1,0 Kw each;

Suspensions: nm. 24 STD in rubber,

Flange and counter flange;

Anti-vibration joint bolted to carpentry;

Deflector cone: tilting 45°;

Included devices: set of bolts;

Expansion joint in the outlet.

Nm.03 Blade Manual Valves 370x370 mm (MV/1-2-3)

Main size: mm. 1.000 height mm. H 125;

Position: bolted to vibrating cone;

Included devices: set of bolts, manual drive.

Nm. 03 Square Pneumatic Valve 370x370 mm (AGV/1-2-3)

Main size: mm. 1.400x370 height mm H 125;

Position: bolted to hand valve;

Included devices: set of bolts, pneumatic drive, solenoid valves, limit switches, flexible hoses, pipes, expansion joint, coupling with telescopic discharger with flanged tube.



Nr. 01 Technological Support Structure for S/1-2-3, BCW/1-2-3 (ST/1)

Technical characteristics:

Carpentry structure in HE profile DIN;

Main dimension: see drawing study.

Cover roof and lateral side: excluded;

Nm. 03 Weighing Belt Conveyor for Three Different Type of Material (BCW/1-2-3)

Technical characteristics:

Material: normal conditions;

Nominal flow: from 20 m<sup>3</sup>/h to 80 m<sup>3</sup>/h;

Belt type: width 800 mm. EP 400.3 4+2 Transflex;

Speed: 0, 25 m/sec, adjustable by inverter (inverter at Customer charge);

Belt supports: roller with bearings horizontal, roller diameter 89 mm.;

Charge / discharge distance axis: 6.000 mm.;

Installed power: 7, 5 kW;

Belt supporting rollers distance in upper charging and weighing part: from 200 to 350 mm.;

Belt supporting rollers distance in upper part: from 350 to 500 mm.;

Belt supporting rollers distance in lower part (idle branch): 1.000 mm.;

Drive drum diameter: 323 mm machined.;

Idle drum diameter: 323 mm. machined;

Drums coating: drive drum th.8 mm rhombus design;

Structure: self-carrying structure;

Pull rope switches: nm. 02;

Misalignment switches: nm 02;

Side plates with rubber stripes along all belt;

Bolted sheet covers Th. 1,5mm;

Cabling: cable ways with galvanized pipe, joint with RTA sheath;

Junction Boxes;

Rotating detector switch;

Belt scraper before the idle drum;

### Nr. 01 Main Bucket Belt Conveyor (EL/1)

Technical characteristics:

Material: normal conditions;

Nominal flow 80 m<sup>3</sup>/h – 200 tons/h;

Cups belt type: EP500/4-5+3 belt width= 800 mm.;

Edge height: 240 mm.;

Cups height: 220 mm.;

Cups pitch: 260 mm.;

Speed: 1,15 m/s;

Vertical belt length: 37 ml. / slope 90°;

Horizontal belt length (lower part): 11 ml.

Horizontal belt length (upper part): 3,0 ml.

Installed power: 30 kW;

Drive drum diameter: 800 mm. machined;

Idle drum diameter: 800 mm. machined;

Deflection wheel diameter: 1.000 mm.;

Cups belt supporting rollers diameter: 89 mm.;

Drums coating: drive drum th.8 mm rhombus design;

Belt supporting rollers distance in load area: 400 mm.;

Belt supporting rollers distance in horizontal parts: 1.000 mm.;

Tilt switch (security switch for belt position): nm. 04;

Pull rope security switch: nm. 04;

Vertical tube: completely closed, with manhole near rollers;

Self-carrying structure;

Drive: orthogonal backstop gear directly coupled on the shaft, motor with hydraulic joint;

Cabling: Excluded;

Junction Boxes: Excluded;

Rotating detector switch, ;

Belt scraper before the idle drum;

Charging and discharging chute with wear plates thickness 8 mm.;

Drive end service platform: Excluded;

Supporting structures, handrails, ladder: Excluded

Drive drum: assembled with shaft by self-centering elements;

Idle drum: assembled with shaft by self-centering elements;

#### Nr. 01 Technological Support Structure for EL/1 and Back Gallery to Support the BC/1 tail (ST/2)

Technical characteristics:

Carpentry structure in HE profile DIN;

Main dimension: see drawing study;

Step stair from 0,0 to 37 ml. level;

Access to EL/1 head, platform comprise;

Access to BC/1 gallery;

Access to bins roof;

Cover roof and lateral side: excluded;

#### Nm. 01 Horizontal Belt Conveyor (BC/1)

Technical characteristics:

Material quality: normal conditions;

Nominal flow: 80 m<sup>3</sup>/h, 200 ton/h;

Belt type: HR (+80°) width 650 mm., EP 400.3 4+2 Transflex,

Belt speed: 1.1 m/s;

Belt supports: roller with bearings, triad 30°, roller diameter 89 mm.;

Charge / discharge distance axis: 30.000 mm.;

Installed power (for belt rotation): 7,5 Kw (electric TOP);

Impact belt supporting rollers distance in load area: 300 mm.;

Belt supporting rollers distance in upper part: 1.000 mm.;

Belt supporting rollers distance in lower part (idle branch): 3.000 mm.;

Drive drum diameter: 400 mm. machined;

Idle drum diameter: 400 mm. machined;

Drive drum: with self-centering coupling;

Idle drum: welded assembled;

Screw tensioning system;

Drum coating: drive drum th.8 mm rhombus design;

Structure: fully enclosed sheet (USA model) with proper legs, leaning against the below steel frame;

Pull rope switch: nm. 02 (electric TOP);

Tilt switches: excluded;

Side plates with rubber stripes along all the belt;

Drive: orthogonal gearmotor directly coupled on the shaft, without hydraulic joint;

Nm. 01 Rotating detector switch (electric TOP);

Belt scraper before the idle drum;

Nm. 02 Belt scraper at drive drum;

Discharge chutes with bolted wear plates thickness 8 mm., HB400;

Total cover of the belt.

#### Nm.01 Supporting Gallery for Belt Conveyor BC/1 (ST/3)

Technical characteristics:

Carpentry structure in HE profile DIN;

From level +0,0 to + 15.000 mm.;

Main dimension: length 30 ml, height 3,0 ml; width 2,7 ml;

With step access ladder from ST/2 structure;

Completely closed;

#### Nm.01 BC/1 Discharging Chute

Technical characteristics:

Material: normal conditions;

Nominal flow: 80 m<sup>3</sup>/h, 200 ton/h;

Size: 500x400 L= 5.200 mm.;

Bolted wear plates thickness 10 mm. on the bottom and lateral walls;

## 10.4.2 Fumes Treatment Plant

### 10.4.2.1 FTP general description

The FTP is responsible to collect and treat the air and gas emissions proceeding from the following emission points:

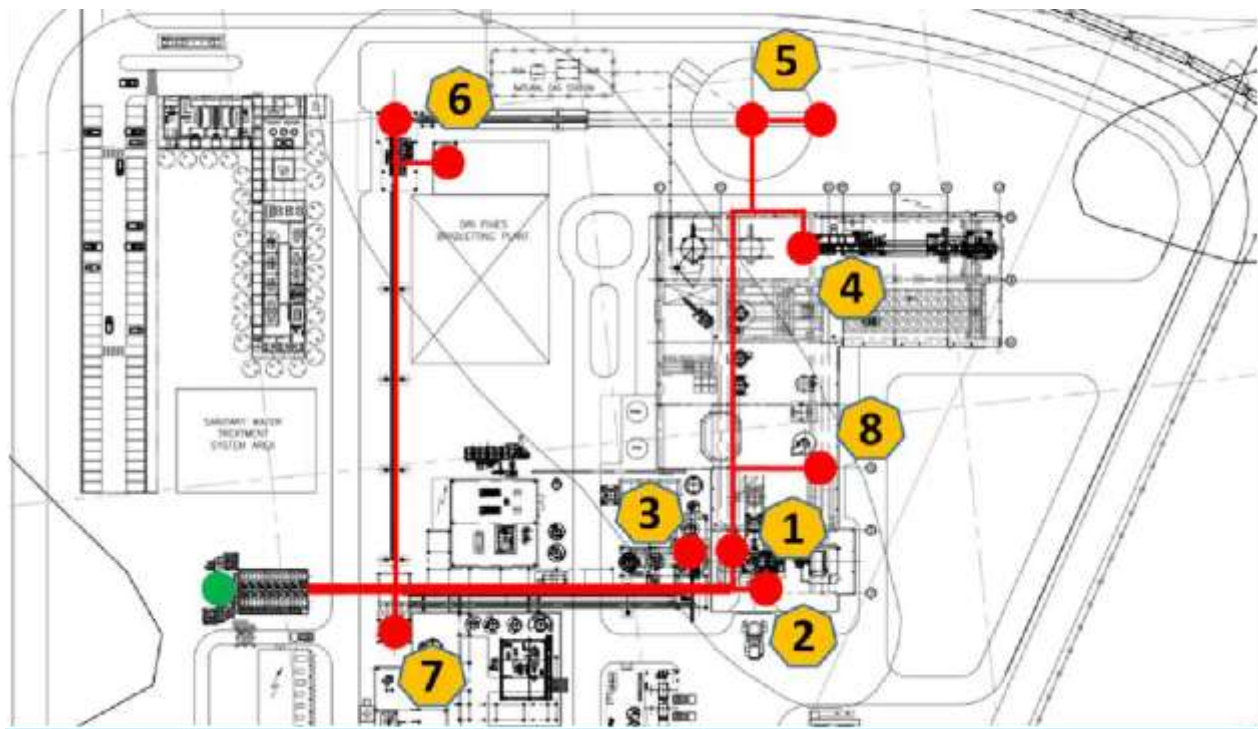


Figure 10.4-3.: location of the air emission points in the plant

1. Primary EAF off gasses
2. Main building canopy
3. DRI hot discharge bins
4. Pig Casting machine canopy
5. Dome fumes and truck discharge canopy
6. Vibratory screen building canopy and briquetting plant fumes
7. Day bins fumes
8. Material handling silos for EAF fluxes

Maximum flow in the system occurs when the EAF is in melting mode, the pig caster is casting, the dome is concurrently charging and the main building canopy is at its maximum draft (the other flows are minor). In this situation the volume of gasses in the unit of time is around 600,000 Actual cubic meters per hour – equal to around 350 actual cubic foot per minute.

The baghouse has been sized in order to handle this volume of gasses at an inlet temperature of 77 degrees C.

It has to be noted that there are other emission points in the plant. The main one is relevant to gaseous emissions from the DRI process, which are treated at the flare and do not require of a bag house to meet the environmental requirements.

Other emission points are relevant to some tanks of the water treatment plant and some other tanks and silos with material, which have dedicated small bag filters to meet the emission standards

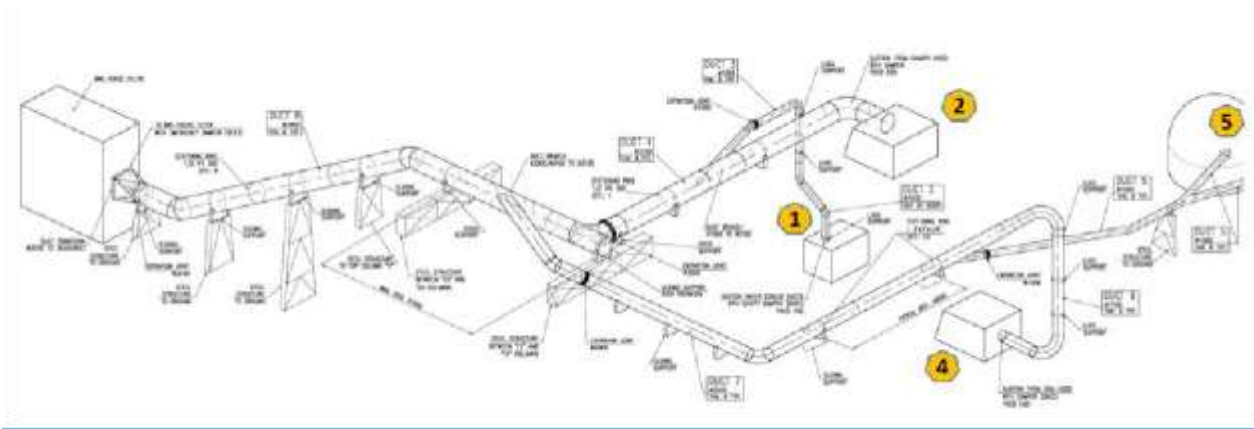


Figure 10.4-4.: isometric representation of the main ducts of the FTP

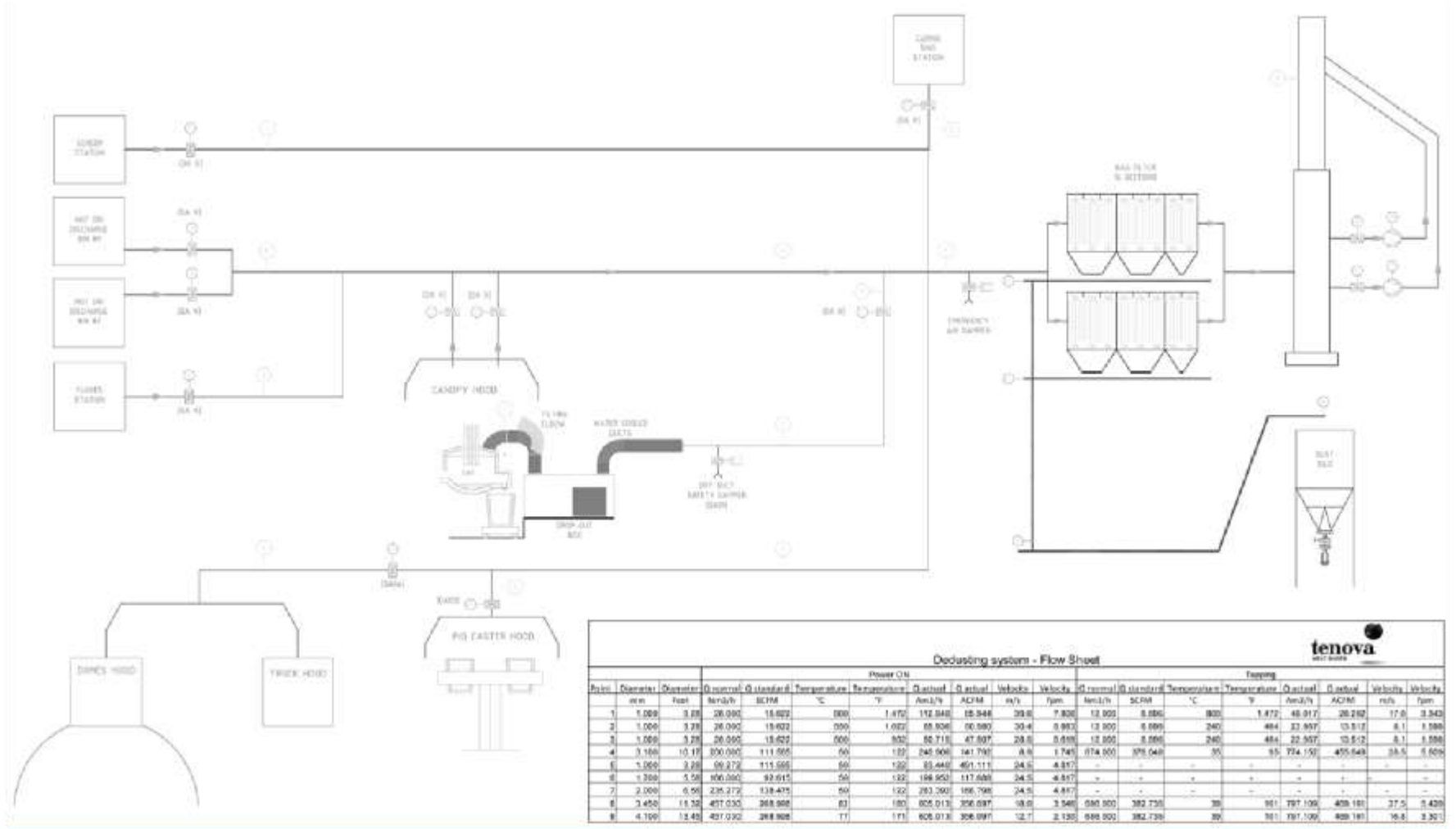


Figure 10.4-5.: FTP flow sheet



### 10.4.2.2 Primary Suction from EAF and Primary Off Gas Cooling

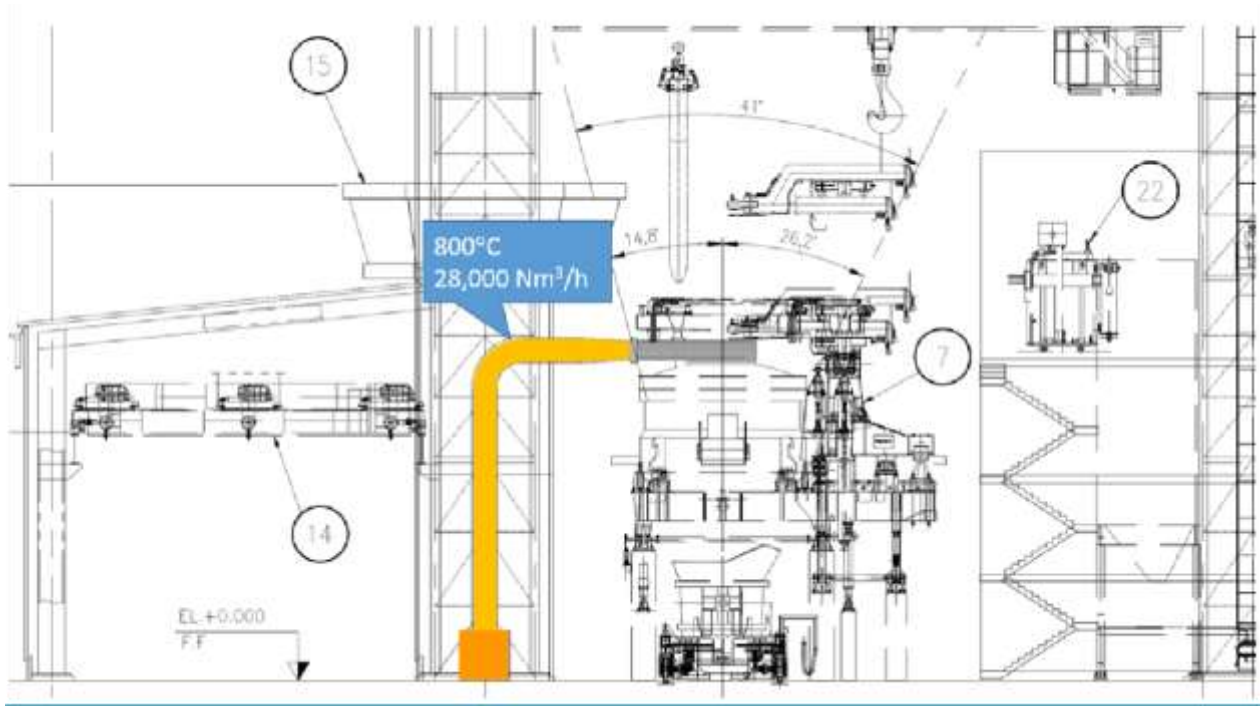


Figure 10.4-6.: primary duct from EAF to DOB

#### Technical description:

The primary fumes generated during DRI melting will be extracted through the hood around the electrodes on the furnace roof, by a water cooled duct, per figure 10.4-6.

The connection between the furnace hood and water cooled ducts is obtained with a movable sliding skirt foreseen to allow the change of the gap for the air inlet; the sliding skirt is located on the first fixed duct.

On the first part of the first water cooled duct there will be a sliding cooled elbow to avoid dust deposit and to allow EAF roof opening and maintenance works on the furnace.

After this connection, before the fixed cooling duct line, the arrangement of a settling chamber – or drop out box (DOB) – will allow to perform the combustion of CO and to separate the heaviest particles of dust from the off-gasses.

The dust deposited on the DOB floor has to be periodically removed from the chamber: access to internal part of the settling chamber is possible by truck loader through a water-cooled door located close to the deslagging area and accessible through an expansion of the existing ramp, in the area presently occupied by the primary suction duct.

The DOB and door dimensions are set to be suitable for the easiest chamber cleaning operation; the DOB has the following preliminary dimensions: 7m x 2m x 2m.

Further cooling is achieved in the remaining part of the water-cooled hot gas line.

The main parameter to be controlled for a correct primary fume suction, according to the EAF working conditions, is the pressure inside the furnace; for maintenance reason the pressure probe is located inside the furnace elbow. The target is to have slightly positive pressure in the EAF (as seen in the process section of this FS) and that is the reason why there is no water cooled elbow on the EAF roof, so to avoid the direct suction and consequent infiltration of fresh air, which would unnecessarily oxidize the EAF bath.

At the end of the water-cooled line a safety false air damper is installed to protect the dry duct downstream and the cooler from extra temperatures.

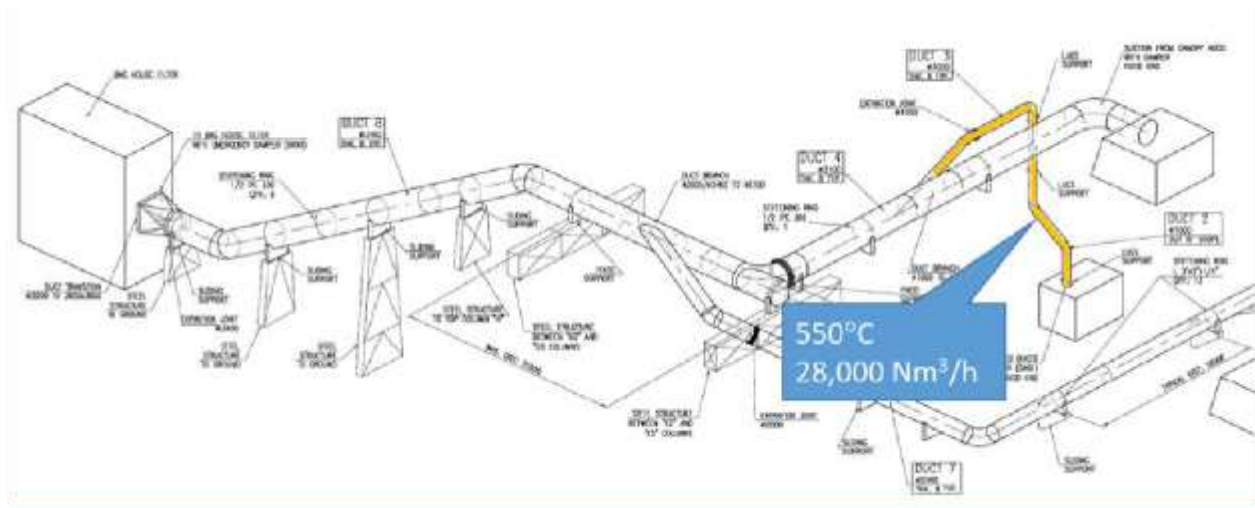


Figure 10.4-7.: primary duct from DOB to main duct

## Technical Data of the water cooled hot gas line

### FIXED DUCT from EAF to DOB

- Design: pipe-to-pipe water cooled type
- Fume Temperature in: 800°C
- Diameter (round): 1,000 mm
- Water cooled duct length: 10 m
- Fumes velocity: 39.6 m/s
- Flow rate: 28.000 Nm<sup>3</sup>/h
- Fume Temperature out: 658°C

### DOB

- Design: refractory walls, water cooled roof and doors
- Flow rate: 28.000 Nm<sup>3</sup>/h
- Dimensions (rectangular): L = 7.2 m x H = 1.9 m x W = 1.8 m
- Retention time
- Total water cooled surface: 15 m<sup>2</sup>
- Fume Temperature out: 611°C

### FIXED DUCT from DOB to main duct

- Design: pipe-to-pipe water cooled type
- Diameter (round): 1,000 mm
- Water cooled duct length: 6 m
- Fumes velocity: 30.4 m/s
- Flow rate: 28.000 Nm<sup>3</sup>/h
- Fume Temperature out: 550°C

### 10.4.2.3 Canopy Hood Extraction

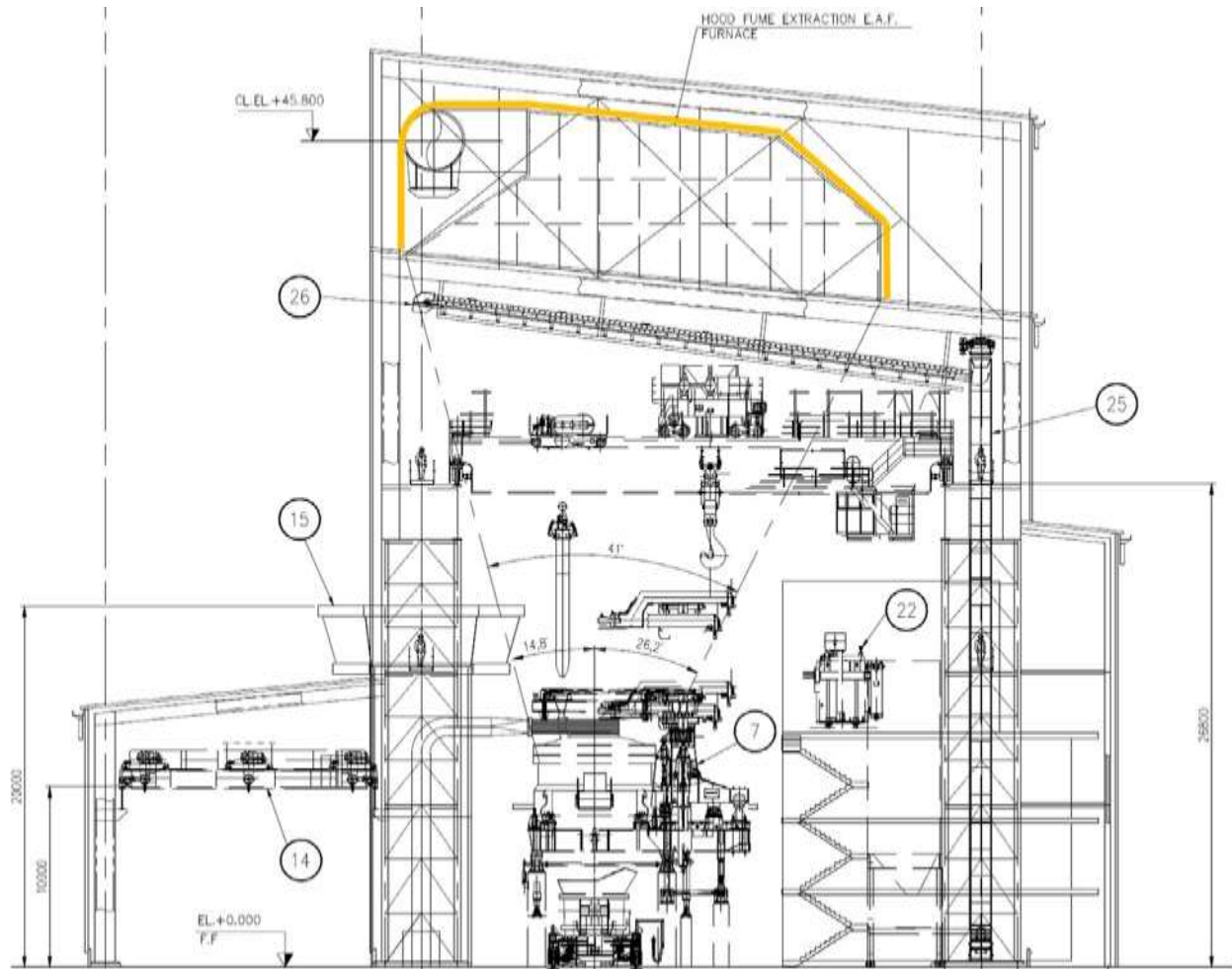


Figure 10.4-8.: Canopy hood on top of the EAF in the main building

#### Technical Description

The secondary fume generated during the various furnace operating phases is controlled with a canopy hood located on the main building roof.

The canopy hood is designed according to the EAF dimension and levels and considering the following main assumption:

- Emission cone angle between EAF wall & vertical between 14° and 26°
- Canopy hood nom. velocity @ generated cone base 1,0m/s
- Canopy hood face mean velocity 0,93m/s
- Retention Time: 7s

The suction control of the secondary fume is allowed by means of two dampers.

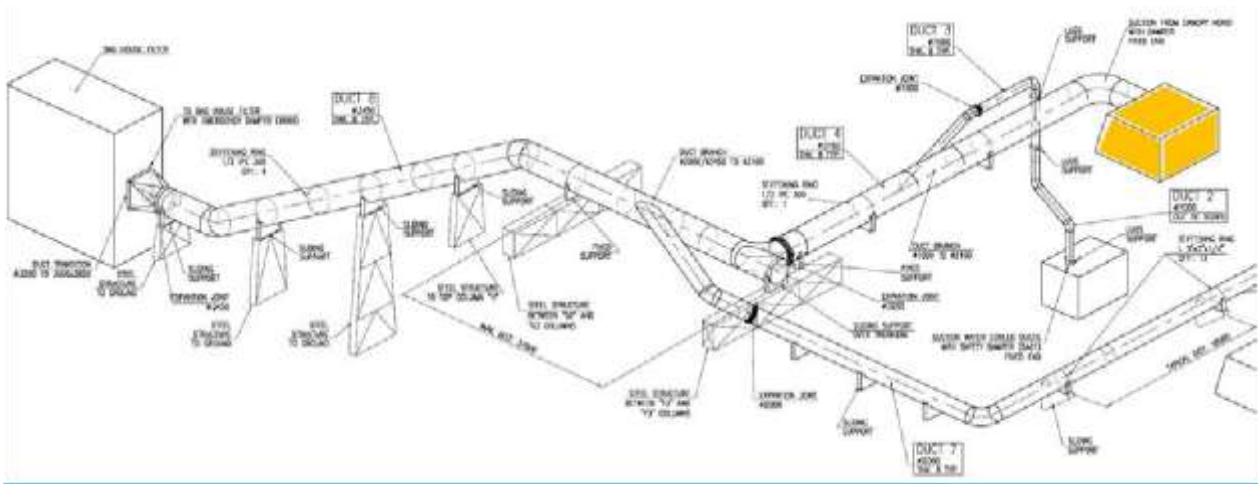


Figure 10.4-9.: Canopy hood in the isometric view

- Approx. front dimensions 15 x 15m
- Approx. hood front area 225m<sup>2</sup>
- Approx. volume: 1.400m<sup>3</sup>
- Flow Rate melting/tapping: 600,000 / 680,000 m<sup>3</sup>/h
- Temperature melting/tapping: 50°C / 35°C

The canopy hood is also used to maintain the required ventilation inside the main melt shop building.

### 10.4.2.4 Single Wall Ducts

Ductworks and supporting structure are foreseen to convey the fume to the bag filter. Expansion joints for the compensation of the displacements due to heat loads, cleaning and inspection doors for the ducts are provided.

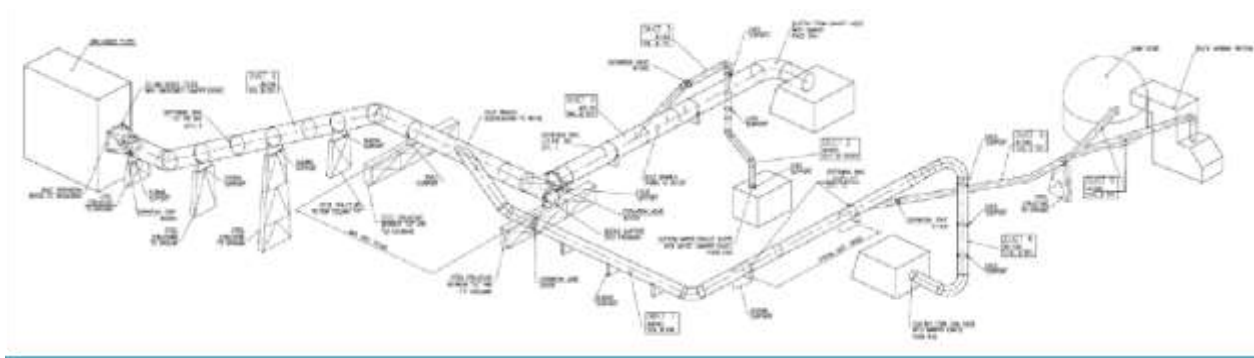


Figure 10.4-10.: complete isometric of the main single wall ducts

PARTICULAR NOTES:				PARTICULAR NOTES:				PARTICULAR NOTES:				PARTICULAR NOTES:				PARTICULAR NOTES:							
01- CANOPY HOOD WILL BE PROVIDED BY OTHERS.- 02- THICKNESS SHOWN ARE MINIMUM.-				01- DOME HOOD WILL BE PROVIDED BY OTHERS.- 02- THICKNESS SHOWN ARE MINIMUM.-				01- CCM HOOD WILL BE PROVIDED BY OTHERS.- 02- THICKNESS SHOWN ARE MINIMUM.-				01- THICKNESS SHOWN ARE MINIMUM.-				01- A EXPANION JOINT MUST BE LOCATED IN THE HOUSE FILTER BAG ENTRY.- 02- THICKNESS SHOWN ARE MINIMUM.-							
DUCT 4 - INFORMATION				DUCT 5 - INFORMATION				DUCT 6 - INFORMATION				DUCT 7 - INFORMATION				DUCT 8 - INFORMATION							
SERVICE	HOT AIR + DUST			SERVICE	HOT AIR + DUST			SERVICE	HOT AIR + DUST			SERVICE	HOT AIR + DUST			SERVICE	HOT AIR + DUST						
DIAMETER	3100mm	TOTAL LENGTH	80mts	DIAMETER	1000mm	TOTAL LENGTH	18mts	DIAMETER	1700mm	TOTAL LENGTH	53mts	DIAMETER	2000mm	TOTAL LENGTH	18mts	DIAMETER	3450mm	TOTAL LENGTH	80mts				
OPERATING TEMPERATURE	[°C]	50		OPERATING TEMPERATURE	[°C]	50		OPERATING TEMPERATURE	[°C]	50		OPERATING TEMPERATURE	[°C]	80		OPERATING TEMPERATURE	[°C]	80					
CONDITIONS	PRESS INT./EXT.	[mmHg]	-5/2	CONDITIONS	PRESS INT./EXT.	[mmHg]	-5/2	CONDITIONS	PRESS INT./EXT.	[mmHg]	-5/2	CONDITIONS	PRESS INT./EXT.	[mmHg]	-5/2	CONDITIONS	PRESS INT./EXT.	[mmHg]	-5/2				
LOADS	DUST (1400 kg/m <sup>3</sup> )	[kg/m <sup>2</sup> ]	540	LOADS	DUST (1400 kg/m <sup>3</sup> )	[kg/m <sup>2</sup> ]	230	LOADS	DUST (1400 kg/m <sup>3</sup> )	[kg/m <sup>2</sup> ]	275	LOADS	DUST (1400 kg/m <sup>3</sup> )	[kg/m <sup>2</sup> ]	300	LOADS	DUST (1400 kg/m <sup>3</sup> )	[kg/m <sup>2</sup> ]	600				
SUPPORT	TYPE	SADDLE	QTY.: 4	SUPPORT	TYPE	SADDLE	QTY.: 4	SUPPORT	TYPE	SADDLE	QTY.: 3	SUPPORT	TYPE	SADDLE	QTY.: 10	SUPPORT	TYPE	SADDLE	QTY.: 4				
	TYPE	-	QTY.: =		TYPE	-	QTY.: =		TYPE	LOG	QTY.: 3		TYPE	-	QTY.: =		TYPE	-	QTY.: =				
EXPANION JOINT	STEEL HOLLOW	QTY.: 4		EXPANION JOINT	STEEL HOLLOW	QTY.: 1		EXPANION JOINT	STEEL HOLLOW	QTY.: 1		EXPANION JOINT	STEEL HOLLOW	QTY.: 1		EXPANION JOINT	STEEL HOLLOW	QTY.: 1					
THICKNESS:	6mm MIN.	CORR. ALLOW.	1,5mm	THICKNESS:	6mm MIN.	CORR. ALLOW.	1,5mm	THICKNESS:	6mm MIN.	CORR. ALLOW.	1,5mm	THICKNESS:	6mm MIN.	CORR. ALLOW.	1,5mm	THICKNESS:	6mm MIN.	CORR. ALLOW.	1,5mm				
INSULATION:	NO			INSULATION:	NO			INSULATION:	NO			INSULATION:	NO			INSULATION:	NO						
EMPTY WEIGHT:	51.400kg	OPEN WEIGHT:	83.000kg	EMPTY WEIGHT:	14.300kg	OPEN WEIGHT:	29.300kg	EMPTY WEIGHT:	19.500kg	OPEN WEIGHT:	23.600kg	EMPTY WEIGHT:	78.200kg	OPEN WEIGHT:	133.200kg	EMPTY WEIGHT:	57.200kg	OPEN WEIGHT:	71.000kg				
WINDY (km/h/ft/s)	24 / 3			WINDY (km/h/ft/s)	20 / 3			WINDY (km/h/ft/s)	24 / 3			WINDY (km/h/ft/s)	24 / 3			WINDY (km/h/ft/s)	24 / 3						
STILL STRUCTURE WEIGHT (KWH (kg))	[N]	7.800		STILL STRUCTURE WEIGHT (KWH (kg))	[N]	5.000		STILL STRUCTURE WEIGHT (KWH (kg))	[N]	6.600		STILL STRUCTURE WEIGHT (KWH (kg))	[N]	9.900		STILL STRUCTURE WEIGHT (KWH (kg))	[N]	39.200					
	MATERIALS				MATERIALS				MATERIALS				MATERIALS				MATERIALS				MATERIALS		
SHELL:	A-30			SHELL:	A-30			SHELL:	A-30			SHELL:	A-30			SHELL:	A-30			SHELL:	A-30		
REINFORCEMENT:	A-30			REINFORCEMENT:	A-30			REINFORCEMENT:	A-30			REINFORCEMENT:	A-30			REINFORCEMENT:	A-30			REINFORCEMENT:	A-30		
FLANGES:	A-30			FLANGES:	A-30			FLANGES:	A-30			FLANGES:	A-30			FLANGES:	A-30			FLANGES:	A-30		
SUPPORTS:	A-30			SUPPORTS:	A-30			SUPPORTS:	A-30			SUPPORTS:	A-30			SUPPORTS:	A-30			SUPPORTS:	A-30		
MANWAYS:	A-30			MANWAYS:	A-30			MANWAYS:	A-30			MANWAYS:	A-30			MANWAYS:	A-30			MANWAYS:	A-30		

Table 10.4-1.: technical data for the main single wall ducts



### 10.4.2.5 Bag House

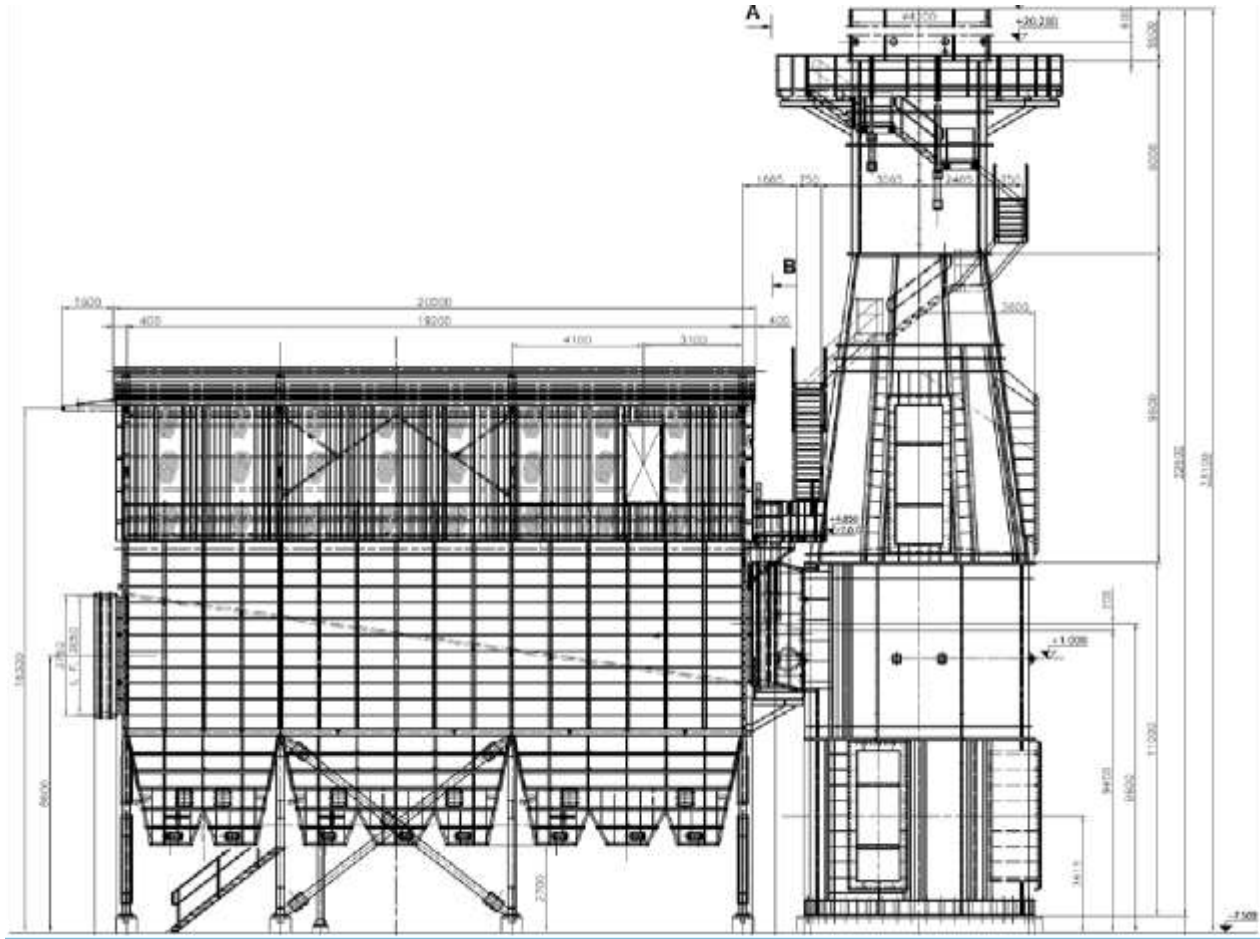


Figure 10.4-11.: elevation view of the bag house (BH) and stack

The selected bag filter (or bag house, BH) will be “pulse-jet negative pressure” type designed for high filtering velocity with bag cleaning performed by means of compressed air.

The filter will be constructed in such a way that the body is split in separate cells to be cut off by dampers. Inside the filter, the flow of raw gases raises upward by crossing the polyester felt bags from the outside to the inside. The bags have mechanical and physical characteristics to withstand abrasion and chemical aggression, and can operate continuously to a maximum working temperature of 130 °C.

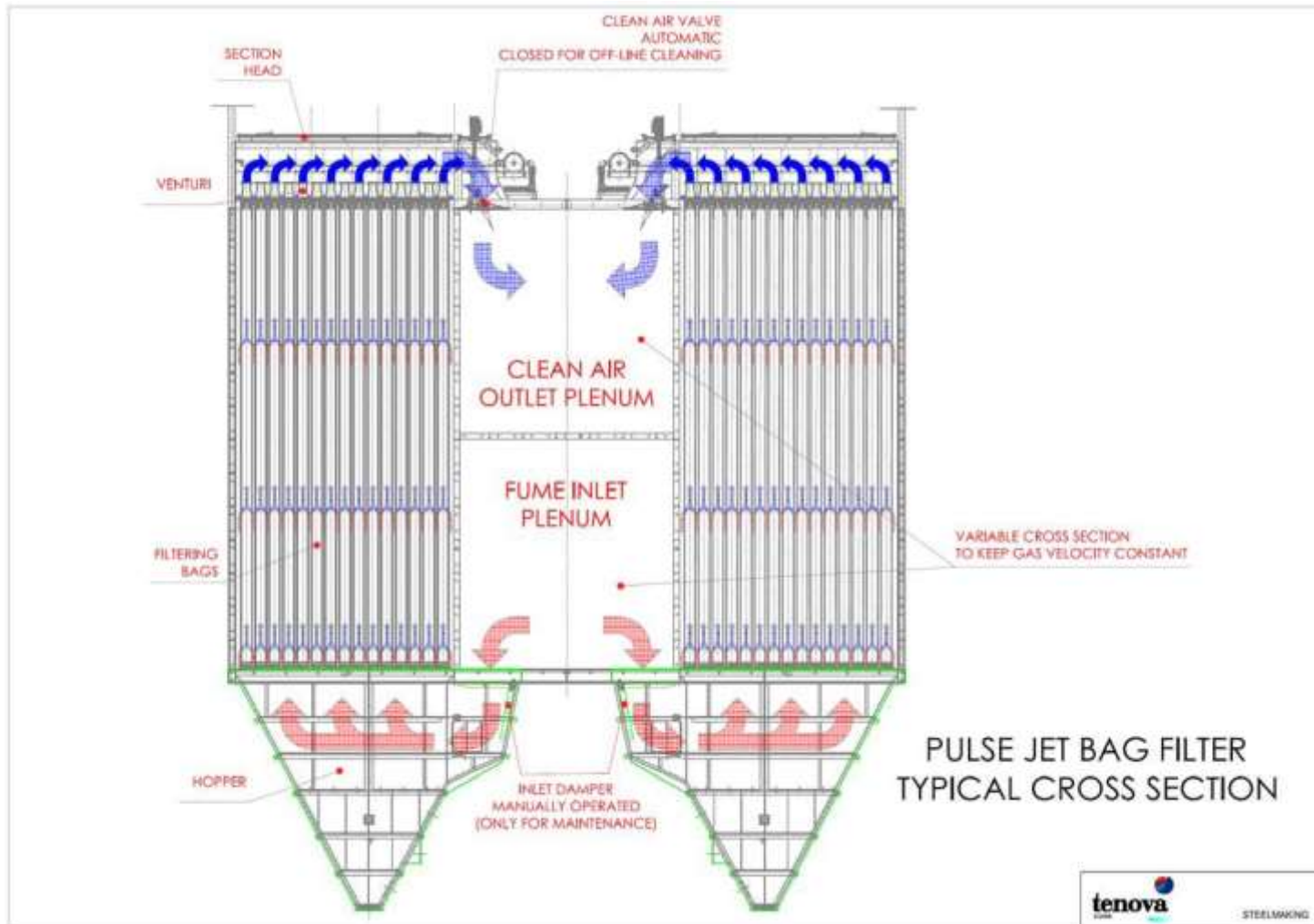


Figure 10.4-12.: Pulse Jet bag filter typical cross section



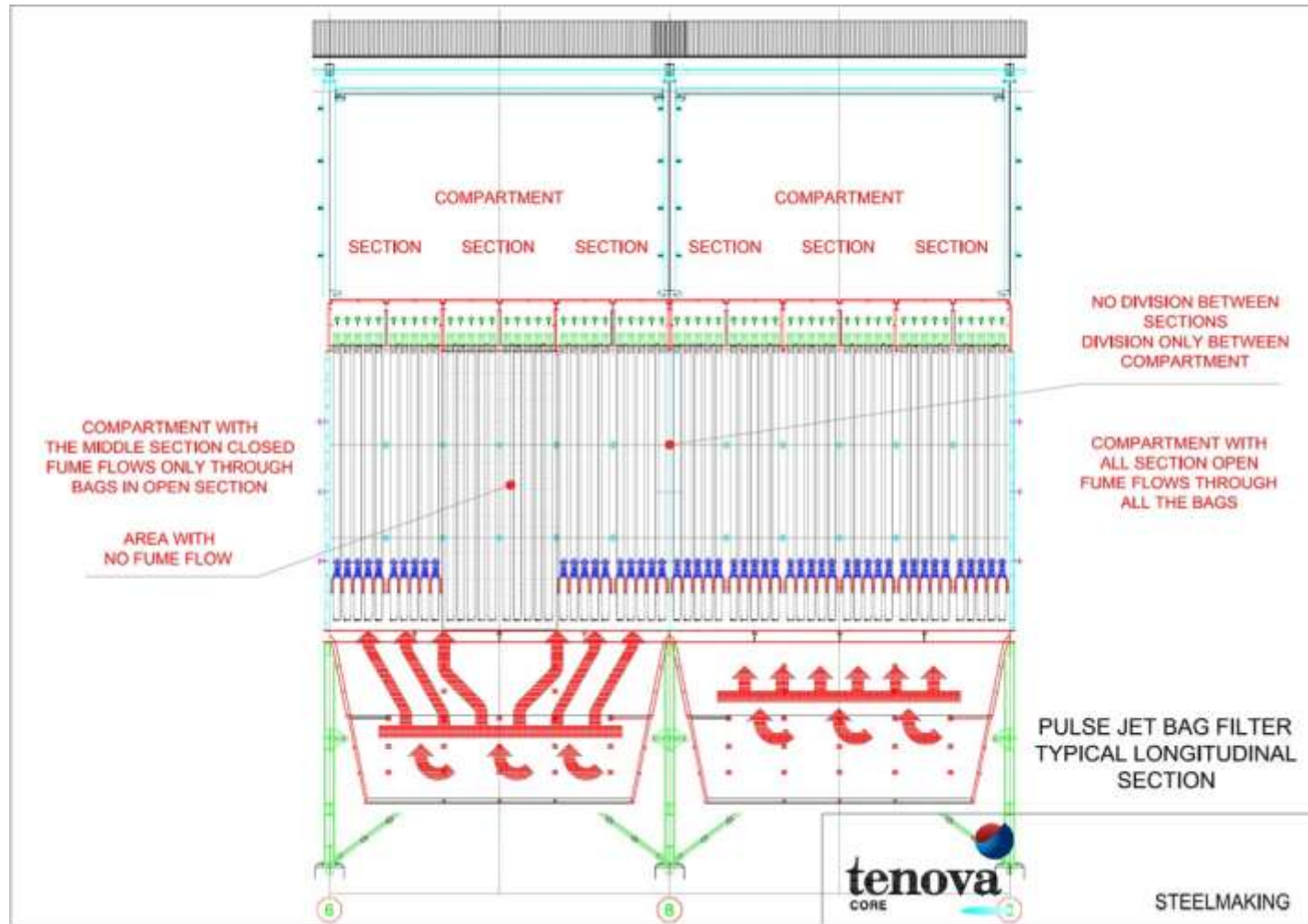


Figure 10.4-13.: Pulse Jet Bag Filter typical longitudinal section

Bags pre-coating with limestone powder shall be executed during start up.

The dust particles remain attached to outside the bag surface and are cleaned periodically by a compressed air pulse-jet.

The cleaning cycle time is adjustable and depends on the operating phase and will be set during start up and operation.

Bag cleaning is performed in ON-LINE mode (filter in operation) but OFF-LINE mode will be also allowed.

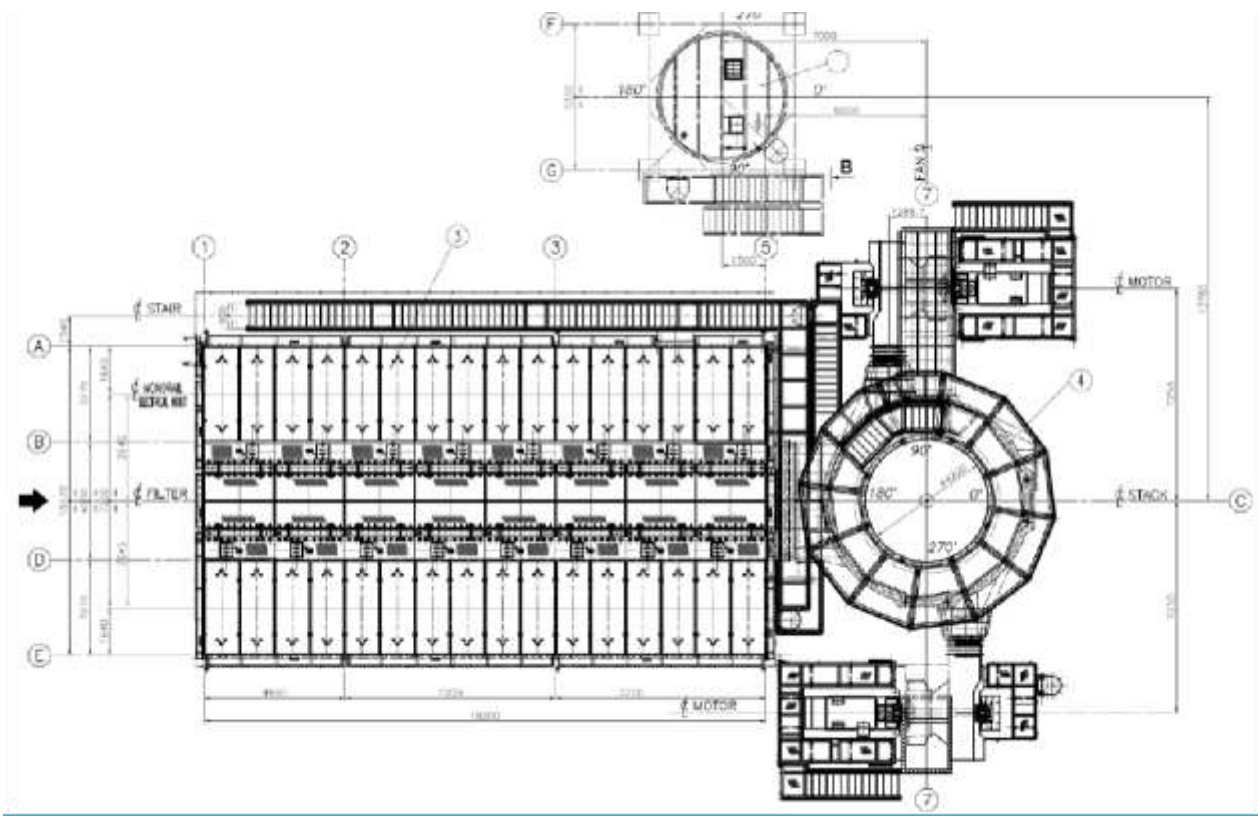


Figure 10.4-14.: Plan view of the Bag House and Stack

The top of the filter is equipped with covers to allow the periodic maintenance operation performed without the need to enter inside the filter shell.

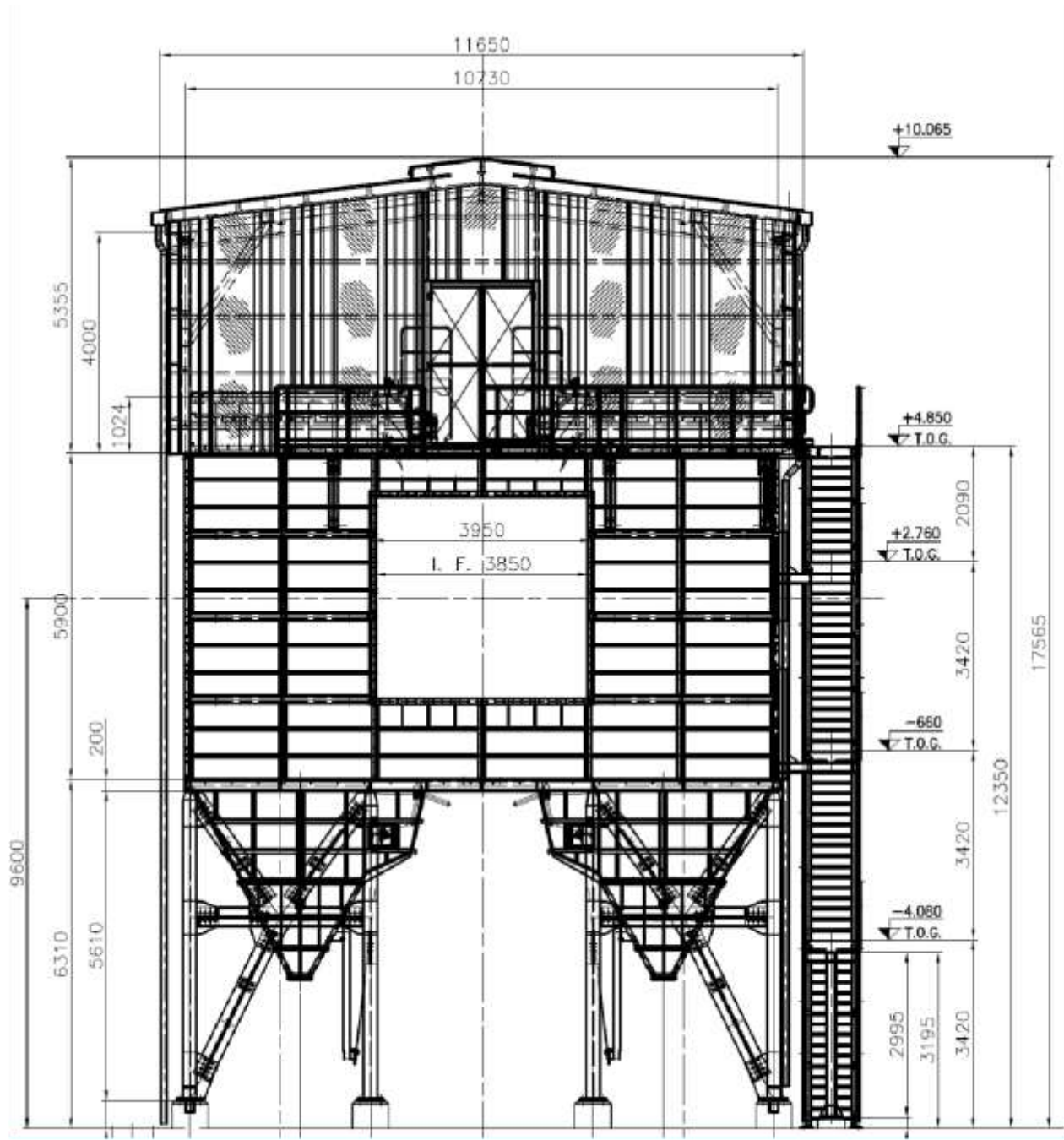


Figure 10.4-15.: cross section of the bag house

### Technical Data of the filter unit

- Filter type: Pulse Jet
- Filtering total surface: 7.200m<sup>2</sup>
- Number of filter sections: 16
- Number of bags for section: 150
- Total number of bags: 2.400
- Filter bag diameter: 165mm
- Filter bag length: 6.010mm
- Material of bags: Polyester with Teflon lining
- Weight of cleaning media: 550g/m<sup>2</sup>
- Bag cages: 2 halves
- Type of cleaning: OFF-LINE & ON-LINE
- Number of hoppers: 6
- Number of cleaning valves: 160
- Cleaning valves nominal diameter: 2"
- Number of shut off dampers (clean gas side): 16
- Actuators for shut off valves (clean gas side): pneumatic cylinders
- Number of shut off dampers (raw gas side): 16
- Actuators for shut off valves (raw gas side): manual winches
- Air to cloth ratio during charging/melting: 1,74-1,85 / 1,41-1,50
- Temperature: 60 / 107°C
- Actual Flow rate during melting/tapping: 680,000 / 600,000m<sup>3</sup>/h
- Nr. of compartments: 6
- Filter pressure drop (approx.): 20mbar
- Required compressed air (approx.): 850Nm<sup>3</sup>/h
- Required compressed air pressure: 6 bar (g)
- Required compressed air quality: dry, oil and dust free
- Design pressure for the casing: - 80mbar

#### 10.4.2.5.1 Induced Draft Fans

##### Technical Description of the ID-Fans

Two main fans will provide the fume suction from the EAF system and each fan is coupled to an electric motor.

The fans are equipped with Inlet Dampers to control the flow, parallel blades louver type, located in the fan inlet box.

The selected fans are heavy duty, SWSI centrifugal type with airfoil blades high efficiently type, arranged with one bearing on each side and coupling connection motor side.

The fans mainly consist of:

- Casing in split design
- Impeller with shaft and elastic coupling
- Roller bearings with casing, grease lubricated
- Inlet damper with regulating electric actuator
- Base frame with anchoring bolts
- Inlet/outlet expansion joints
- Anti-wind milling device

The ID–fans are designed to operate on the clean gas side.

To avoid unsafe running conditions (i.e. motor stator overheating, fan bearings high temperature or vibrations) the fans are provided with the relevant sensors and transmitters.

Excessive under pressure can be cause of damage for the equipments and ductworks upstream the ID-fans: a hardwired pressure switch is installed to automatically switch off the fans if the measurement exceeds the set point value.



### Technical Data of the ID-Fans

- Installed: 2 N°
- In operation: 2 N°
- Type: AIR FOIL – SWSI TYPE
- Actual Flow Rate charging/melting: 375.000/305.000m<sup>3</sup>/h each
- Operating temperature charging/melting: 60/107°C
- Static Pressure Rise melting: 650mmH<sub>2</sub>O
- Rotation: 1.180RPM
- Abs Power (charging/melting): 860/615kW
- Motor Power: 1.000kW
- Balancing classVDI 2060 (ISO 1.940-1), G 2.5

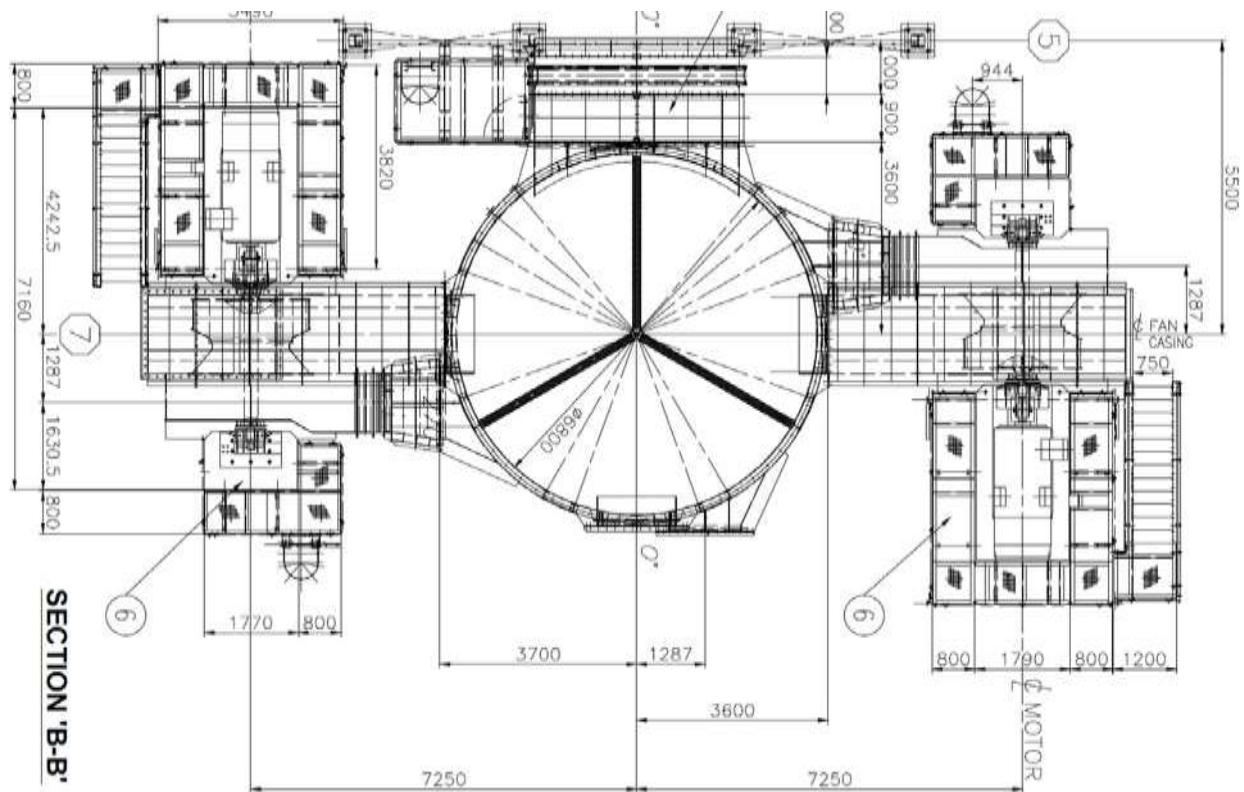


Figure 10.4-16.: plan view of the stack and the two ID fans and motors

10.4.2.5.2 Clean Gas Ducts with Stack

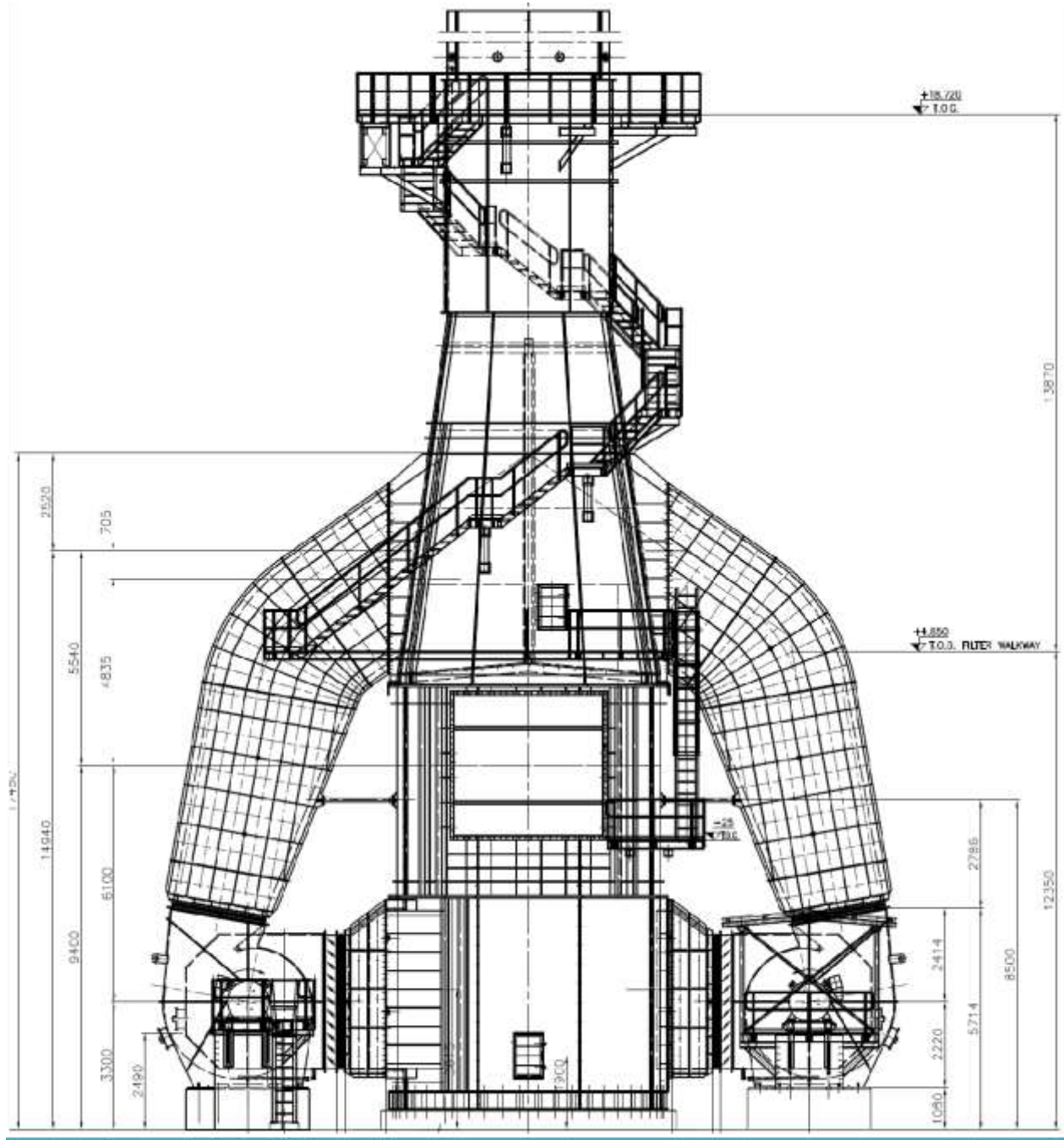


Figure 10.4-17.: elevation view of the stack body and clean air ducts

### **Stack Technical Description**

Downstream the Bag Filter the cleaned gas flows through Clean Gas Ducts to the Stack.

The ducts are designed with the relevant supporting structures and properly stiffened. Accessible manholes for inspection will be installed.

The clean gas ducts mainly consist of:

- Duct from filter unit to the concrete stack basement
- Ducts from concrete basement to ID-fans
- Ducts from ID-fans to stack and relevant supporting structure
- Manholes

The stack is self-supporting type. A platform with ladders to the sockets for measurement of the clean gas dust content is foreseen.

The stack mainly consists of:

- Base frame with anchoring bolts
- Stack with clean gas inlet flanges
- Measurement platform

Access ladder with intermediate platforms

### **Stack technical Data**

- Diameter: 4,2m
- Height: 30m
- Material: ASTM A572 Gr. 50 or equivalent S355 JR EN 10155 (Carbon Steel). Alternatively, ASTM A588 or equivalent S355 JOW (Corten A)
- Plate thickness: according to the structural design



### 10.4.2.5.3 Dust Handling Equipment

#### Technical Description for the dust handling equipment

The chain conveyor system delivers dust from the bag filter hoppers towards the dust storage silo.

Slide gates are installed below the hoppers, in order to allow drag-chain maintenance operations without stopping the filter.

In case of problems at the elevator, the transversal chain conveyor can discharge in a container located at the opposite end with respect to the silo.

For this purpose, the transversal chain conveyor will be provided with a slide gate valve at either end.







The chains are guided by manganese steel rods, to enable a long maintenance free operation.

The dust will be discharged from the silo by a suitable valve and movable spout into a truck for disposal.

The dust handling equipment mainly consists of:

- set of slide gates, pneumatically operated, below the filter hoppers
- horizontal longitudinal chain conveyors with gear motors (installed under the filter hoppers)
- rotary cells at chain conveyors discharge with gear motors
- 1 horizontal transversal chain conveyor, reversible type, with gear motor collecting from the longitudinal ones and discharging on the elevator or on the opposite side, provided with slide gates at either end
- 1 cross vertical chain conveyor with gear motor for dust discharge from the transversal chain conveyor and conveying up to the batching silo
- dust silo with fluidizing system
- discharge vibrating bottom with double guillotine valve
- piping and valve for instrument air
- loading spout discharge device
- steel structure
- platform, stairs and ladders

### Technical Data for the dust handling equipment

-  Dust amount (approx.) 900kg/h
-  Conveying capacity of each Horizontal Chain Conveyor 1,5t/h
-  Conveying capacity of each Rotary Cell 1,5t/h
-  Conveying capacity of Cross Horizontal Chain Conveyor 4,0t/h
-  Conveying capacity of vertical Chain Conveyor 4,0t/h
-  Silo volume (for approx. 3 days dust production) (approx.) 75m<sup>3</sup>

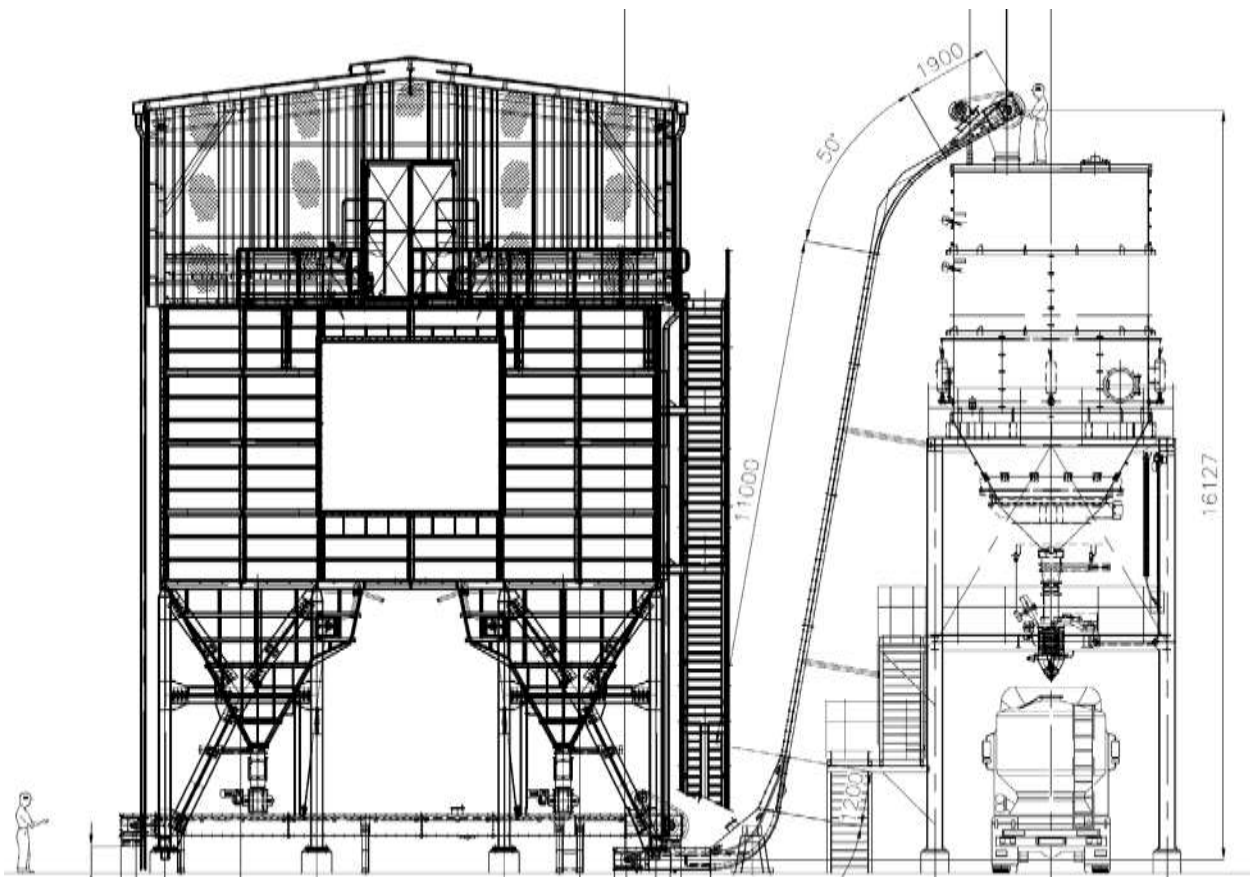


Figure 10.4-18.: elevation view of the baghouse and dust handling equipment

## 10.4.3 Ladles, ladle car and ladle maintenance equipment

### 10.4.3.1 Ladles

This plant will require a minimum of five (5) ladles for a safe continuous operation.

The number of five is calculated considering that there must be 1 ladle always ready for EAF tapping, 1 ladle in the casting position, 1 ladle in turnaround mode (cleaning and heating mode waiting to go in EAF tapping car), 1 ladle in maintenance / relining and 1 ladle in the drying area after having been relined.

The ladle will have the following characteristics:

- Hot metal volume: 120 ton
- Esternal diameter: 3,500 mm
- Internal refractory diameter: 2,838 mm

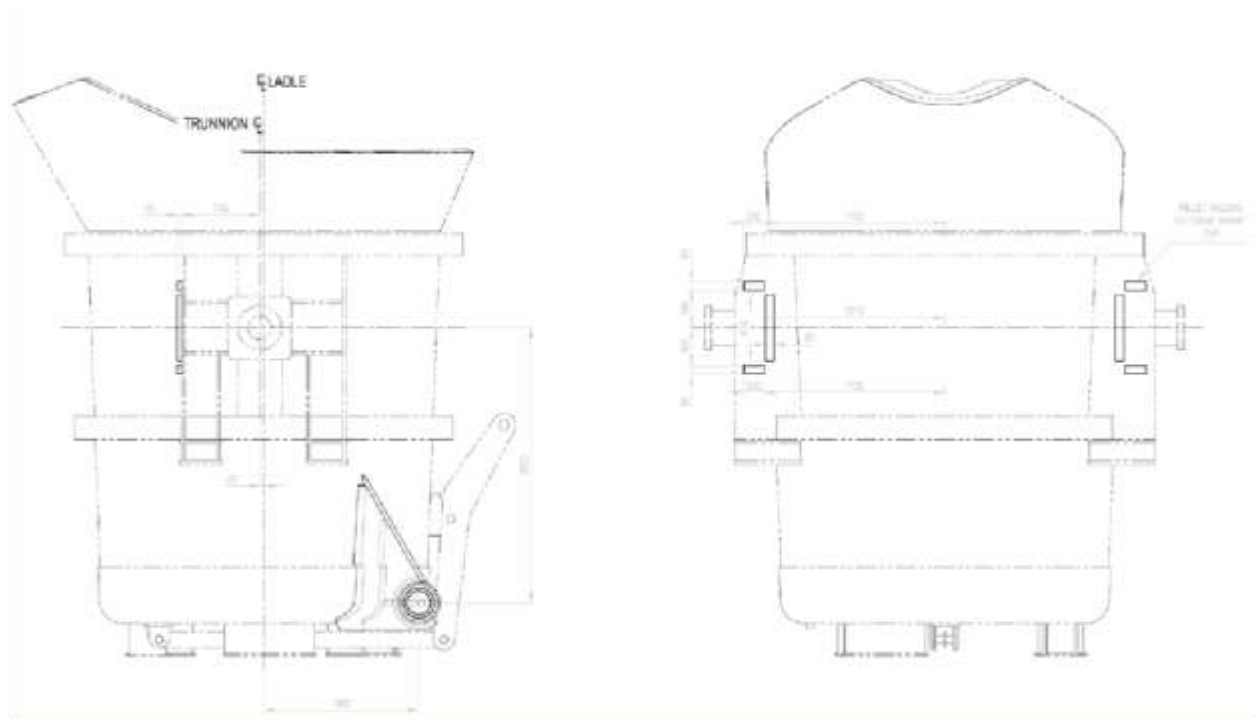


Figure 10.4-19.: Hot Metal Ladle side and elevation view

### 10.4.3.2 Ladle car

The EAF will tap in a ladle sit on a ladle car, which will be equipped with a ladle weighing system to control the hot metal weight during tapping operation.

The tapping car is electrically driven and has two positions

1. Tapping position
2. Ladle pre-heating position

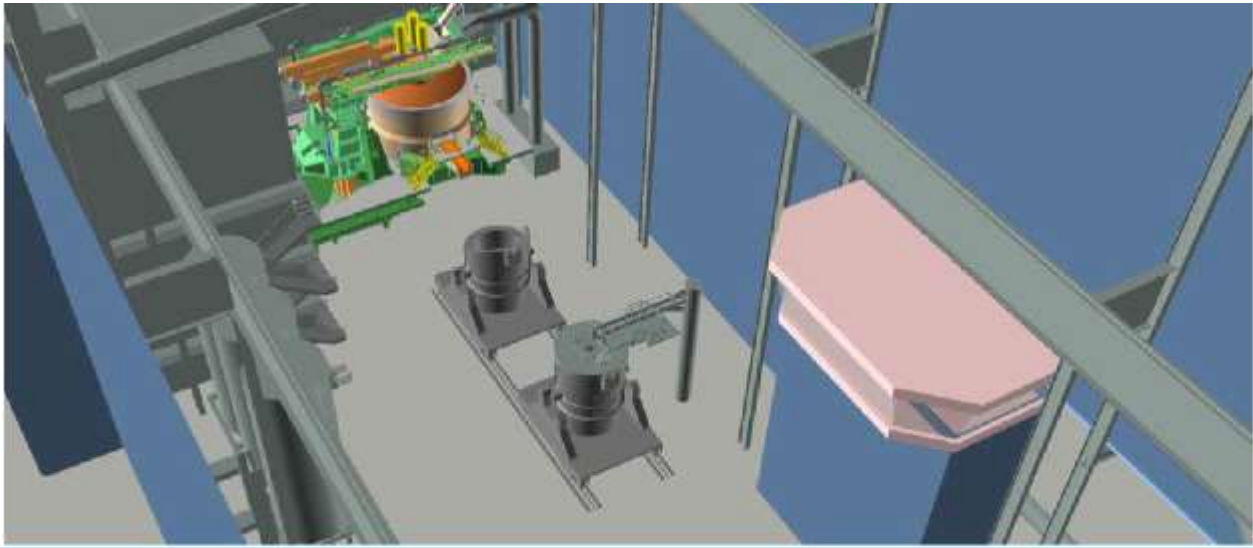


Figure 10.4-20.: 3D view of the tapping area

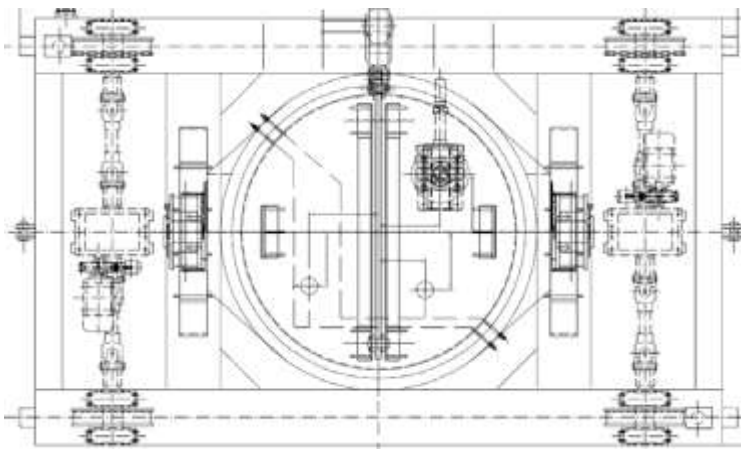


Figure 10.4-21.: plan view of the ladle tapping car

### 10.4.3.3 Ladle Dryer, ladle preheaters and maintenance equipment

In the main EAF building aisle, ladle heaters, drier and maintenance equipment will be installed, namely:

1. One (1) vertical ladle preheating station on tapping car
2. Ladle horizontal preheater for ladle turnaround
3. Ladle refractory dryer
4. Ladle maintenance stand

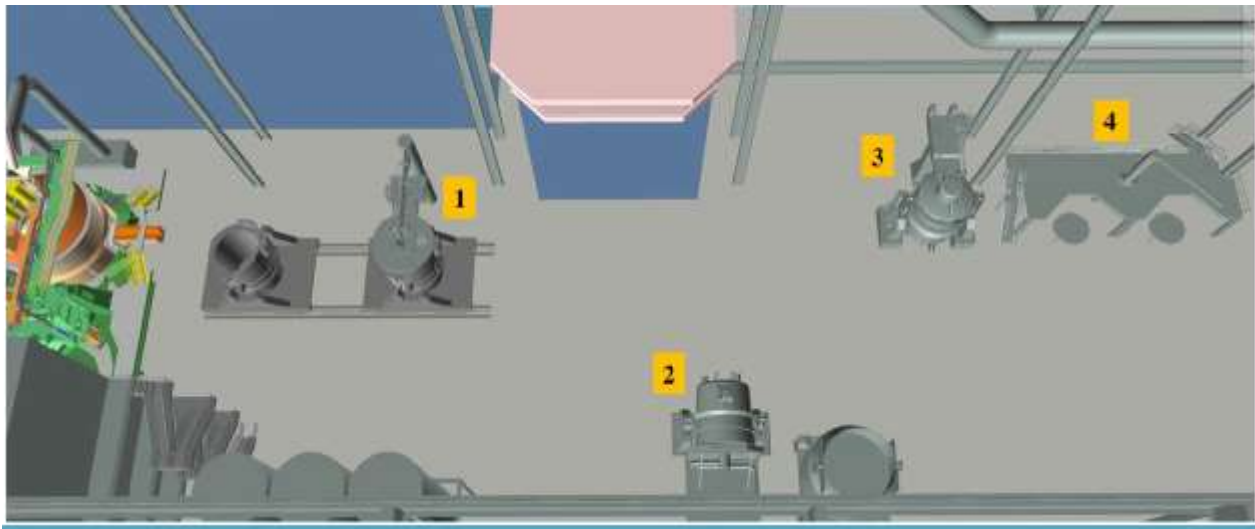


Figure 10.4-22.: Ladle dryer, preheaters and maintenance equipment

The following pages present the manufacturer's technical description.

- CEBA vertical preheater #P.13.6610.AC.010.I\_Rev.04
- CEBA vertical preheater # P.13.6611.AC.010.I\_Rev.04
- CEBA vertical dryer # P.13.6612.AC.011.I\_Rev.03



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E-mail: info@cebasrl.com

**TENOVA S.p.A.**  
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**20149 MILANO**

**Our ref.: P.13.6610.AC.010.I\_Rev.04**  
**Your ref: JOB MS5126**  
**Technical Specification: MTSP-109135 REV.D pos.3.1**

Subject: **Nr. 1 VERTICAL LADLE PREHEATING STATION ON TAPPING CAR**

**1 - Technical characteristics:**

<b>Rev.03</b>	Ladle capacity	130 ÷ 150 ton
	Fuel	Natural Gas
	Calorific value	8500 kCal/Nm <sup>3</sup>
	Network fuel pressure	4 bar
	Burner working pressure	60 mbar
<b>Rev.03</b>	Thermal power	3.500 kW
<b>Rev.03</b>	Type of burners	SIV 400
<b>Rev.03</b>	Max. fuel consumption	350 Nm <sup>3</sup> /h
<b>Rev.03</b>	Air fan capacity	~4200 Nm <sup>3</sup> /h
	Fan static head	75 mbar
	Fan installed power	11 kW
	Ignition and flame detection	automatic by electrode
<b>Rev.04</b>	Vertical Rotation	hydraulic
<b>Rev.04</b>	Vertical Rotation angle	90°
	Hydraulic power unit	capacity 30 lt.
	Hydraulic unit installed power	5,5 kW
	Hydraulic circuit pressure	160 bar
<b>Rev.01</b>	Electrical feeding	460 V - 60 Hz
<b>Rev.01</b>	Auxiliary voltage	120 V - 60 Hz
	Solenoid voltage	24 V d.c.
<b>Rev.03</b>	Working temperature	from 700 to 1100° C
<b>Rev.03</b>	Heating time	50'±70'
	Regulation	automatic with programmable temperature controller
	Altitude	< 1000 m. a.s.l.
	Ref. drawing no.	010-DA-13888-0 Rev.00

## **Rev.04 2 - Description.**

The unit consists of a steel profiles machine which, basically, can be divided into three parts: basement, arm and ladle cover with a centrally located burner.

The basement is fixed to the floor by means of anchor bolts which will have to be positioned according to our basic engineering drawing.

The arm is fixed on the top of the basement. It has the function to hold the ladle cover and the burner. The bottom side of the arm is shielded by means of a ceramic fibre panel to prevent over-heating problems.

The lining of the cover is made with ceramic fibre right for 1350°C.

The vertical movement of the arm is obtained by means of two hydraulic cylinders. The station is provided with complete independent hydraulic unit.

The pre-heater is delivered painted with PRIMER and finishing of colour.

A platform with stairs is provided for a easy maintenance of the devices on the arm.

### **3 - Combustion unit.**

The combustion system consist of a main burner with an high speed flame which allows gases, to get to the bottom of the ladle and raise along the inside wall carrying out a proper thermal exchange.

**Rev.01** The burner is equipped with automatic ignition by electrode and flame control by electrode.

### **4 - Gas feeding.**

The combustion plant, relevant equipment and operating logic complies with the latest safety US standard (NFPA 86).

The gas circuit is equipped with manual shut off valve, filter, pressure reducer, pressure switch, and two main solenoid valves.

The air/gas relation is created pneumatically by an in built air/gas ratio controller installed on the gas line.

The fan and all the other regulation, control and safety devices are located in a position accessible for maintenance and protected from the heat.

### **5 - Electric equipment.**

The electrical equipment consists of an electrical cabinet, containing all the controls, safety and operating elements. The controls and indications are located on the door of the panel.

Temperature regulation is carried out by a regulator/programmer.

**Rev.01** All elements are completely wired internally and externally (customer shall provide only one 460V feeder).

**Rev.01** Protection: NEMA 12.

## 6 - Temperature automatic control with programmer.

Temperature regulation is carried out by a regulator/programmer.

It can work like regulator or like programmer to obtain heating cycles previously programmed. This programming can be carried out by frontal keyboard and it is guided by display of the instrument. It is possible to memorise 8 different programs.

The memorised programs can be recalled quickly only by the keys on the instrument.

## 7 – Safety devices

The station is provided with devices which don't permit the burner ignition or the flame to be extinguished, due to following problems:

- power failure;
- low pressure of combustion air;
- high and low gas pressure;
- purge cycle not accomplished.

The station is provided with acoustic and optical devices to signal the following problems:

- fan air pressure not normal;
- ladle temperature over set value;
- gas pressure not normal.

The station is also provided with all protection devices which stop the burner on detection of one of the following problems:

- power failure;
- lack of flame.

After each heating cycle the tightness of the main valves is checked automatically with the tightness control device. In case of a failure the unit cannot be started again unless the failure has been cleared.

## 8 – Exclusions

- Packing and transport.
- Assembly on site.
- Commissioning and start up.
- Supervision of erection and commissioning
- All foundation structures.
- All the necessary works for the ladle positioning.
- Connection with electric and fuel network
- Any spare parts.
- UL certification for complete machine.
- Whatever not included in the scope of supply.





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**20149 MILANO**

Trescore Balneario  
**Our ref.: P.13.6611.AC.010.I\_Rev.04**  
**Your ref: JOB MS5126**  
**Technical Specification: MTSP-109135 REV.D pos.3.1**

Subject: **Nr. 1 VERTICAL LADLE PREHEATING STATION ON FIX POSITION**

**1 - Technical characteristics:**

<b>Rev.03</b>	Ladle capacity	130 ÷ 150 ton
	Fuel	Natural Gas
	Calorific value	8500 kCal/Nm <sup>3</sup>
	Network fuel pressure	4 bar
	Burner working pressure	60 mbar
<b>Rev.03</b>	Thermal power	3.500 kW
<b>Rev.03</b>	Type of burners	SIV 400
<b>Rev.03</b>	Max. fuel consumption	350 Nm <sup>3</sup> /h
<b>Rev.03</b>	Air fan capacity	~4200 Nm <sup>3</sup> /h
	Fan static head	75 mbar
	Fan installed power	11 kW
	Ignition and flame detection	automatic by electrode
<b>Rev.04</b>	Vertical Rotation	hydraulic
<b>Rev.04</b>	Vertical Rotation angle	90°
	Hydraulic power unit	capacity 30 lt.
	Hydraulic unit installed power	5,5 kW
	Hydraulic circuit pressure	160 bar
<b>Rev.01</b>	Electrical feeding	460 V - 60 Hz
<b>Rev.01</b>	Auxiliary voltage	120 V - 60 Hz
	Solenoid voltage	24 V d.c.
<b>Rev.03</b>	Working temperature	from 700 to 1100° C
<b>Rev.03</b>	Heating time	50'±70'
	Regulation	automatic with programmable temperature controller
	Altitude	< 1000 m. a.s.l.
	Ref. drawing no.	010-DA-13889-0 Rev.00

## **Rev.04 2 - Description.**

The unit consists of a steel profiles machine which, basically, can be divided into three parts: basement, arm and ladle cover with a centrally located burner.

The basement is fixed to the floor by means of anchor bolts which will have to be positioned according to our basic engineering drawing.

The arm is fixed on the top of the basement. It has the function to hold the ladle cover and the burner. The bottom side of the arm is shielded by means of a ceramic fibre panel to prevent over-heating problems.

The lining of the cover is made with ceramic fibre right for 1350°C.

The vertical movement of the arm is obtained by means of two hydraulic cylinders. The station is provided with complete independent hydraulic unit.

The pre-heater is delivered painted with PRIMER and finishing of colour.

A platform with stairs is provided for a easy maintenance of the devices on the arm.

## **3 - Combustion unit.**

The combustion system consist of a main burner with an high speed flame which allows gases, to get to the bottom of the ladle and raise along the inside wall carrying out a proper thermal exchange.

**Rev.01** The burner is equipped with automatic ignition by electrode and flame control by electrode.

## **4 - Gas feeding.**

The combustion plant, relevant equipment and operating logic complies with the latest safety US standard (NFPA 86).

The gas circuit is equipped with manual shut off valve, filter, pressure reducer, pressure switch, and two main solenoid valves.

The air/gas relation is created pneumatically by an in built air/gas ratio controller installed on the gas line.

The fan and all the other regulation, control and safety devices are located in a position accessible for maintenance and protected from the heat.

## **5 - Electric equipment.**

The electrical equipment consists of an electrical cabinet, containing all the controls, safety and operating elements. The controls and indications are located on the door of the panel.

Temperature regulation is carried out by a regulator/programmer.

**Rev.01** All elements are completely wired internally and externally (customer shall provide only one 460V feeder).

**Rev.01** Protection: NEMA 12.

## **6 - Temperature automatic control with programmer.**

Temperature regulation is carried out by a regulator/programmer.

It can work like regulator or like programmer to obtain heating cycles previously programmed. This programming can be carried out by frontal keyboard and it is guided by display of the instrument. It is possible to memorise 8 different programs.

The memorised programs can be recalled quickly only by the keys on the instrument.

## **7 – Safety devices**

The station is provided with devices which don't permit the burner ignition or the flame to be extinguished, due to following problems:

- power failure;
- low pressure of combustion air;
- high and low gas pressure;
- purge cycle not accomplished.

The station is provided with acoustic and optical devices to signal the following problems:

- fan air pressure not normal;
- ladle temperature over set value;
- gas pressure not normal.

The station is also provided with all protection devices which stop the burner on detection of one of the following problems:

- power failure;
- lack of flame.

After each heating cycle the tightness of the main valves is checked automatically with the tightness control device. In case of a failure the unit cannot be started again unless the failure has been cleared.

## **EXTENT OF PREASSEMBLING.**

The machine will be shipped in the following conditions:

- basement,
- column;
- arm
- ladle cover and the burner.

The arm must be fixed to the column by means of bolts.

The cover is provided with flanges for assembling and for the connection to the arm.

All the required bolts are shipped with the heater.

## 8 – Exclusions

- Packing and transport.
- Assembly on site.
- Commissioning and start up.
- Supervision of erection and commissioning
- All foundation structures.
- All the necessary works for the ladle positioning.
- Connection with electric and fuel network
- Any spare parts.
- UL certification for complete machine.
- Whatever not included in the scope of supply.

## 9 - Vendor List

- Solenoid valve: ELSTER, ELEKTROGAS, ASCO
- Pressure switch, regulation valve: ELSTER/ DWYER
- Pressure reducer: EMERSON/FIORENTINI
- Fan: FERRARI/MORO/MEZ
- Thermocouple: CEBA
- Relays and electrical components: SIEMENS
- Temperature programmer: EUROTHERM
- Control panel: Standard manufacturer
- Push button (Ø22): SIEMENS/GE/TELEMECANIQUE
- Pneumatic part: PARKER
- Hydraulic part: Standard (components: REXROTH VICKERS – cylinders: CEBA)
- Burners: CEBA

## Rev.04 STANDARDS

Measurement system:	Metric (ISO)
Profiles:	UNI/DIN
Instrumentation:	UL Listed
Mechanical connections	European standard for internal American standard at T.O.P.
Electric motors	IEC
Electrical standards:	IEC / UL*
Safety:	NFPA 86

\* **NOTE:** - UL Certification for control panel only is provided.  
 - UL Certification for the complete machine is not included in the scope of supply.

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Trescore Balneario  
**Our ref.: P.13.6612.AC.011.I\_Rev.03**  
**Your ref: JOB MS5126**  
**Technical Specification: MTSP-109135 REV.D pos.3.3**

Subject: **Nr. 1 VERTICAL LADLE DRYING STATION**

**1 - Technical characteristics:**

<b>Rev.03</b>	Ladle capacity	130÷150 ton
	Fuel	Natural Gas
	Calorific value	8500 kCal/Nm <sup>3</sup>
	Network fuel pressure	4 bar
	Burner working pressure	60 mbar
	Thermal power	2.500 kW
	Type of burners	SIV 300
	Max. fuel consumption	250 Nm <sup>3</sup> /h
	Air fan capacity	~3600 Nm <sup>3</sup> /h
	Fan static head	75 mbar
	Fan installed power	11 kW
	Ignition and flame detection	automatic by electrode
	Vertical Rotation	hydraulic
	Vertical Rotation angle	90°
	Hydraulic power unit	capacity 30 lt.
	Hydraulic unit installed power	5,5 kW
	Hydraulic circuit pressure	160 bar
<b>Rev.01</b>	Electrical feeding	460 V - 60 Hz
<b>Rev.01</b>	Auxiliary voltage	120 V - 60 Hz
	Solenoid voltage	24 V d.c.
<b>Rev.01</b>	Working temperature	700÷1000 °C
<b>Rev.01</b>	Heating time	50 ÷ 60' or according to drying pattern
	Regulation	automatic with programmable temperature controller
	Altitude	< 1000 m. a.s.l.
	Ref. drawing no.	011-DA-13890-0 Rev.00

## 2 - Description.

The unit consists of a steel profiles machine which, basically, can be divided into three parts: basement, arm and ladle cover with a centrally located burner.

The basement is fixed to the floor by means of anchor bolts which will have to be positioned according to our basic engineering drawing.

The arm is fixed on the top of the basement. It has the function to hold the ladle cover and the burner. The bottom side of the arm is shielded by means of a ceramic fibre panel to prevent over-heating problems.

The lining of the cover is made with ceramic fibre right for 1350°C.

The vertical movement of the arm is obtained by means of two hydraulic cylinders. The station is provided with complete independent hydraulic unit.

The pre-heater is delivered painted with PRIMER and finishing of colour.

A platform with stairs is provided for a easy maintenance of the devices on the arm.

## 3 - Combustion unit.

The combustion system consist of a main burner with an high speed flame which allows gases, to get to the bottom of the ladle and raise along the inside wall carrying out a proper thermal exchange.

**Rev.01** The burner is equipped with automatic ignition by electrode and flame control by electrode.

## 4 - Gas feeding.

The combustion plant, relevant equipment and operating logic complies with the latest safety US standard (NFPA 86).

The gas circuit is equipped with manual shut off valve, filter, pressure reducer, pressure switch, and two main solenoid valves.

The air/gas relation is created pneumatically by an in built air/gas ratio controller installed on the gas line.

The fan and all the other regulation, control and safety devices are located in a position accessible for maintenance and protected from the heat.

## 5 - Electric equipment.

The electrical equipment consists of an electrical cabinet, containing all the controls, safety and operating elements. The controls and indications are located on the door of the panel.

Temperature regulation is carried out by a regulator/programmer.

**Rev.01** All elements are completely wired internally and externally (customer shall provide only one 460V feeder).

**Rev.01** Protection: NEMA 12

## **6 - Temperature automatic control with programmer.**

Temperature regulation is carried out by a regulator/programmer.

It can work like regulator or like programmer to obtain heating cycles previously programmed. This programming can be carried out by frontal keyboard and it is guided by display of the instrument. It is possible to memorise 8 different programs.

The memorised programs can be recalled quickly only by the keys on the instrument.

## **7 – Safety devices**

The station is provided with devices which don't permit the burner ignition or the flame to be extinguished, due to following problems:

- power failure;
- low pressure of combustion air;
- high and low gas pressure;
- purge cycle not accomplished.

The station is provided with acoustic and optical devices to signal the following problems:

- fan air pressure not normal;
- ladle temperature over set value;
- gas pressure not normal.

The station is also provided with all protection devices which stop the burner on detection of one of the following problems:

- power failure;
- lack of flame.

After each heating cycle the tightness of the main valves is checked automatically with the tightness control device. In case of a failure the unit cannot be started again unless the failure has been cleared.

## **8 – SCIROCCO system - Excess air flame regulation:**

According to drying pattern, very slow heating rates (~10°C/h) and very low starting temperature (~ 180°C) can be required.

In this case the drying station shall be provided with an separate air line to the additional external burners cones to reach a very high excess air flame (turn down of the burner is increased up).

As soon as the ladle temperature reach the limit value(e.g. 400°C) selected on the temperature programmer, the line is closed automatically and the burner works in stoichiometric conditions.

## **EXTENT OF PREASSEMBLING.**

The machine will be shipped in the following conditions:

- basement,
- column;
- arm
- ladle cover and the burner.

The arm must be fixed to the column by means of bolts.

The cover is provided with flanges for assembling and for the connection to the arm.

All the required bolts are shipped with the heater.

## **9 – Exclusions**

- Packing and transport.
- Assembly on site.
- Commissioning and start up.
- Supervision of erection and commissioning
- All foundation structures.
- All the necessary works for the ladle positioning.
- Connection with electric and fuel network
- Any spare parts.
- UL certification for complete machine.
- Whatever not included in the scope of supply.

## **10 - Vendor List**

- Solenoid valve: ELSTER, ELEKTROGAS, ASCO
- Pressure switch, regulation valve: ELSTER/ DWYER
- Pressure reducer: EMERSON/FIORENTINI
- Fan: FERRARI/MORO/MEZ
- Thermocouple: CEBA
- Relays and electrical components: SIEMENS
- Temperature programmer: EUROTHERM
- Control panel: Standard manufacturer
- Push button (Ø22): SIEMENS/GE/TELEMECANIQUE
- Pneumatic part: PARKER
- Hydraulic part: Standard (components: REXROTH VICKERS – cylinders: CEBA)
- Burners: CEBA





INDUSTRIAL SERVICE

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N° Mecc.BG 015579- Capitale Sociale Euro 99.000,00 i.v.  
E-mail: info@cebasrl.com

### **Rev.03 STANDARDS**

Measurement system:	Metric (ISO)
Profiles:	UNI/DIN
Instrumentation:	UL Listed
Mechanical connections	European standard for internal American standard at T.O.P.
Electric motors	IEC
Electrical standards:	IEC / UL*
Safety:	NFPA 86

**\* NOTE: - UL Certification for control panel only is provided.  
- UL Certification for the complete machine is not included in the scope of supply.**

## 10.4.4 Overhead Cranes

The plant will have the following overhead cranes

1. One (1) Hot metal crane for ladle handling 180(320)/50t, main EAF bay
2. One (1) crane for maintenance 15t, for Pig Casting bay
3. One (1) crane for maintenance 15t, for pig iron storage bay



Figure 10.4-23.: 3D view of the main crane for the EAF bay

The following pages present the manufacturer's technical description and crane drawings:

- JASO proposal # 30/44.308/16 - Technical description
- JASO Hot metal ladle crane Lay-Out 180t(320t)
- JASO Maintenance Crane 15t - Open Winch
- JASO Maintenance Crane 15t - Standard

**TENOVA METALS**

To the Attention of:  
**Mr. Francesco Memoli**

**Proposal No.:** 30/44.308/16  
**Date:** 01.05.2016  
**Subject:** *Technical offer for New Ladle EOT Crane*

Dear Sir,

We are pleased to submit our **r r 30/44 30 /16** for one EOT crane for the continuous casting liquid steel and three maintenance cranes for a steel plant in Quebec (Canada), hoping that it will be of your interest.

Do not hesitate to contact us for any further information you may require.

Looking forward to hearing from you

Yours sincerely

Alberto Lacarra

Key Account Manager / Business Development  
JASO Industrial Cranes

## INDE

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## 1 INTRODUCTION

### 1 1 ASO INDUSTRIAL CRANES

JASO INDUSTRIAL CRANES specialized in the design, manufacturing, assembly and after sales service of industrial cranes, mainly EOT cranes and Gantry cranes.

More than 50 years of experience, personalized service and the high product quality, have made JASO Industrial Cranes one of the global leaders for standard and custom-made cranes for the iron and steel industry, paper mills, power stations, automotive industry, construction, shipbuilding industry, etc.

With more than 350 employees JASO Industrial Cranes counts with a production surface of 33.500 m<sup>2</sup> worldwide and production facilities in Spain (Itsasondo-Gipuzkoa and Palencia), Mexico, Argentina and India.

All of it has resulted in more than 52.000 units supplied since 1965 in 21 countries, with an outstanding presence in markets like Europe, Saudi Arabia, Emirates, Northern Africa, USA, Central America, Mexico, Brazil, Peru, Chile and Malaysia among others.

We design and produce the lifting devices that equip our cranes, in accordance with FEM (European Federation of Materials Handling) and in compliance with all norms and regulations of the EU. Therefore, all our machines are certified with the Declaration of Conformity "CE".

Furthermore, JASO Industrial Cranes is certified since 2003 by LLOYD'S REGISTER LRQ with the ISO 9001 certificate, for an assurance of excellent quality in all our processes.

Thanks to the international expansion during the last years, and with help of the experience achieved in the different markets, since 2012 JASO Industrial Cranes can develop cranes according to the standards and specifications of the Russian GOST certificate (CU TR – Customs Union Technical Requirements).



## 1 2 CERTIFICATE ISO 001 200



### CERTIFICATE OF APPROVAL

This is to certify that the Quality Management System of:

**TALLERES JASO INDUSTRIAL, S.L.**  
**Ctra. Madrid - Irún, Km. 426**  
**20249 Itsasondo, Guipúzcoa**  
**Spain**

has been approved by Lloyd's Register Quality Assurance  
to the following Quality Management System Standard:

**ISO 9001:2008**

The Quality Management Systems applicable to:

**Design, manufacturing, installation, after sales services of hoists,  
travelling cranes, jibs, gantry cranes, semigantry cranes, cranes with  
revolving trolley, carriages and transfer cars.**

This certificate is valid only in association with the certificate schedule bearing the same number  
on which the locations applicable to this approval are listed.

Approval  
Certificate No: SGI 1202540

Original Approval: 05 June 2003

Current Certificate: 13 September 2015

Certificate Expiry: 14 September 2018



Issued by: LRQA España, S.L.  
For and on behalf of: Lloyd's Register Quality Assurance Limited



C/ Princesa, 29 - 1ª - 28008 Madrid, España

For and on behalf of: 1 Trinity Park, Bickenhill Lane, Birmingham B37 7ES, United Kingdom

This approval is carried out in accordance with the LRQA assessment and certification procedures and monitored by LRQA.  
The use of the UKAS Accreditation Mark indicates Accreditation in respect of those activities covered by the Accreditation Certificate Number 001.  
March 2010 - 14

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## 2 DG CRANE r LADLE HANDLING 1 0(320)/50T & 2 m S a 2

### 1 CRANE GENERAL CHARACTERISTICS

Crane Type	Double girder with open trolley lifting mechanism
Crane Operation	Ladle handling
Crane Capacity	180t under the traverse beam with lamellar hooks 320t (de-rated)
Crane Span	27 m
Crane Height of Lift	23 m
Service	Indoor
Temperature Range	0°C ÷ +60°C
FEM Classification	M8 for Main Lifting ( M4 de-rated) M8 for Aux Lifting M8 for Cross and Long Travelling A8 for Structure
Main Lifting Speed	6 mpm with frequency inverter
Auxiliary Lifting Speed	6 mpm with frequency inverter
Trolley Traveling Speed	30 mpm with frequency inverter
Bridge Traveling Speed	60 mpm with frequency inverter
Power Supply	480 V (±10%) - 60 Hz
Controls Power Supply	230 V - 60Hz

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**Ba C ra**

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- ✓ The crane for ladle handling has been quoted following the JASO criteria for this kind of applications without any Technical Specification from the customer.

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- ✓ The crane has been dimensioned as per the FEM M8/A8 for the nominal capacity of 180t & as per FEM M4 for 320t

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- ✓ The crane will include the CE certificate of compliance.

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- ✓ It has been considered in the scope of supply the erection and commissioning of the crane at site, including the mobile cranes, platforms and all necessary tools.
- ✓ Not included in the scope of work any civil work or bay roof removal.
- ✓ Training included.
- ✓ JASO personnel with requested qualification and trades for the mentioned activities.

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- ✓ “Black Assembly” will be performed in our workshop prior to painting process. It means that the crane will be fully assembled on ground for alignments checks and empty load running test (CT speed, LT speed, electrical tests, safety features test,...)

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- ✓ In case of nomination, JASO will provide all technical information such as drawings, showing details for subassemblies, maintenance and operation manual and CE certificate.

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- ✓ Warranty period for the crane is stated to 24 months, against all manufacturing flaw, bad quality of materials, given that all corresponding preventive maintenance instructions have been undertaken. These instructions will be included in the Operation and Maintenance Manual supplied with the cranes.

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- ✓ According to the EU legislation in terms of safety regulations for ladle handling cranes, “Performance Level D” (PLD) have been considered.

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- ✓ After sales maintenance actions are possible to be performed upon order from beneficiary.

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## L g

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- ✓ We have considered a total crane capacity of 180t below the integrated ladle traverse hook. Calculated for the requested FEM Group M8 (de-rated to 320t @ M4).
  - We have considered the lifting mechanism with open trolley configuration in double cinematic chain with two motors coupled to two planetary gear boxes. This solution provides cinematic redundancy in motors and reducers. It means that in case one of the motors/gear boxes fails, the crane can continue operating at full load (180t), half speed (3 mpm) and same FEM class M8.
  - ✓ The total lifting height is considered to be 23 m. below the lamellar hooks.
  - ✓ We have considered wire rope VEROPRO 8 with tensile strength of 200 Kg/mm<sup>2</sup>.
  - ✓ Lifting motion is equipped with frequency inverters, one for each one of the motors. One spare unit automatically commuted has been considered for both liftings.
  - ✓ An additional counterweight limit switch has been considered for security.
  - ✓ Approaches of each hook are reflected in the crane lay-out attached to this offer.
  - ✓ All the lifting mechanisms have considered overlapping prevention system for the wire ropes.
- 

## Tra g

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- We have considered for the trolley travelling mechanisms, groups consisting on one motor coupled one gearbox that drives the wheel through the corresponding couplings. Control by means of frequency inverters. Emergency mode has been considered.
  - We have considered, for the bridge travelling mechanism, four groups consisting on one motor coupled to one gearbox that drives the wheel through the corresponding couplings. They will be commanded by two frequency converters. Emergency mode has been considered.
  - Travelling motions are equipped with frequency inverters. One spare unit automatically commuted has been considered for both, CT and LT.
  - We have considered rail type Burbach for the bridge travelling. For trolley travelling movement Burbach type rails have been selected as well depending on the selected wheels and reactions.
  - We have included a centralized manual lubing system.
  - Crane flanged wheels have been considered, then crane guiding rollers have not been included in the scope of supply.
  - ✓ The crane has been designed taking into consideration a minimum temperature of 0°C by using standard materials and lubricants to guarantee the performances under these conditions.
  - We have considered fans installed in the trolleys and bridge end-carriages for rails cleaning.
-

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## E r a a r

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- The crane control with cabin and radio remote system.
  - The electrical equipment will be installed within the main girder, correctly confined and protected.
  - No regenerative drives have been considered.
  - Spare frequency converters with automatic commuting have been considered for lifting and travelling mechanisms.
  - Weighing system by means of extensometric shafts placed on balancing units of the main lifting mechanisms.
  - Load limiters with summation device included.
  - No emergency mode for crane control has been considered by means of double PLC system.
  - The electrical room inside the girder will be equipped with two industrial A/C with the corresponding filters for the proper functioning of the frequency inverters. Both system with 100% capacity to provide cooling redundancy.
  - Warning systems have been included in the access of the cranes and when handling loads
  - Over load limit switch, detector for wire rope tension and derailing are included for both liftings.
  - Crane power supply collector (3 phases + ground phase) with wear detection
  - Crane positioning system for all movements not included.
  - Redundancies and emergency modes that we have considered:
    1. Main lifting: redundancy in motors and gear boxes. In case of one of the motors/inverters or reducers fail, the lifting is able to operate at full load conditions with half speed and same FEM class.  
  
One spare frequency inverter is considered in the electrical room.
    2. Cross travelling: redundancy in motors. In case of one of the motors/inverters fails, the trolley is able to operate at full load and max speed in emergency mode.
    3. Bridge travelling: redundancy in motors. The crane is able to operate at full load and max. speed in case that one motor/inverter fail but in emergency mode.  
  
One spare frequency inverter is considered, common for CT & LT.
-

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**O r**

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- We have considered walkways with handrails along both girders with inclined stairs for access between girders and walkways.
  - Maintenance platforms with handrails in the trolley have also been considered to guarantee maintenance and accessibility to every single component.
  - Heat protections for the traverse beam have been provided.
- 
- We have considered sand-blasted surface treatment (minimum SA 2,5), special coating and painting suitable for iron and steel production environment conditions.
- 
- All girders have been considered suitable for internal welding inspections by providing the proper accessibility.
-

## 2 2 MAIN LIFTING MECHANISM 1 0 Ca a

<b>G r a C a r a r</b>	
Lifting Capacity	180t below traverse beam with lamellar hooks
Lifting Speed	6 mpm
Height of Lift	23 m
FEM Classification	M8 (180t) / M4 (320t)
Features	Continuous speed control with two frequency inverters

<b>E r a M r</b>	
Quantity	2
Type	Squirrel cage three phase asynchronous motor
Brand	ABB
Model	355SMC / Foot-mounted B3
Power	200 kW 750 rpm
Service Factor	100%ED
Protection	IP-55
Others	With incremental encoder
	Insulation Class F
	Thermal sensors

<b>C g M r-G a r x</b>	
Quantity	4
Type	Crowned-tooth gear coupling
Brand	JAURE
Model	MTFS-JS 100-625

<b>S r B r a k</b>	
Quantity	4
Type	Electro-hydraulic
Brand	SIBRE
Model	USB 3-I EB 800-60

<b>G a r x</b>	
Quantity	2
Type	Planetary
Brand	JASO
Model	P6DH16

<b>C g G ar x/ Dr m</b>	
Quantity	2
Type	Barrel coupling
Brand	JAURE
Model	TCBN-2100
<b>Dr m</b>	
Quantity	2, equipped with anti-slack and anti-derailing rope devices
Type	Welded rolled steel plate w/ turned grooves & single wire layer
Diameter	Ø 1200 mm (3300 mm long), 12/2 + 12/2
Over-speed system	By means of 2 centrifugal encoder in the drums shafts
Emergency Brake	2, Brand SIBRE mod. SHI201 / Disk Ø2250 mm
Special Coupling	MSS-2100 Brand JAURE (between both drums)
<b>W r R</b>	
Type	Steel wire rope
Number of Falls	24 / 4
Model	VEROPRO 8
Tensile Strength	200 kg/mm <sup>2</sup>
Length / Diameter	4 pieces of 188 m / Ø30 mm
<b>H k Tra r B am A m</b>	
Hook	2 units, lamellar type
Type	Size No.125x205 acc. to DIN 15407
Traverse Beam	Heat protected box type with 12 welded rolled steel pulleys (4 x Ø1000 mm + 8 x Ø900 mm)
<b>S a B k</b>	
Quantity	8
Pulley Type	Welded rolled steel
Pulleys Diameter	Ø900 mm
<b>C m a A m</b>	
Quantity	2
Type	Balancing Unit for wire rope Ø30 mm with weighing system acting as load limiter
<b>O r</b>	
Lifting limit switches	Rotary type with four contacts in each drum
Additional limit switch	Counterweight type for additional security
Load limiter	Including summation device.
Weighting system	Extensimetric shafts placed in the balancing units.
Encoders	2 incremental in the motors shaft 2 for overspeed detection in the drums shafts
Frequency Inverters	2, one commanding each motor, brand SCHNEIDER. 1 spare unit common for main and aux. lifting. Redundancy in motors
Positioning System	Not included

## 2 3 AU ILIARY LIFTING MECHANISM 50 Ca a

### G ra C ara r

Lifting Capacity	50 t
Lifting Speed	6 mpm
Height of Lift	25 m
FEM Classification	M8
Features	Continuous speed control with one frequency inverter

### E r a M r

Quantity	1
Type	Squirrel cage three phase asynchronous motor
Brand	ABB
Model	315SMB
Power	90 kW a 1000 rpm
Service Factor	S1, 100% ED
Protection	IP-55
Others	With incremental encoder
	Insulation Class F
	Thermal sensors

### C g M r-G ar x

Quantity	1
Type	Crowned-tooth gear coupling
Brand	JAURE
Model	MTFS-JS 90-445

### S r Brak

Quantity	1
Type	Electro-hydraulic
Brand	SIBRE
Model	USB 3-I EB 300-50
Diameter	Disk brake Ø 450 mm

### G ar x

Quantity	1
Type	Tandem with parallel shafts
Brand	JASO
Model	T6H

<b>C g G ar x/ Dr m</b>	
Quantity	1
Type	Barrel Coupling
Brand	JAURE
Model	TCB-1000
<b>Dr m</b>	
Quantity	1, equipped with anti-slack and anti-derailing rope devices
Type	Welded rolled steel plate w/ turned grooves & single wire layer
Diameter	Ø 650 mm (4000 mm long)
<b>W r R</b>	
Type	Steel wire rope
Number of Falls	8 / 2
Model	VEROPRO 8
Tensile Strength	200 kg/mm <sup>2</sup>
Length / Diameter	2 pieces of 116 m. / Ø26 mm
<b>S a B k</b>	
Quantity	2
Pulley Type	Welded rolled steel
Pulleys Diameter	Ø710 mm
<b>C m a A m</b>	
Quantity	1
Type	Balancing Unit Ø26 mm
<b>O r</b>	
Lifting Limit Switches	Rotary type with four contacts
Additional Limit Switch	Counterweight type for additional security
Load limiter	Summation device included in main lifting
Weighting system	Not included
Encoders	1 incremental in the motors shaft
Frequency Inverters	1, brand SCHNEIDER 1 spare unit common with main lifting No redundancy
Positioning System	Not included

## 2 4 TROLLEY TRAVELLING MECHANISM

### G r a C a r a r

Trolley Traveling Speed	30 mpm
FEM Classification	M8
Features	Continuous speed control with one frequency inverter per motor

### E r a M r

Quantity	2
Type	Squirrel cage three phase asynchronous motor
Brand	ABB
Model	180M4A
Power	18,5 kW a 1.500 rpm
Service Factor	S1, 100% ED
Protection	IP-55
Others	Encoder in the motor Thermal sensors
	Insulation Class F

### C g M r-G a r x

Quantity	2
Type	Crowned-tooth gear coupling
Brand	JAURE
Model	MTFS 62/315

### S r Brak

Quantity	2
Type	Electro-hydraulic
Brand	SIBRE
Model	USB 3-05 E50
Diameter	Ø 315 mm

### G a r x

Quantity	2
Type	Tandem with parallel shafts
Brand	JASO
Model	T3V



<b>C g G ar x-W A m</b>	
Quantity	2
Type	Crowned-tooth gear coupling
Brand	JAURE
Model	MT-112
<b>W A m</b>	
Quantity	8
Type	Double-flanged forged type
Material	F-1252F
Diameter	Ø 630 mm
<b>B r</b>	
Quantity	4
Type	Hydraulic
Brand	SHB
Model	KP 50x50
<b>Ra</b>	
Type	Burbach per DIN-536
Size	A-120
Others	Clamps and neoprene band for vibrations absorption
<b>Tr S a</b>	
Approximate Span	9.000 mm
<b>O r</b>	
Frequency Inverters	2 units commanding each one of the motors, Brand SCHNEIDER
	1 spare unit common with bridge travelling. Redundancy in motors/inverters in emergency mode
Cleaning fans	4 units attached to the trolley end-carriages
Positioning System	Not included

## 2 5 BRIDGE TRAVELLING MECHANISM

### G ra C ara r

Bridge Traveling Speed	60 mpm
FEM Classification	M8
Features	Continuous speed control with frequency inverters

### E r a M r

Quantity	4
Type	Squirrel cage three phase asynchronous motor
Brand	ABB
Model	225M4A
Power	45 kW a 1.500 rpm
Service Factor	S1, 100% ED
Protection	IP-55
Others	Encoders in the motors Thermal sensors
	Insulation Class F

### C g M r-G ar x

Quantity	4
Type	Crowned-tooth gear coupling
Brand	JAURE
Model	MTFS 62-315

### S r Brak

Quantity	4
Type	Electro-hydraulic
Brand	SIBRE
Model	USB 3-05 E50
Diameter	Ø 315 mm

### G ar x

Quantity	4
Type	Tandem with parallel shafts
Brand	JASO
Model	T4H

<b>C g G ar x-W A m</b>	
Quantity	4
Type	Crowned-tooth gear coupling
Brand	JAURE
Model	MT-190
<b>W A m</b>	
Quantity	16
Type	Double-flanged forged type
Material	F-1252
Diameter	Ø 630 mm
<b>B r</b>	
Quantity	4
Type	Hydraulic
Brand	SHB
Model	KP 63x350
<b>Ra (R mm )</b>	
Type	Burbach per DIN-536
Size	A-120
<b>O r</b>	
Frequency Inverters	2 units commanding 2 motors each Brand SCHNEIDER
	1 spare unit common with trolley travelling Redundancy in motors/inverters in emergency mode
Cleaning fans	4 units attached to the end-carriages
Positioning System	Not included
Anti-collision	2, for both sides of the crane

## 2 6 OVERHEAD CRANE TOTAL WEIGHT AND REACTIONS

<b>W g</b>	
Crane Total Weight	294.100 kg
Main Trolley Weight	119.060 Kg
Bridge Weight	175.040 Kg
<b>R a            W</b>	<b>1 0 / 320 (Kg)</b>
Maximum Vertical Reaction R11 ÷ R18	43.480 / 58.710
Minimum Vertical Reaction R21 ÷ R 28	15.790 / 18.050
Horizontal Transversal Reaction Y11 ÷ Y18	4.348 / 5.871
Horizontal Lengthwise Reaction Kr1 , Kr2	6.211 / 7.387
<b>La ra R a</b>	
Approximate Main Hook Lateral Reach	See drawing



### 3 GENERAL DESCRIPTION

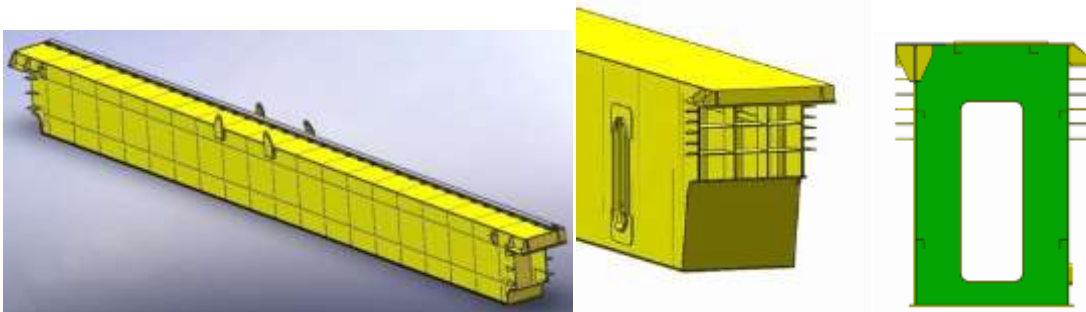
#### 3 1 CRANE STRUCTURE

The structure has been calculated following the prescriptions of the mentioned Standards and the operation characteristics of the crane. It has been considered as per FEM standards class A8. We have followed design criteria to get an easy maintenance and parts replacement.

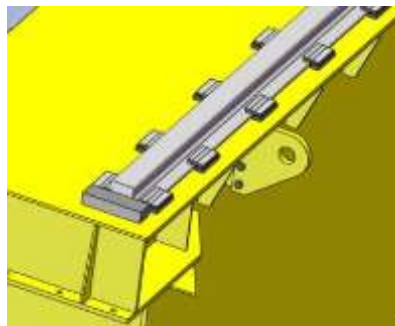
**M a g r r** the girders are composed of two welded rolled steel reinforced box girders. They include, if required, diaphragms and inside stiffeners to assure webs and flanges stability. The central part of the girders is manufactured in whole sheet metal parts with no welding in a minimum length of 6m.

The trolley running rails are clamped on the upper surface of the beam properly aligned with the vertical plate. Neoprene bands for vibration absorption have been considered.

Manholes for welding inspection have been considered. Access to the girders by means of doors.



**R a** Trolley and crane traveling movements are performed by means of Burbach type per DIN-536 rails.



**W a k a a a r a** all outside the girders perimeter will be protected with welded steel tube handrails, calculated to support a 50 kg horizontal load. The trolleys will also be protected with two handrails on both sides in-between the girders.

The crane includes walkways along both girders. In addition to the walkway, inclined and vertical stairs for access between walkway and girder are included. The crane also include maintenance platforms on the trolley.

All the accesses to the crane components are guaranteed and always possible by means of stairs instead of ladders.

**E** **arr ag** ( **r k am** ) built with box type steel structure for casting crane, rigidly fastened to the girders, the end carriages include the wheel assemblies mounting supports on both sides. The girder fastening section areas include additional stiffeners in the inside of the end carriages. The end carriages include 90° L-type machined mounting surfaces to accommodate the wheel assemblies.

The end carriages will be provided with seats for disassembly jacks. Rail-guards at the front as shown in the sketch below as well as the attachments for the cleaning fans have been considered. Inspection windows have been considered.

See the end-carriage concept in the drawing, based on boogies.



**Tr** **ram** Built with sheet metal plates and profiles, it consists of main girders and auxiliary cross girders, which serve as the binding elements of the trolley and as a mounting support for the lifting mechanisms, creating a highly rigid assembly.

The mounting surfaces of the lifting mechanisms will be machined to assure their adequate alignment.

The frame of the trolley will be provided with seats for disassembly jacks as well as rail-guards at the front as per sketch above.

Cleaning fans have been also included.

**B** **r** The trolleys and bridge will include buffers, hydraulic type, selected to absorb the energy of an impact at 70% of maximum trolleys and bridge speed respectively and with the trolleys in any position.

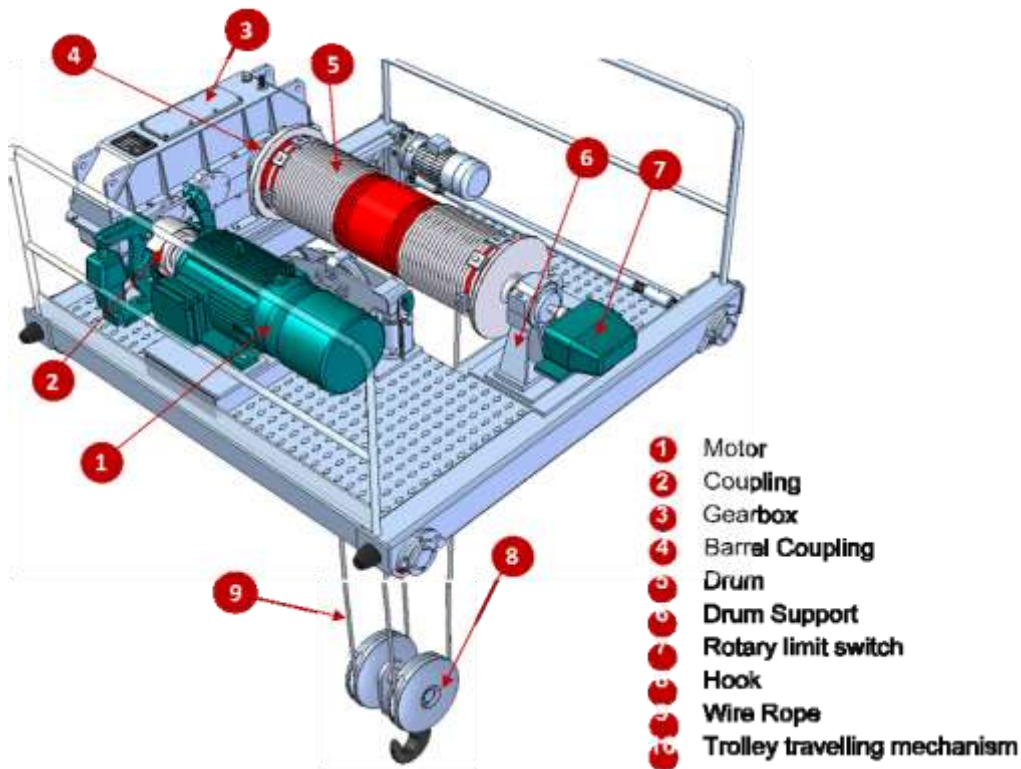
**L** **r a** manual centralized lubrication system, composed of different lubing points, one in each individual component to be lubricated by means of grease cartridges.



### 3 2 LIFTING MECHANISMS

The lifting mechanisms are composed by three-phase squirrel cage type electrical motors, coupled to the corresponding gearbox through JAURE crowned-tooth couplings and with drum-type electro-hydraulic brakes, selected with a safety factor of 1,6 times the electrical motor torque.

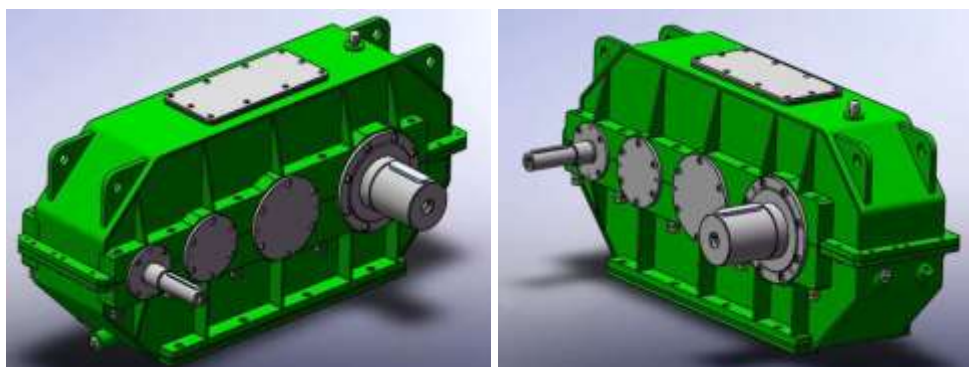
One frequency inverter commands each one of the lifting motors, main and aux. The sketch below represents the general lay-out of a open winch or named build-up lifting configuration.



**G a r x** the gearboxes are built with welded sheet metal plates and are perfectly machined. Before the machining, the housing is both normalized to remove the internal stresses and deoxidized with sand-blasting treatment.

It's a tandem type gearboxes, with a parallel inlet and an outlet shaft and with machined pinions in the shafts, forming one single part. Gears are built from rolled steel parts.

See a sketch of a JASO tandem gear box with parallel shaft.



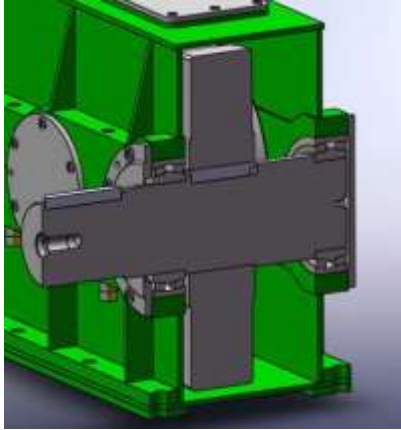
The gearbox includes a blow valve, oil level stick and a drain plug, as well as a large inspection cover to allow frequent inspection of the gearbox. The gearboxes are coupled to the drums through barrel



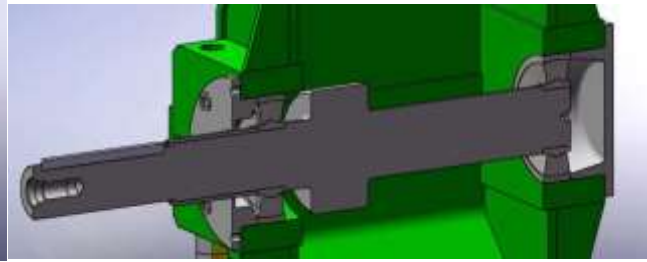
couplings. The shafts, gears and bearings are lubed with the same oil of the gearbox which is splashed with the same movement of the gears all around the gearbox.

Attached some sketches showing the gears and shafts configuration of the JASO gearboxes.

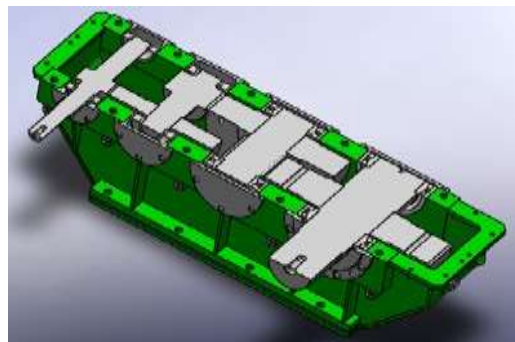
Output Shaft:



Input Shaft:



Gears Configuration:



For main lifting (180t) the gear boxes are planetary type in central position to permit redundancy in case one of the motors/inverter fail.

**Dr m** Built from welded rolled steel plates and turned to obtain the required grooves for the wire cable. The drum is designed to have one single layer of rope wire and to have always a minimum of three wraps of wired cable on the drum on each side when the hook is at its lowest position, as well as two safety additional free wraps when the hook is at its highest position.

The wire cables are clamped to the drum using steel clips with screws.

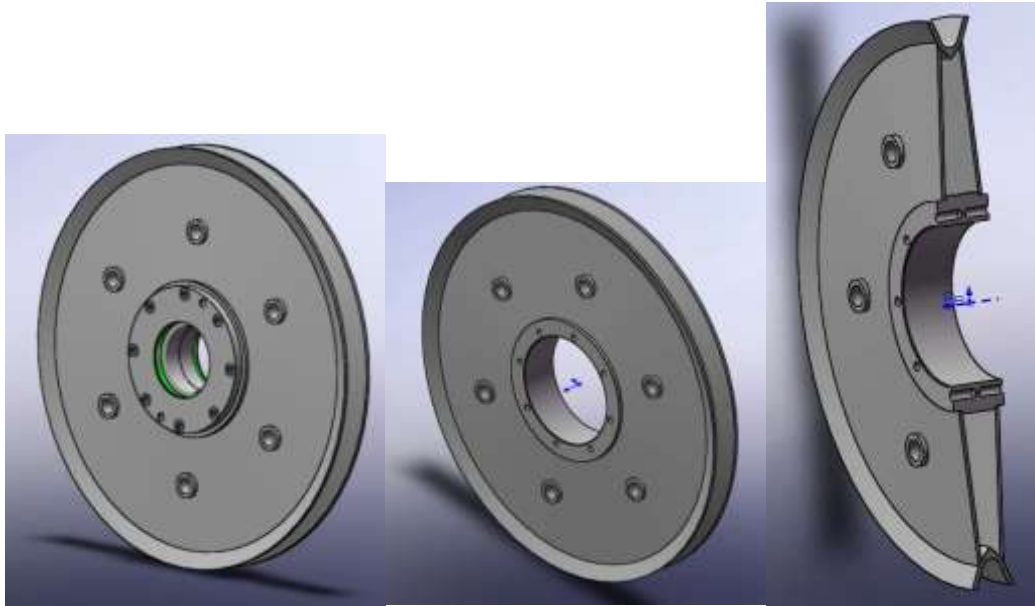
The drum is mounted on roller bearings.

The main drums do have a welded disk brake for emergency.

**W r a** made of steel, calculated following the previously mentioned standards. The wire rope steel material has 200 kg/mm<sup>2</sup> tensile strength.

**P** rolled steel welded pulleys with a deep groove for the wire rope, when applicable. The pulleys are mounted on shafts and roller bearing assemblies, allowing their rotation.

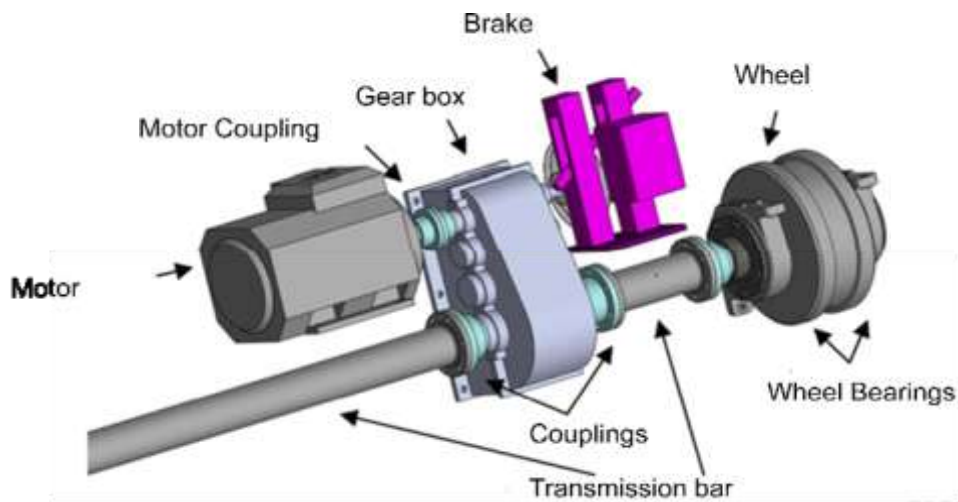
Attached some sketches showing this type of pulleys.



In order to maintain the relative distance between the vertical plates 6 bushes are installed. Also to reinforce and release efforts over the welding lines.

### 3 3 TROLLEY TRAVELING MECHANISM

The trolleys traveling mechanisms are composed by driving groups consisting on three-phase squirrel cage type electrical motor coupled to a gearbox through an JAURE crowned-tooth coupling and a drum-type electro-hydraulic brake SIBRE brand, selected with a safety factor of 1,6 times the electrical motor torque. The electrical motor is controlled by means of one frequency inverter.



**G** ar x the trolley gearbox is built with welded sheet metal plates and are perfectly machined. Before the machining, the housings are both normalized to remove the internal stresses and deoxidized with sand-blasting treatment.

They are a tandem type gearbox, with parallel inlet and outlet shafts and with machined pinions in the shafts, forming one single part. Gears are built from rolled steel parts. The gearboxes include blow valves, oil level sticks and drain plugs, as well as inspection covers to allow frequent inspections of the gearboxes.

The gearboxes are coupled to the wheel assemblies through JAURE crowned-tooth couplings and coupled transmission bars.

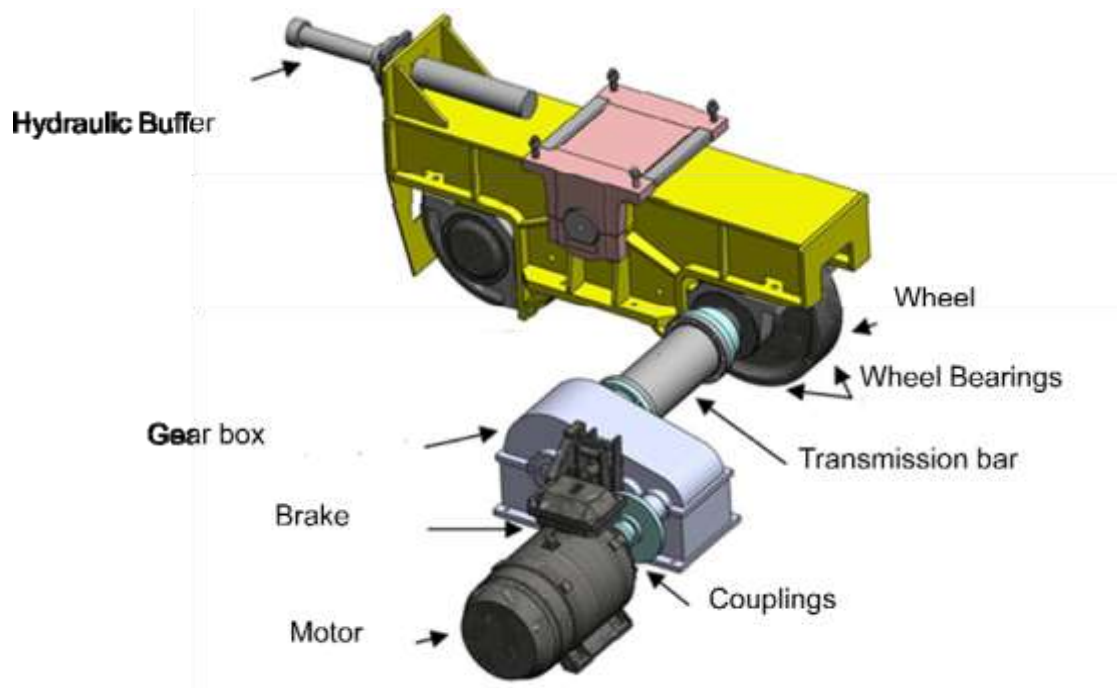
The shafts, gears and bearings are lubed with the same oil of the gearbox which is splashed with the same movement of the gears all around the gearbox or pumped in vertical gearbox configurations.

See sketches showed in the previous paragraphs for lifting components.

**W** the trolleys are mounted on wheel assemblies. They are double-flanged forged steel wheels, fixed and mounted with keyways on carbon steel shafts. The wheel assemblies are assembled and bolted on L-shaped 90°-machined surfaces on the end carriages, with ball bearings, including lubrication points.

### 3 4 CRANE TRAVELING MECHANISM r La Cra

The bridge traveling mechanisms are composed by four groups of three-phase squirrel cage type electrical motors, coupled to a gearbox through a JAURE crowned-tooth coupling and a drum-type electro-hydraulic brake, selected with a safety factor of 1,6 times the electrical motor torque. Both motors commanded by one frequency inverter.



**G**ear boxes the travelling gearboxes are built with welded sheet metal plates and are perfectly machined. Before the machining, the housings are both normalized to remove the internal stresses and deoxidized with sand-blasting treatment.

They are a tandem type gearbox, with parallel inlet and outlet shafts and with machined pinions in the shafts, forming one single part. Gears are built from rolled steel parts. The gearboxes include blow valves, oil level sticks and drain plugs, as well as large inspection covers to allow frequent inspections of the gearboxes.

The gearboxes are coupled to the wheel assemblies through JAURE crowned-tooth couplings and coupled transmission bars.

The shafts, gears and bearings are lubed with the same oil of the gearbox which is splashed with the same movement of the gears all around the gearbox.

**W**heels the bridges are mounted on wheel assemblies. They are double-flanged forged steel wheels, fixed and mounted with keyways on carbon steel shafts. The wheel assemblies are assembled and bolted by means of steel mounting brackets with mounting surfaces at 90° and with ball bearings that include lubrication points.

### 3 5 LIST OF MATERIALS

	MATERIAL	AS PER STANDARD
<b>STRUCTURE</b>		
Unalloyed rolled steel	S275JR St 44.2	UNE-EN 10025 DIN 17100
<b>TWISTED SHAFTS</b>		
Unalloyed steel	F-1140	UNE 36011
Treated alloyed steels	F-1252	UNE-36012
<b>BENT SHAFTS</b>		
Unalloyed steel	F-1140	UNE 36011
Treated alloyed steels	F-1252	UNE-36012
<b>BENT AND TWISTED SHAFTS (PINION SHAFTS)</b>		
<b>S r ra</b>		
Steels for carburizing	F-1580	UNE 36013
<b>O ra ra</b>		
Steels for carburizing	F-1580 F-1551	UNE 36013 UNE 36013
<b>GEAR-WHEELS</b>		
<b>S r ra</b>		
Steels for carburizing	F-1551	UNE 36013
<b>O ra ra</b>		
Steels for carburizing	F-1580 F-1551	UNE 36013 UNE 36013
<b>CRAB TR AVERSING WHEELS</b>		
<b>S r ra</b>		
Nodular cast iron	GGG-70	DIN 1693
Forged steel	F-1140	UNE 36011
<b>O ra ra</b>		
Nodular cast iron	GGG-70	DIN 1693
Treated forged steel alloyed steels	F-1252 ASTM 504 C	UNE-36012 ASTM 504 C
<b>OVERHEAD TRAVELLING WHEELS</b>		
<b>S r ra</b>		
Nodular cast iron	GGG-70	DIN 1693
<b>S a Cra</b>		
Nodular cast iron	GGG-70	DIN 1693
Treated forged steel alloyed steels	F-1252 ASTM 504 C	UNE-36012 ASTM 504 C
<b>ROPE PULLEYS</b>		
<b>S r ra</b>		
Unalloyed rolled steel	S355JR St 52.3	UNE-EN 10025 DIN 17100
<b>O ra ra</b>		
Rolled steel	St 52.3	DIN 17100
<b>HOOKS</b>		
Forged steel	P: StE 355 S: 34 CrMo4 T (<N°50): 34CrMo4 T(>N°50): 34CrNiMo6 V(N°2.5/40): 34CrNiMo6 V(>N°40): 34CrNiMo8	DIN 17135 DIN 17200 DIN 17200 DIN 17200 DIN 17200 DIN 17200

### 3 6 ELECTRICAL INSTALLATION

All electrical components are appropriately dimensioned and protected for the application and for the environmental conditions where they are going to be installed. They will respect the low voltage regulations. Also, we have followed the requirements as per applicable customer specification.

We have considered the following voltages:

- ✓ Power supply: 480V 60Hz
- ✓ Auxiliary services:
  - Plugs and lights 230V 60Hz
  - Lights: 230V 60Hz
  - Contactor coil control/relays: 230V 60Hz
  - PLC control: 24 Vdc

We have considered the following electrical configuration for both type of cranes:

E r a m a		C g
Commercial electrical cabinet on walkway	NO	
Electrical room on Walkway	NO	
Within the Girders	YES	a/c (industrial) with redundancy and pressurization

We have considered an outside range of temperature between 0°C and +60°C

The electrical installation will mainly be SCHNEIDER, designed for 600 operations per hour. Three-phase squirrel cage motors with F-type insulation, selected for an operation mode based on 60% ED. The main characteristics of the proposed electrical equipment are as follows:

#### Ma S

The main switch is located in the main protection panel and includes the following features:

- Thermal and magnetic protection.
- Manual cut-off and disconnect. Mechanical interlock.
- Emergency stop.

Please note: in order to guarantee the non-appearance of tension in the electrical rooms and the electrical installation girders, apart from the main switch, the magneto-thermal circuit breaker for the illumination power supply of the interior of the girder/electrical room has to be disconnected, as indicated on an explanatory note located near the main switch.

When the electrical equipment is installed in an electrical cabinet, the main switch isolates completely the crane's entire installation.

### Ma a r

The main contactor is situated in the main protection panel, downstream from the main switch and includes the following features:

- It is controlled by the main command circuit.
- The safety elements act on the main contactor causing a “0 category shutdown as per EN60204-1”

### Dr

The drives considered for all lifting and travelling mechanisms are squirrel cage type asynchronous electrical motors, controlled by frequency inverters.

MOTION	MOTORS	INVERTERS		REMARKS
Ma L g 1 0 (320 )	2	SCHNEIDER	2 + 1(*)	Redundancy in motors/inverters (*) spare unit
A x ar L g 50	1	SCHNEIDER	1	No redundancy/No emergency (*) common spare unit
Tr Tra g	2	SCHNEIDER	2	Redundancy in emergency mode (**) common spare unit
Cra Tra g	4	SCHNEIDER	2 + 1(**)	Redundancy in emergency mode (**) spare unit

### Fr r r

With help of frequency inverters, the torque and speed are being controlled, what allows a proper operation of the motor in all working phases. Progressive starting and stopping of the movements, adjustable speed-control and a constant control of the torque in the entire speed range.

Modes of control of the frequency converters:

- Lifting movements: flux vector control in closed-loop (or direct torque control in closed-loop as per the frequency converter’s manufacturer). The variator knows at any time the real motor speed through a signal provided by an incremental encoder installed on the motor shaft.
- Travelling movements: voltage/frequency law or vector control in open-loop.

The frequency inverter’s most relevant protection features are the following:

- Short-circuits between phases and between phases and ground (motor).
- Overvoltage and voltage drop (triggering the frequency inverter)
- Phases disadjustment.
- Single phase operation.

The frequency variator power supply is protected against the short-circuits through a magnetic switch upstream.

The spare frequency inverter are automatically commuted in the electrical room in case of failure of the service units. One common for both liftings and one common for CT & LT movements.



### E r a m r r

The electrical motors are protected against long-term overloads as follows:

- Main lifting motors through double thermal sensors.
- Travelling motors:
  - Through thermal sensors for motors with 15kW and higher
  - Through thermal relays for motors below 15kW

Protection against short-circuit is incorporated in the frequency converter.

Brake protection is attained through automatic magneto-thermal switches.

### Cra r

Type of control		Location	I/O Distribution
PLC SIEMENS S7 (including profibus)	YES	Electrical Room	Centralized in electrical installation
Local area network	YES	Electrical Room	---
Movement relays	NO	---	---

### C r

Pushbutton pendant	NO
Radio remote control	YES
Cabin	YES

Control circuit provided with UPS (Uninterruptible Power Supply).

### A x a r r

Auxiliary services' options	
Triphasic plugs 400V	NO
Single phase plugs 230V 60Hz	YES - in electrical installation panels
Power plugs 24V	NO
Access lighting & emergency lights	YES
Crane working area lighting	YES
Ventilation for cleaning the crane's rail	YES
Earth protection system	YES
Control screen	YES, size 10", inside e-room and cabin
Travelling limit switches	SCHMERSAL
Fire extinguishing system	NO
Air Conditioning	2 units for electrical room 1 unit for the cabin
Power supply voltage and current monitoring controller	YES



## Pr m a m

### 1 L g m a m

Load limit switch: avoids lifting loads which exceed the nominal capacity of the crane.

Four contact rotary type: Limits the lifting height

Includes the following features:

- Stop downwards motion
- Decelerate upwards motion
- Stop upwards motion
- Emergency stop: 0 category shut-down as per EN60204-1

Counterweight type limit switch: activated by the counterweight, triggering the main contactor of the crane (0 category shut-down as per EN60204-1)

SCHNEIDER XCKM115 brand.

### 2 Br g ra g m a m

Limit switches: SCHMERSAL brand. Two detectors in each sense will be installed, one for deceleration and one for stop.

### 3 Tr ra g m a m

Limit switch:

For speeds equal to or lower than 60 mpm. The detectors will be limit switch SCHMERSAL brand

For speeds higher than 60 mpm, the detectors will be SCHMERSAL brand as well. Two detectors will be installed, one in each direction, one for deceleration, one for stop.

## H ma r

All receptors will be ground connected through a special protection conductor added to the multiple hose of active cables. The ground system will be centralized in one distribution bar mounted in the lower part of the electrical cabinet where the connectors of the active conductors are mounted.

This distribution bar will be connected to the plant power supply system through the rails and crane power connectors. The ground conductor section will be the same as the one of the active conductors until 16mm<sup>2</sup> and a size smaller for sections above 16mm<sup>2</sup>.

This is the JASO recommendation: a reliable ground connection in the point of the power supply, above all for those cranes controlled by means of frequency converters. Certain frequencies are derivated to the ground connection.

In the case there is no space in the existing power supply to add the ground point, this function can be done by means of brushes, which is the case for this offer.

D ag r r r a a a r OPTION AL

S a r g

**SIEMENS**
SIMATIC PANEL

CARGA HORNO 170(300)/50/16Tm ##

MARCHA  
  BOT  
  RAD1  
  RAD2

**ELEVACION AUXILIAR**

- PROTECCION VARIADOR: 3Q1
- VARIADOR 3A1:
- ORDEN ABRIR FRENO DESDE VARIADOR 3A1
- LIMIT CARGA: MECANICO:  ON    ELECTR:  ON
- PROTECCION FRENO: 3Q2
- CONFIRMACION CONTACTOR FRENO: 3KM10
- SONDA: 3F2                      SONDA ACTIVADA
- FC HUSILLO RALENT.SUBIR: 3S272/2
- FC HUSILLO PARO SUBIR: 3S272/3
- FC HUSILLO PARO BAJAR: 3S272/4

PANT  
GENERAL

ELEV  
PPAL 1

ELEV  
PPAL 2

VARIAD  
RESERV

TRASL  
PHRNTR

TRASL  
CARRO

TOUCH

D ag m r

**SIEMENS**
SIMATIC PANEL

CARGA HORNO 170(300)/50/16Tm ##

MARCHA  
  BOT  
  RAD1  
  RAD2

**CONFIGURACION PLC**

CPU	RADIOS	PUENTE	CARRO+ POLIP

ELEV M1	ELEV M2	ELEV AUX	V_RES

PANTALLA  
GENERAL

RADIO1

RADIO2

HISTORICO  
FALLOS

IDIOMA

TOUCH

H r a r r r



**W r m m a W-La E r OPTIONAL**

With this option it is possible to get access to the crane's PLC, as well as to visualize the same images as the ones programmed in the touch screen on any computer connected to the client's red. Therefore the computer needs the necessary SIEMENS licenses and a password for authorized access. In informatics terms, the PLC of the crane is another "IP"-address in the client's Ethernet.

Crane:

By means of the communications processor CP343-1 Lean, located in the rack of the PLC, a compatible connection with the Ethernet is obtained, which is connected by a wireless switch installed in the crane (SCALANCE from SIEMENS). This way the crane is prepared to connect "in client's mode" to a W-Lan network.

W-Lan bay:

One (or several depending on the covering) wireless switch installed in the fixed part of the bay, act as "access point" to the W-Lan and is connected to the client's main switch (Ethernet).

As a standard solution and logic in the scope of delivery, JASO provides the necessary devices for the crane, with the fixed part of the installation remains to the criteria of the responsible for informatics in each company



## R m m a a (T r ) OPTIONAL

The tele-maintenance or remote assistance for the cranes consists in the availability of a connection to internet for the crane, in order to be able to access from JASO's offices to the crane's machine. This way, it is possible to realize a diagnosis of maintenance or modification of the program without necessity for the techniques to move.

In JASO, we propose two options of Tele-maintenance:

1. Access internet by "remote desktop"

This type of connection does not cause any additional costs. The client needs to have a computer for connection to the crane and at the same time to internet.

We provide software, which does not need any license and which serves to enlance with the client's computer and take control from there. This way, from the computer we can enlance to the crane's machine.

The client needs to have the necessary means to connect to the crane's machine, as well as the necessary software for programming.

## 4 DG CRANE r MAINTENANCE 15T & 1 m S a (O W V r )

### 4.1 CRANE GENERAL CHARACTERISTICS

Crane Type	Double girder with open trolley lifting mechanism
Crane Operation	Maintenance
Crane Capacity	15t under the hook
Crane Span	18 m
Crane Height of Lift	20 m
Service	Indoor
Temperature Range	0°C ÷ +40°C
FEM Classification	M5 for Lifting M5 for Cross and Long Travelling A5 for Structure
Main Lifting Speed	6 mpm with frequency inverter
Trolley Traveling Speed	20 mpm with frequency inverter
Bridge Traveling Speed	40 mpm with frequency inverter
Power Supply	480 V (±10%) - 60 Hz
Controls Power Supply	230 V - 60Hz

---

**Ba C ra**

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- ✓ The crane for maintenance has been quoted following the JASO criteria for this kind of applications without any Technical Specification from the customer.

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- ✓ The crane has been dimensioned as per the FEM M5/A5 for the nominal capacity of 15t

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- ✓ The crane will include the CE certificate of compliance.

---

- ✓ It has been considered in the scope of supply the erection and commissioning of the crane at site, including the mobile cranes, platforms and all necessary tools.
- ✓ Not included in the scope of work any civil work or bay roof removal.
- ✓ Training included.
- ✓ JASO personnel with requested qualification and trades for the mentioned activities.

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- ✓ “Black Assembly” will be performed in our workshop prior to painting process. It means that the crane will be fully assembled on ground for alignments checks and empty load running test (CT speed, LT speed, electrical tests, safety features test,...)

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- ✓ In case of nomination, JASO will provide all technical information such as drawings, showing details for subassemblies, maintenance and operation manual and CE certificate.

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- ✓ Warranty period for the crane is stated to 24 months, against all manufacturing flaw, bad quality of materials, given that all corresponding preventive maintenance instructions have been undertaken. These instructions will be included in the Operation and Maintenance Manual supplied with the cranes.

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- ✓ After sales maintenance actions are possible to be performed upon order from beneficiary.

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**L g**

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- ✓ We have considered a total crane capacity of 15t below the hook. Calculated for the requested FEM Group M5
  - We have considered the lifting mechanism with open trolley configuration in single cinematic chain with one motor coupled to one tandem gear box
  - ✓ The total lifting height is considered to be 20 m. below the hook
  - ✓ We have considered wire rope W.S. with tensile strength of 180 Kg/mm<sup>2</sup>
  - ✓ Lifting motion is equipped with frequency inverter, one commanding the motor. No spare unit automatically commuted has been considered for lifting
  - ✓ An additional counterweight limit switch has been considered for security
  - ✓ Approaches of each hook are reflected in the crane lay-out attached to this offer
  - ✓ All the lifting mechanisms have considered overlapping prevention system for the wire ropes
- 

**Tra g**

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- ✓ We have considered for the trolley travelling mechanisms, groups consisting on one gear-motor with direct drive to the wheels. Control by means of frequency inverter. Emergency mode has not been considered
  - ✓ We have considered for the bridge travelling mechanisms, groups consisting on one gear-motor with direct drive to the wheels. Control by means of frequency inverter. Emergency mode has not been considered
  - ✓ We have considered rail type steel square bar for trolley and bridge travelling
  - ✓ We have included a centralized manual lubing system.
  - ✓ Crane flanged wheels have been considered, then crane guiding rollers have not been included in the scope of supply.
  - ✓ The crane has been designed taking into consideration a minimum temperature of 0°C by using standard materials and lubricants to guarantee the performances under these conditions.
-

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## E r a a r

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- The crane control by means of pendant and radio remote system
  - The electrical equipment will be installed within an electrical cabinet, correctly confined and protected placed on the walkway
  - No regenerative drives have been considered
  - Spare frequency converters with automatic commuting have not been considered for lifting and travelling mechanisms
  - Weighing system not included
  - Load limiter included, pulley type
  - No PLC control system
  - The electrical installation placed inside the cabinet will be equipped with std. A/C with the corresponding filters for the proper functioning of the frequency inverters
  - Anti-collision device, acoustic alarm and light alarm included
  - Crane power supply collector
- 

## O r

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- We have considered walkway with handrails along the main girder with vertical stairs for access between girder and walkway.
  - Maintenance platforms with handrails in the trolley have also been considered to guarantee maintenance and accessibility to every single component.
  - Two maintenance platforms at the opposite side have been considered with the access from the girder by means of vertical stairs
  - We have considered sand-blasted surface treatment before painting.
-



## 4 2 LIFTING MECHANISM 15 Ca a

<b>G r a C a r a r</b>	
Lifting Capacity	15t below hook
Lifting Speed	6 mpm
Height of Lift	20 m
FEM Classification	M5
Features	Continuous speed control with one frequency inverter

<b>E r a M r</b>	
Quantity	1
Type	Squirrel cage three phase asynchronous motor
Brand	ABB
Model	180M / Foot-mounted B3
Power	18,5 kW 1500 rpm
Service Factor	100%ED
Protection	IP-55
Others	With incremental encoder
	Insulation Class F
	Thermal sensors not included

<b>C g M r-G a r x</b>	
Quantity	1
Type	Crowned-tooth gear coupling
Brand	JAURE
Model	MTFS-JS 55-200

<b>S r B r a k</b>	
Quantity	1
Type	Electro-hydraulic
Brand	ANTEC
Model	NDT I-356 / Ø250 mm

<b>G a r x</b>	
Quantity	1
Type	Tandem
Brand	JASO
Model	T3H

<b>C g G a r x / D r m</b>	
Quantity	1
Type	Barrel coupling
Brand	JAURE
Model	TCB-200
<b>D r m</b>	
Quantity	1, equipped with anti-slack and anti-derailing rope devices
Type	Welded rolled steel plate w/ turned grooves & single wire layer
Diameter	Ø 362 mm (1970 mm long), 4/2
Over-speed system	N/A
Emergency Brake	N/A
Special Coupling	N/A
<b>W r R</b>	
Type	Steel wire rope
Number of Falls	4 / 2
Model	W.S. 6x36 (7x7+0)
Tensile Strength	180 kg/mm <sup>2</sup>
Length / Diameter	99 m / Ø18 mm
<b>H k A m</b>	
Hook	1 units, single forged hook
Type	Size N° 6 / material T acc. to DIN 15401
Pulleys	2 x Ø355 mm (welded rolled steel)
<b>S a B k</b>	
Quantity	1
Pulley Type	Welded rolled steel
Pulleys Diameter	Ø250 mm (with incorporated load limit switch)
<b>C m a A m</b>	
Quantity	N/A
Type	N/A
<b>O r</b>	
Lifting limit switches	Rotary type with four contacts
Additional limit switch	Counterweight type for additional security
Load limiter	Located in the reeving pulley
Weighting system	N/A
Encoders	1 incremental in the motors shaft
Frequency Inverters	1, commanding the motor, brand SCHNEIDER.
Positioning System	N/A

### 4 3 TROLLEY TRAVELLING MECHANISM

#### G r a C a r a r

Trolley Traveling Speed	20 mpm
FEM Classification	M5
Features	Continuous speed control with one frequency inverter

#### E r a M r

Quantity	2
Type	Squirrel cage three phase asynchronous motor
Brand	OBEKI
Model	80
Power	1,1 kW a 1.500 rpm
Service Factor	40% ED
Protection	IP-55
Others	Encoder in the motor
	Insulation Class F
	Electro-magnetic brake incorporated in the motor

#### C g M r-G a r x

Quantity	N/A
Type	N/A
Brand	N/A
Model	N/A

#### S r B r a k

Quantity	N/A
Type	N/A
Brand	N/A
Model	N/A
Diameter	N/A

#### G a r x

Quantity	2
Type	With parallel shafts
Brand	JASO
Model	JR20

<b>C g G ar x-W A m</b>	
Quantity	N/A
Type	N/A
Brand	N/A
Model	N/A
<b>W A m</b>	
Quantity	4
Type	Double-flanged
Material	GGG-70 (casting steel)
Diameter	Ø160 mm
<b>B r</b>	
Quantity	4
Type	Rubber
Brand	AMC
Model	T70
<b>Ra</b>	
Type	Square bar
Size	50 x 40 mm
Others	Welded to the upper plate of the girder
<b>Tr S a</b>	
Approximate Span	2.500 mm
<b>O r</b>	
Frequency Inverters	1 units commanding the two motors, Brand SCHNEIDER
	No spare unit common with bridge travelling. No redundancy in motors/inverters in emergency mode
Cleaning fans	N/A
Positioning System	N/A

#### 4 4 BRIDGE TRAVELLING MECHANISM

<b>G r a C a r a r</b>	
Trolley Traveling Speed	40 mpm
FEM Classification	M5
Features	Continuous speed control with one frequency inverter

<b>E r a M r</b>	
Quantity	2
Type	Squirrel cage three phase asynchronous motor
Brand	OBEKI
Model	90
Power	1,90 kW a 1.500 rpm
Service Factor	40% ED
Protection	IP-55
Others	Encoder in the motor
	Insulation Class F
	Electro-magnetic brake incorporated in the motor

<b>C g M r-G a r x</b>	
Quantity	N/A
Type	N/A
Brand	N/A
Model	N/A

<b>S r Brak</b>	
Quantity	N/A
Type	N/A
Brand	N/A
Model	N/A
Diameter	N/A

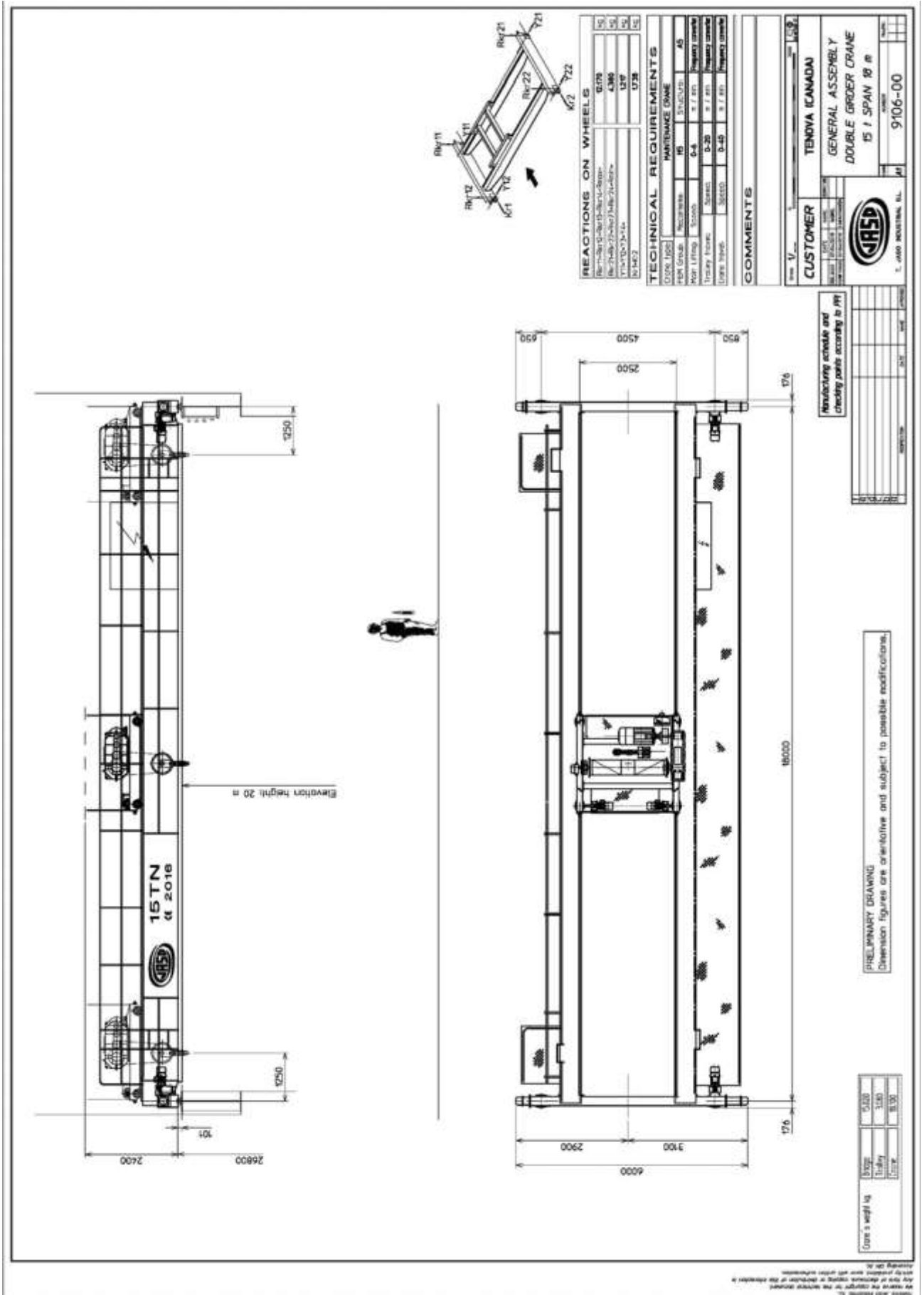
<b>G a r x</b>	
Quantity	2
Type	With parallel shafts
Brand	JASO
Model	JR25

<b>C g G ar x-W A m</b>	
Quantity	N/A
Type	N/A
Brand	N/A
Model	N/A
<b>W A m</b>	
Quantity	4
Type	Double-flanged
Material	GGG-70 (casting steel)
Diameter	Ø315 mm
<b>B r</b>	
Quantity	4
Type	Rubber
Brand	AMC
Model	T150
<b>Ra</b>	
Type	Square bar
Size	50 x 40 mm
Others	Welded to the run way beam on the bay side
<b>O r</b>	
Frequency Inverters	1 units commanding the two motors, Brand SCHNEIDER
	No spare unit common with trolley travelling. No redundancy in motors/inverters in emergency mode
Cleaning fans	N/A
Positioning System	N/A

#### 4 5 OVERHEAD CRANE TOTAL WEIGHT AND REACTIONS

<b>W g</b>	
Crane Total Weight	18.100 kg
Trolley Weight	3.080 Kg
Bridge Weight	15.020 Kg
<b>R a W</b>	
Maximum Vertical Reaction R11 ÷ R18	12.170 Kg
Minimum Vertical Reaction R21 ÷ R 28	4.380 Kg
Horizontal Transversal Reaction Y11 ÷ Y18	1.217 Kg
Horizontal Lengthwise Reaction Kr1 , Kr2	1.738 Kg
<b>La ra R a</b>	
Approximate Main Hook Lateral Reach	See drawing

46 CRANE DRAWING 15 & 1 m a





## 5 DG CRANE r MAINTENANCE 15T & 1 m S a ( S H V r )

### 5 1 CRANE GENERAL CHARACTERISTICS

Crane Type	Double girder with lifting hoist model VC150H2041B4
Crane Operation	Maintenance
Crane Capacity	15t under the hook
Crane Span	18 m
Crane Height of Lift	20 m
Service	Indoor
Temperature Range	0°C ÷ +40°C
FEM Classification	M5 for Lifting M5 for Cross and Long Travelling A5 for Structure
Main Lifting Speed	6 mpm with frequency inverter
Trolley Traveling Speed	20 mpm with frequency inverter
Bridge Traveling Speed	40 mpm with frequency inverter
Power Supply	480 V (±10%) - 60 Hz
Controls Power Supply	230 V - 60Hz

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**Ba C ra**

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- ✓ The crane for maintenance has been quoted following the JASO criteria for this kind of applications without any Technical Specification from the customer.

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- ✓ The crane has been dimensioned as per the FEM M5/A5 for the nominal capacity of 15t

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- ✓ The crane will include the CE certificate of compliance.

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- ✓ It has been considered in the scope of supply the erection and commissioning of the crane at site, including the mobile cranes, platforms and all necessary tools.
- ✓ Not included in the scope of work any civil work or bay roof removal.
- ✓ Training included.
- ✓ JASO personnel with requested qualification and trades for the mentioned activities.

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- ✓ “Black Assembly” will be performed in our workshop prior to painting process. It means that the crane will be fully assembled on ground for alignments checks and empty load running test (CT speed, LT speed, electrical tests, safety features test,...)

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- ✓ In case of nomination, JASO will provide all technical information such as drawings, showing details for subassemblies, maintenance and operation manual and CE certificate.

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- ✓ Warranty period for the crane is stated to 24 months, against all manufacturing flaw, bad quality of materials, given that all corresponding preventive maintenance instructions have been undertaken. These instructions will be included in the Operation and Maintenance Manual supplied with the cranes.

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- ✓ After sales maintenance actions are possible to be performed upon order from beneficiary.

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**L g**

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- ✓ We have considered a total crane capacity of 15t below the hook. Calculated for the requested FEM Group M5
  - We have considered the lifting mechanism with one standard hoist model VC JASO
  - ✓ The total lifting height is considered to be 20 m. below the hook
  - ✓ We have considered wire rope DIEPA with tensile strength of 220 Kg/mm<sup>2</sup>
  - ✓ Lifting motion is equipped with frequency inverter, commanding the motor. No spare unit automatically commuted has been considered for lifting
  - ✓ An additional counterweight limit switch has been considered for security
  - ✓ Approaches of each hook are reflected in the crane lay-out attached to this offer
  - ✓ Lifting mechanisms have considered overlapping prevention system for the wire ropes by means of a guiding device
- 

**Tra g**

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- ✓ We have considered for the trolley travelling mechanisms, groups consisting on one gear-motor with direct drive to the wheels. Control by means of frequency inverter. Emergency mode has not been considered
  - ✓ We have considered for the bridge travelling mechanisms, groups consisting on one gear-motor with direct drive to the wheels. Control by means of frequency inverter. Emergency mode has not been considered
  - ✓ We have considered rail type steel square bar for trolley and bridge travelling
  - ✓ We have included a centralized manual lubing system.
  - ✓ Crane flanged wheels have been considered, then crane guiding rollers have not been included in the scope of supply.
  - ✓ The crane has been designed taking into consideration a minimum temperature of 0°C by using standard materials and lubricants to guarantee the performances under these conditions.
-

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**E r a a r**

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- The crane control by means of pendant and radio remote system
  - The electrical equipment will be installed within an electrical cabinet, correctly confined and protected placed on the walkway
  - No regenerative drives have been considered
  - Spare frequency converters with automatic commuting have not been considered for lifting and travelling mechanisms
  - Weighing system not included
  - Load limiter included.
  - No PLC control system
  - Anti-collision device, acoustic alarm and light alarm included
  - The electrical installation placed inside the cabinet will be equipped with std. A/C with the corresponding filters for the proper functioning of the frequency inverters
  - Crane power supply collector
- 

**O r**

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- We have considered walkway with handrails along the main girder with vertical stairs for access between girder and walkway.
  - Maintenance platforms with handrails in the trolley have also been considered to guarantee maintenance and accessibility to every single component.
  - Two maintenance platforms at the opposite side have been considered with the access from the girder by means of vertical stairs
  - We have considered sand-blasted surface treatment before painting.
-

## 5 2 LIFTING MECHANISM 15 Ca a

### G r a C a r a r

Lifting Capacity	15t below hook / Hoist Model VC150H2041B4
Lifting Speed	6 mpm
Height of Lift	20 m
FEM Classification	M4
Features	Continuous speed control with one frequency inverter

### E r a M r

Quantity	1
Type	Squirrel cage three phase asynchronous motor
Brand	OBEKI
Model	VC132
Power	18 kW 1500 rpm
Service Factor	40%ED
Protection	IP-55
Others	With incremental encoder
	Insulation Class F
	Thermal sensors not included
	Electromagnetic-brake incorporated in the motor

### C g M r-G a r x

Quantity	N/A
Type	N/A
Brand	N/A
Model	N/A

### S r B r a k

Quantity	N/A
Type	N/A
Brand	N/A
Model	N/A

### G a r x

Quantity	1
Type	With parallel shafts
Brand	JASO
Model	VC

<b>C g G ar x/ Dr m</b>	
Quantity	N/A
Type	N/A
Brand	N/A
Model	N/A
<b>Dr m</b>	
Quantity	1, equipped with anti-slack and anti-derailing rope devices
Type	Welded rolled steel plate w/ turned grooves & single wire layer
Diameter	Ø 268 mm
Over-speed system	N/A
Emergency Brake	N/A
Special Coupling	N/A
<b>W r R</b>	
Type	Steel wire rope
Number of Falls	4 / 1
Model	DIEPA
Tensile Strength	220 kg/mm <sup>2</sup>
Diameter	Ø12 mm
<b>H k A m</b>	
Hook	1 unit, single forged hook
Type	Size N° 5 / material T acc. to DIN 15401
Pulleys	2 x Ø280 mm (welded rolled steel)
<b>S a B k</b>	
Quantity	1
Pulley Type	Welded rolled steel plate
Pulleys Diameter	280 mm
<b>C m a A m</b>	
Quantity	N/A
Type	N/A
<b>O r</b>	
Lifting limit switches	Rotary type with four contacts
Additional limit switch	Counterweight type for additional security
Load limiter	Included
Weighting system	N/A
Encoders	1 incremental in the motors shaft
Frequency Inverters	1, commanding the motor, brand SCHNEIDER.
Positioning System	N/A

### 5 3 TROLLEY TRAVELLING MECHANISM

#### G r a C a r a r

Trolley Traveling Speed	20 mpm
FEM Classification	M4
Features	Continuous speed control with one frequency inverter

#### E r a M r

Quantity	2
Type	Squirrel cage three phase asynchronous motor
Brand	OBEKI
Model	80
Power	1,1 kW a 1.500 rpm
Service Factor	40% ED
Protection	IP-55
Others	Encoder in the motor
	Insulation Class F
	Electro-magnetic brake incorporated in the motor

#### C g M r-G a r x

Quantity	N/A
Type	N/A
Brand	N/A
Model	N/A

#### S r Brak

Quantity	N/A
Type	N/A
Brand	N/A
Model	N/A
Diameter	N/A

#### G a r x

Quantity	2
Type	With parallel shafts
Brand	JASO
Model	JR20

<b>C g G ar x-W A m</b>	
Quantity	N/A
Type	N/A
Brand	N/A
Model	N/A
<b>W A m</b>	
Quantity	4
Type	Double-flanged
Material	GGG-70 (casting steel)
Diameter	Ø160 mm
<b>B r</b>	
Quantity	4
Type	Rubber
Brand	AMC
Model	T70
<b>Ra</b>	
Type	Square bar
Size	50 x 40 mm
Others	Welded to the upper plate of the girder
<b>Tr S a</b>	
Approximate Span	2.400 mm
<b>O r</b>	
Frequency Inverters	1 units commanding the two motors, Brand SCHNEIDER
	No spare unit common with bridge travelling. No redundancy in motors/inverters in emergency mode
Cleaning fans	N/A
Positioning System	N/A



## 5 4 BRIDGE TRAVELLING MECHANISM

<b>G r a C a r a r</b>	
Trolley Traveling Speed	40 mpm
FEM Classification	M4
Features	Continuous speed control with one frequency inverter

<b>E r a M r</b>	
Quantity	2
Type	Squirrel cage three phase asynchronous motor
Brand	OBEKI
Model	90
Power	1,90 kW a 1.500 rpm
Service Factor	40% ED
Protection	IP-55
Others	Encoder in the motor
	Insulation Class F
	Electro-magnetic brake incorporated in the motor

<b>C g M r-G a r x</b>	
Quantity	N/A
Type	N/A
Brand	N/A
Model	N/A

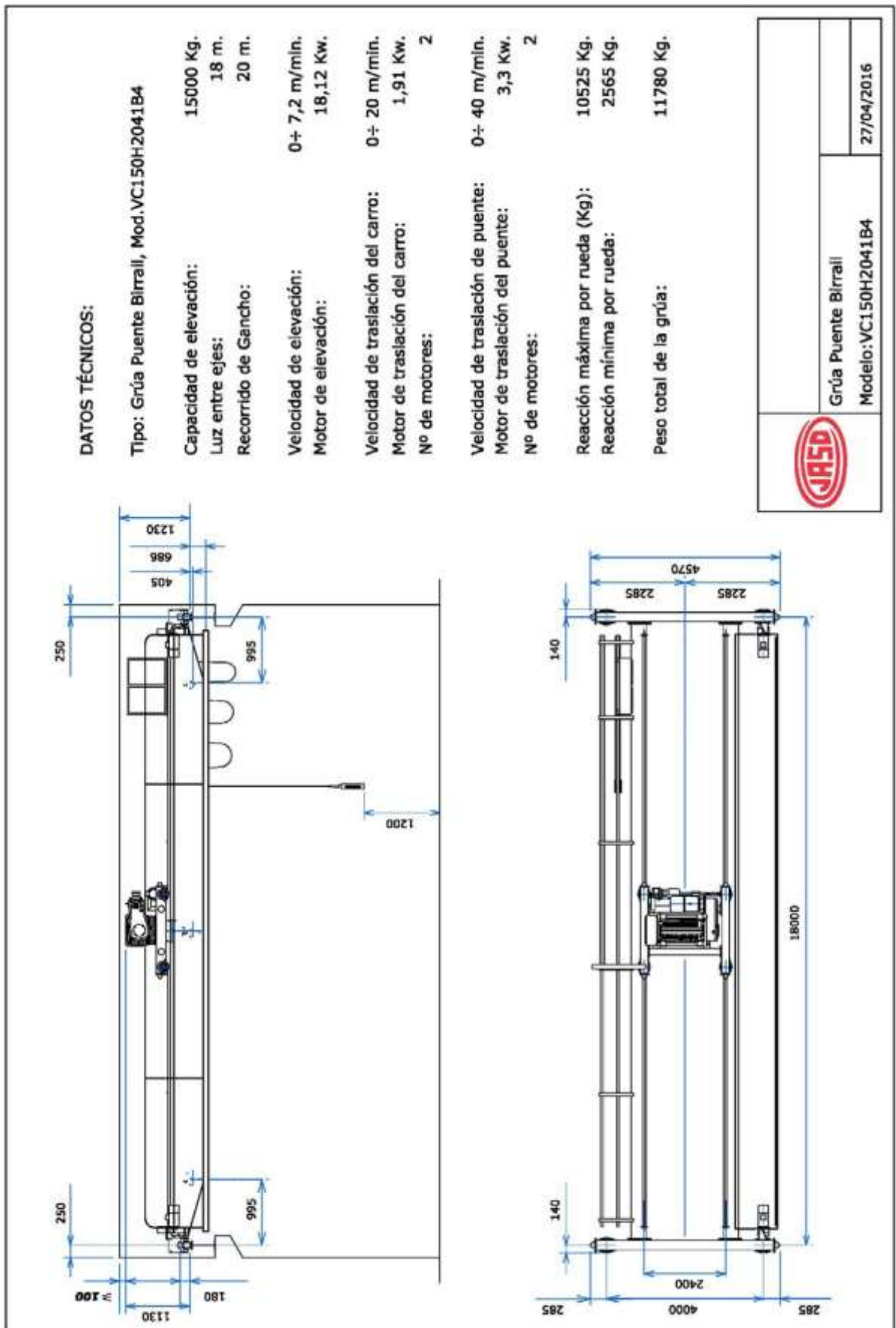
<b>S r Brak</b>	
Quantity	N/A
Type	N/A
Brand	N/A
Model	N/A
Diameter	N/A

<b>G a r x</b>	
Quantity	2
Type	With parallel shafts
Brand	JASO
Model	JR25

<b>C g G ar x-W A m</b>	
Quantity	N/A
Type	N/A
Brand	N/A
Model	N/A
<b>W A m</b>	
Quantity	4
Type	Double-flanged
Material	GGG-70 (casting steel)
Diameter	Ø315 mm
<b>B r</b>	
Quantity	4
Type	Rubber
Brand	AMC
Model	T150
<b>Ra</b>	
Type	Square bar
Size	50 x 40 mm
Others	Welded to the run way beam on the bay side
<b>O r</b>	
Frequency Inverters	1 units commanding the two motors, Brand SCHNEIDER
	No spare unit common with trolley travelling. No redundancy in motors/inverters in emergency mode
Cleaning fans	N/A
Positioning System	N/A

## 5 5 OVERHEAD CRANE TOTAL WEIGHT AND REACTIONS

<b>W g</b>	
Crane Total Weight	11.780 kg
Trolley Weight	
Bridge Weight	
<b>R a W</b>	
Maximum Vertical Reaction R11 ÷ R18	10.525 Kg
Minimum Vertical Reaction R21 ÷ R 28	2.565 Kg
Horizontal Transversal Reaction Y11 ÷ Y18	
Horizontal Lengthwise Reaction Kr1 , Kr2	
<b>La ra R a</b>	
Approximate Main Hook Lateral Reach	See drawing

**5 6 CRANE DRAWING 15 & 1 m a ( S a ar H )**


## 6 PAINT SPECIFICATIONS

### OB ECT

This procedure is intended for setting up the necessary conditions to protect equipment such as overhead cranes, frame cranes, jibs, hoists, etc. against corrosion.

### SCOPE OF APPLIC ATION

This procedure shall be applied to those parts of equipment continuously exposed to external weather conditions.

### SURFACE CONDITIONING

The surface conditioning shall be based on the S.I.S. and S.S.P.C. Standards.

- **CLEANING BY SANDBLASTING Sa 2 ½** according to S.I.S. 055900 of 1967  
All loose oxide particles, rolling skins as well as foreign particles will be thoroughly removed by means of sandblasting, to achieve the Sa 2 ½ grade.  
Once the manual cleaning has been finished, dust and other loose particles will be removed from the surface.

### P AINT TREATMENT

Once the cleaning process has been finished, the following painting procedure must be immediately applied to avoid any further deposition of dust and dirt on the surfaces to be painted.

The scheme shall be based on three paint coats or layers in order to achieve a dry-film thickness from 80 to 100 microns

The whole standards and recommendations included in the Technical Sheets of the product manufacturer will be applied.

The application of the product, after it has been appropriately thinned and homogenized, shall be carried out by means of an "airless" unit.

### F r a

Application of a coat of SHOP PRIMER 3019 PHOSPHATING PRIMER with an adequate efficiency to achieve a dry-film thickness of 10 microns

### S a

Application of a coat of POLYURETHANE 2 THICK COAT COMPONENTS 840 paint with an adequate efficiency to achieve a dry-film thickness of 80 microns, and 1 hour after the first coat has been applied.

The drying period of the first coat depends on the environmental conditions of temperature and relative air humidity.

### T r a

Application of a coat of POLYURETHANE 2 THICK COAT COMPONENTS 840 paint with an adequate efficiency to achieve a dry-film thickness of 80 microns.

Total dry film thickness 170 microns.

### COLOUR CODE

Overhead structure:	Yellow	As per client specs.
Trolleys, Hoists and Mechanisms	Gray	As per client specs

## TESTS

Tests and trials shall be carried out as specified below:

**T g m a a** With nominal load suspended from the hook and with the trolley in the center of the girders, the deflection of the crane main girders shall be measured. This deflection shall not exceed 1/1000 of the span between wheel axes.

All intensive movements of the crane shall be carried out, lifting and lowering the load, as well as moving the trolley and the bridge in both directions. These movements shall last for at least one hour.

The temperature of the motors and the brakes shall then be verified. The atmospheric temperature shall not be greater than 40° C.

The heating of motors and brakes shall be within the limits defined by the applicable Test Standards.

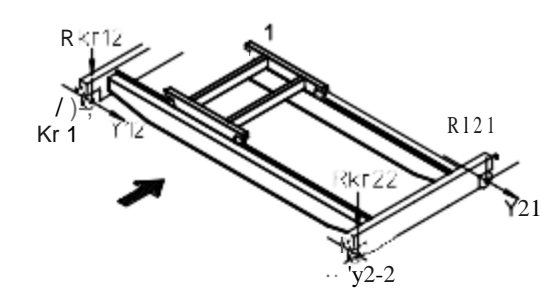
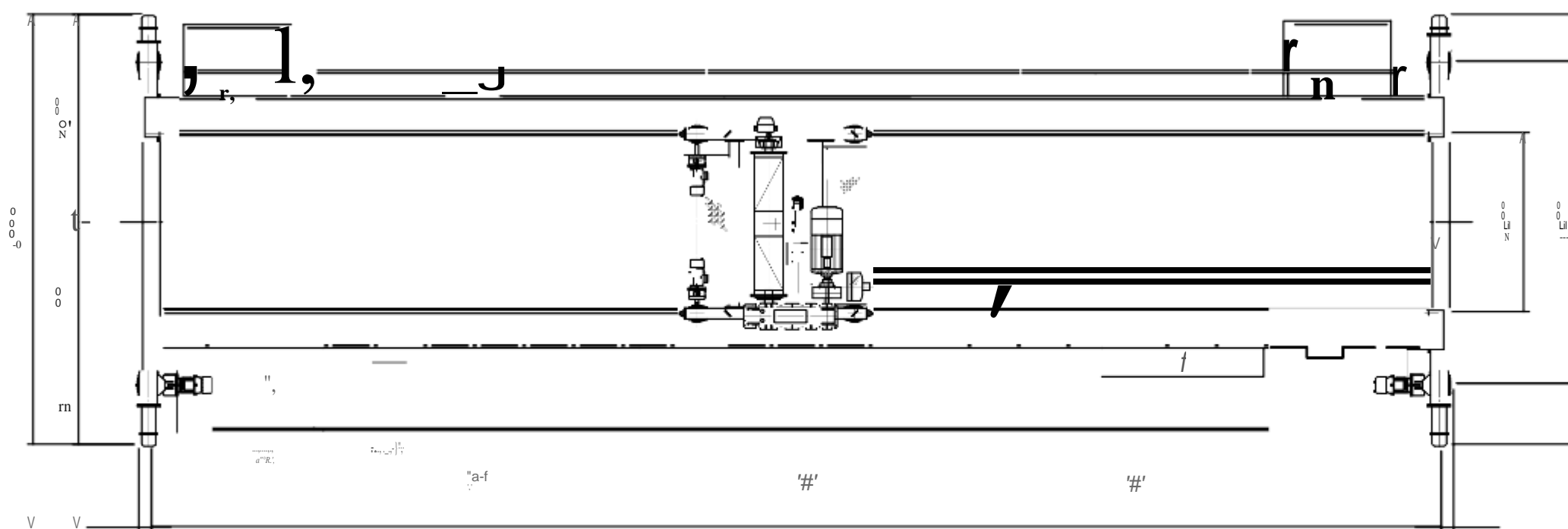
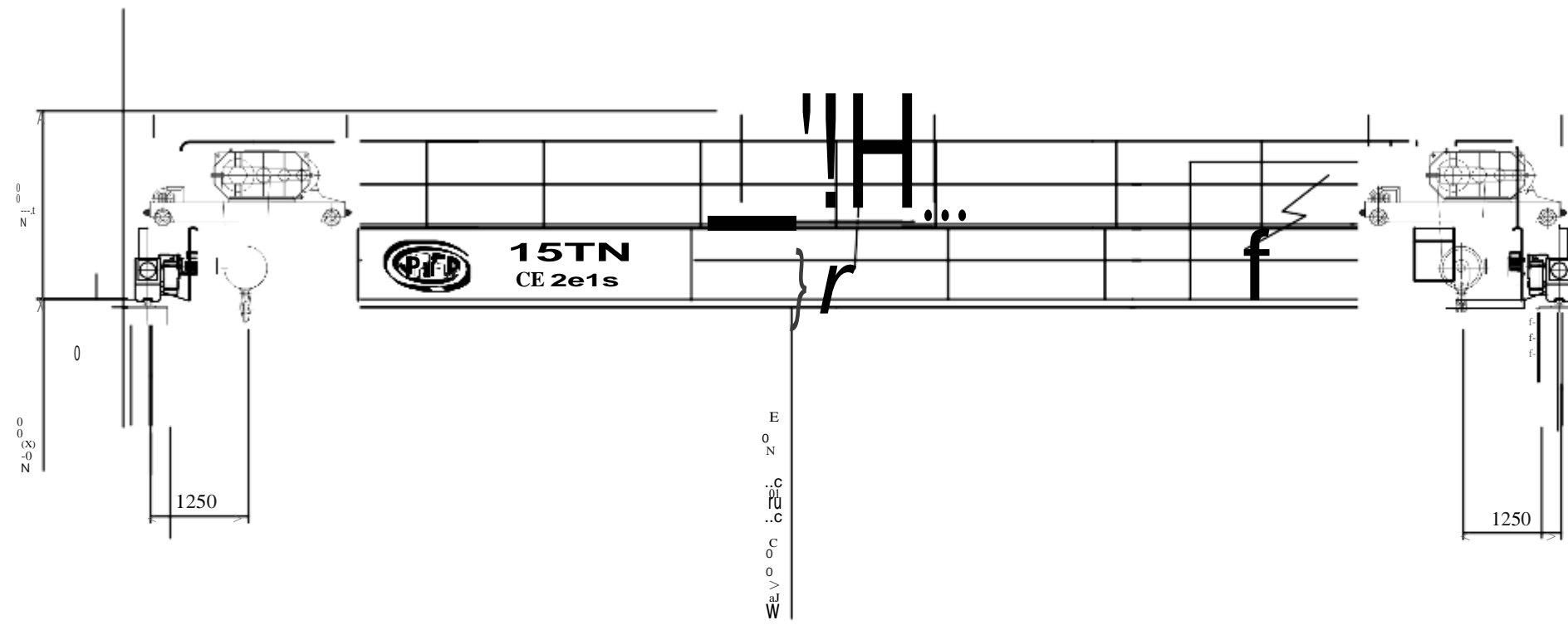
The maximum allowable heating for motors and brakes is 75° C, that is the maximum temperature of these elements shall not exceed 115° C.

**D a m g** Dynamic testing shall be carried out with a load equal to 110% of the nominal load. All movements are sequentially performed with care and without verifying neither the speeds nor the temperature of motors and brakes.

This test only pursues the verification of crane structure resistance and the driving parts resistance.

**S a g** This test shall be carried out without wind and with 125% of the nominal load. The nominal load must be lifted a short distance from the ground and the required overload added little-by-little without any impacts.

The test loads and load manipulation fixtures will be supplied by the Customer. Any external test certification will be at Customer expense.



REACTIONS ON WHEELS	
Rkr 11=Rkr12=Rkr13=Rkr14=Rmo x=	12.170
Rkr 21=Rkr22 =Rkr 23=Rkr 24=Rmin=	4.380
Y11=Y12= Y3=Y4 =	1.217
Kr 1=Kr2	1.738

TECHNICAL REQUIREMENTS				
Crane type	MAINTENANCE CRANE			
FEM Group:	Mechanisms :	MS	Structure :	AS
Main Lifting :	Speed :	0-6	m / min	Frequency converter
Trolley travel :	Speed :	0-20	m / min	Frequency converter
Crane travel :	Speed :	0-40	m / min	Frequency converter

**COMMENTS**

Scale: 1/\_\_\_ 176

**TENOVA (CANADA)**

Manufacturing schedule and GENERAL ASSEMBLY checking points according to PP/ DOUBLE GIRDER CRANE

15t SPAN 18m

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2				
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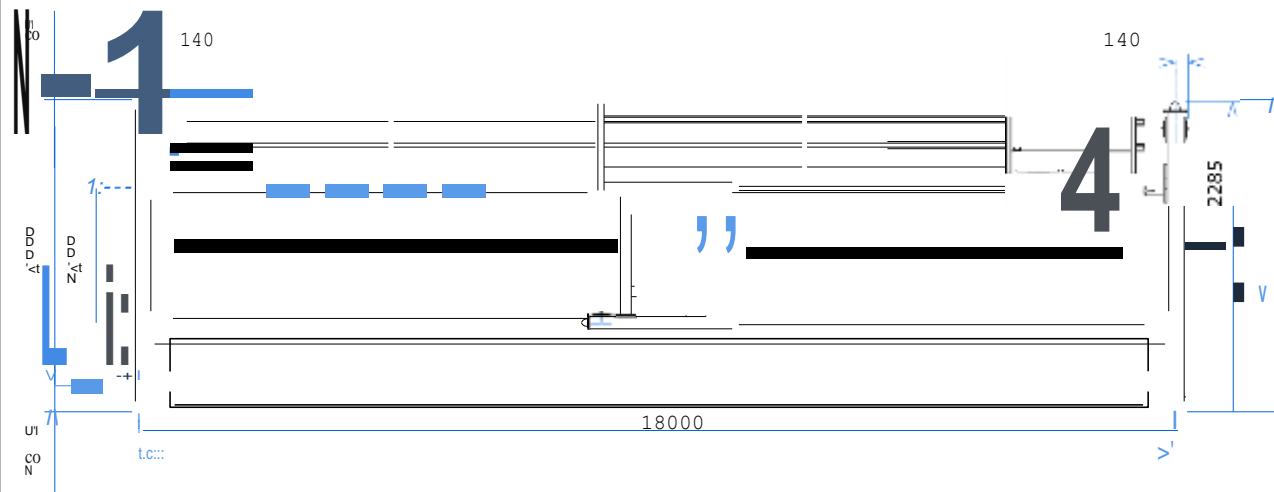
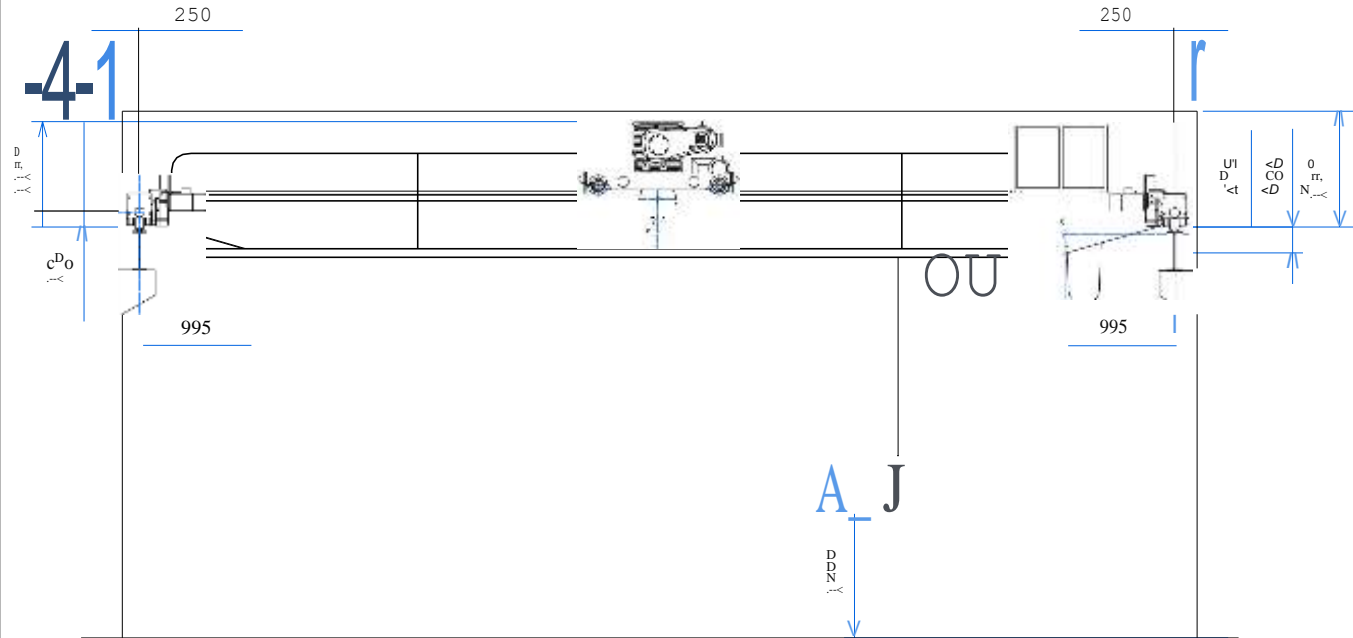
PRELIMINARY DRAWING  
Dimensions are approximate and subject to possible modifications.

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9106-00 | —

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T1





DATOS TECNICOS:

Tipo: Grúa Puento Birrail, Mod.VC150H2041B4

Capacidad de elevacion: 15000 Kg.

Luz entre ejes: 18 m.

Recorrido de Gancho: 20 m.

Velocidad de elevacion: 0-:- 7,2 m/min.

Motor de elevacion: 18,12 Kw.

Velocidad de traslacion del carro: 0-:- 20 m/min.

Motor de traslacion del carro: 1,91 Kw.

Nº de motores: 2

Velocidad de traslacion de puente: 0-:- 40 m/min.

Motor de traslacion del puente: 3,3 Kw.

Nº de motores: 2

Reaccion maxima por rueda (Kg): 10525 Kg.

Reaccion minima por rueda: 2565 Kg.

Peso total de la grúa: 11780 Kg.



Grúa Puento Birrail

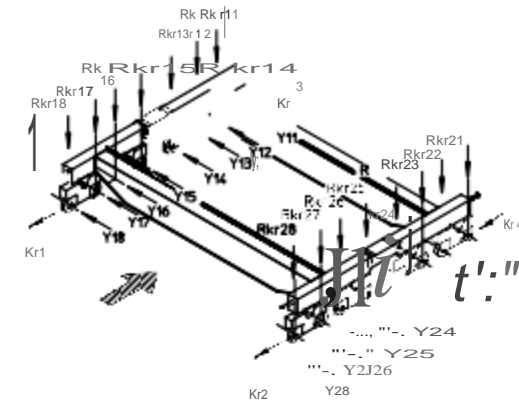
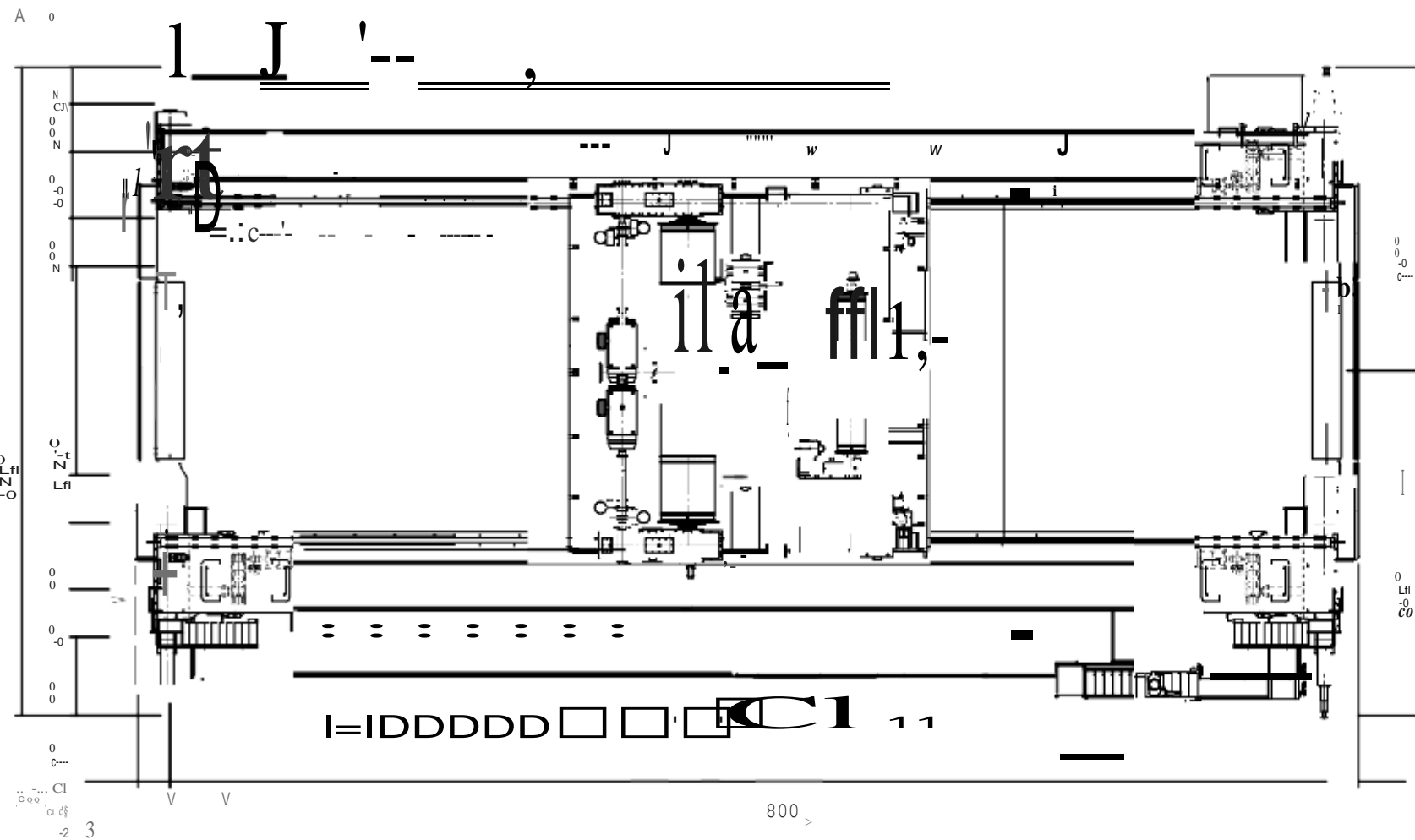
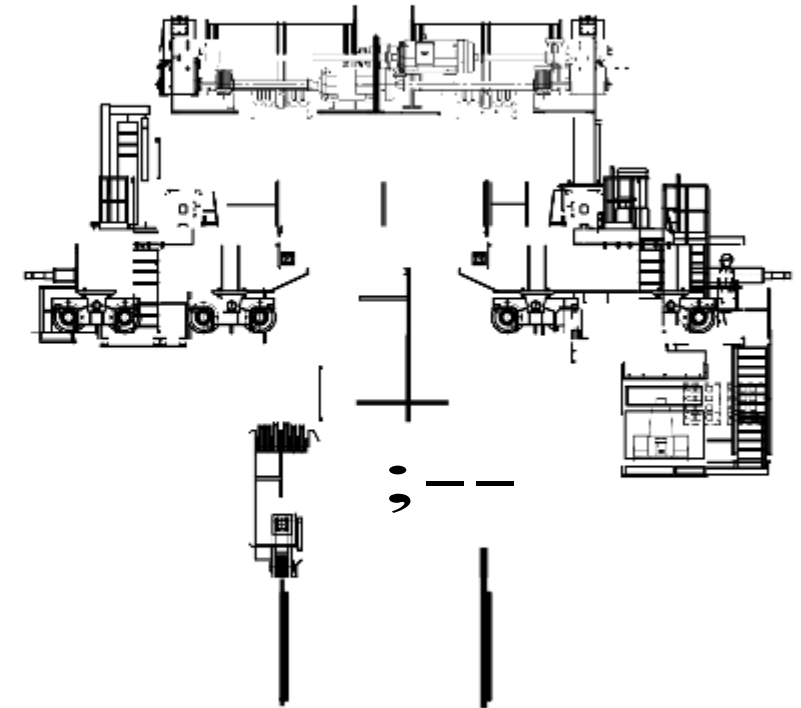
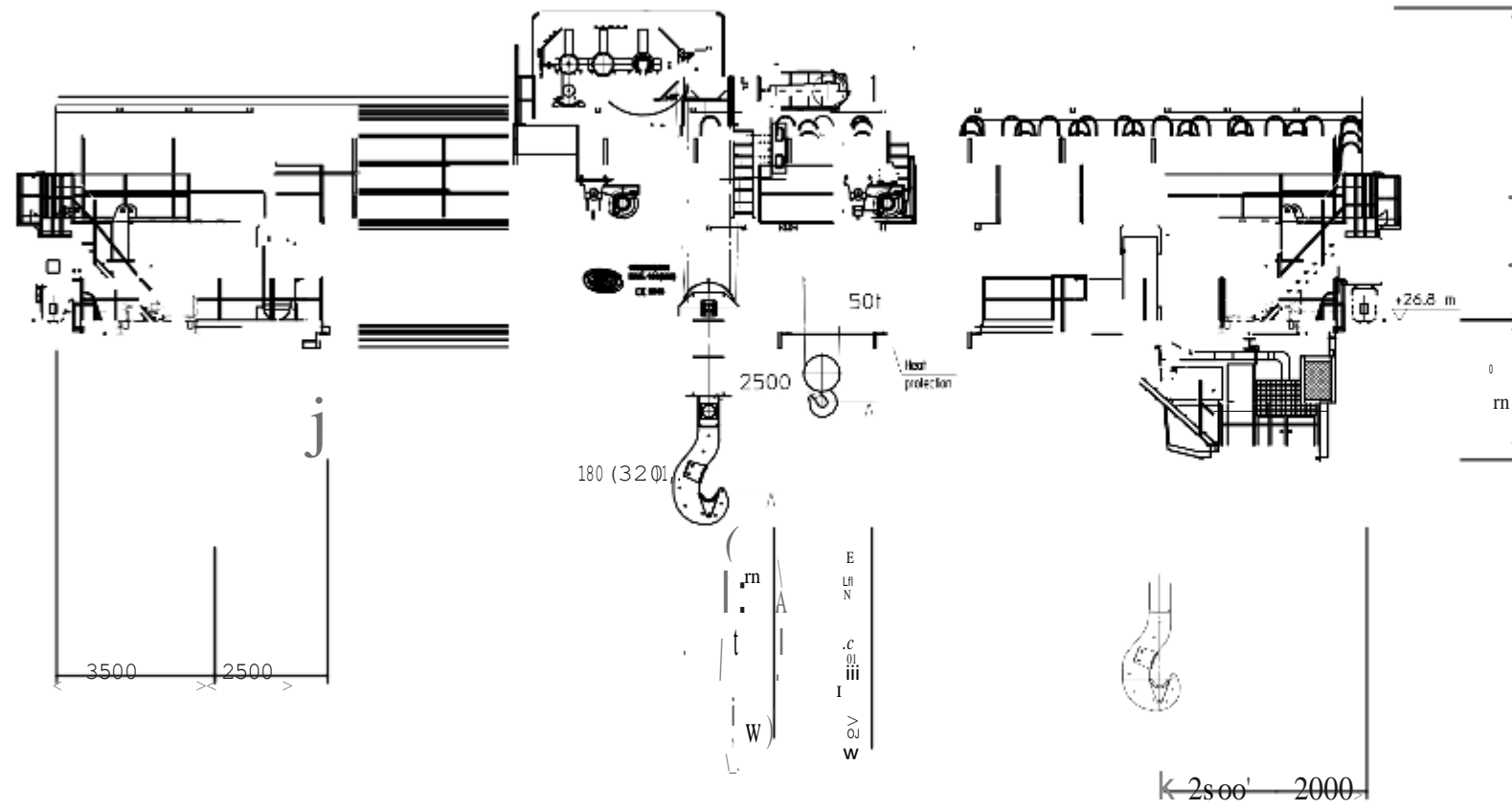
Modelo:VC150H2041B4

27/04/2016

PRELIMINAR Y ORA WING  
 Dimensiones orientativas y sujetas a modificaciones.

Crane weight kg.	Bridge	175.040
	Trolley	119060
	Crane	294.100

REACTIONS ON CRANE WHEELS	1801 (Nominol)	3201 (Maxi)
Vertical max. reaction per wheel (Rkr18, Rmox)	43.480	58.710
Vertical min. reaction per wheel (Rkr21, Rkr28, aRmin)	15.790	18.050
Transversal reaction per wheel (Y11, Y12, ..., Y27, Y28)	4.348	5.871
Horizontal reaction per wheel (Kr1, Kr2, Kr3, Kr4)	6.211	7.387



TECHNICAL REQUIREMENTS				
Crane type :	LADLE CRANE			
FEM Group :	Mecanisms :	<b>MB</b>	Structure :	<b>AB</b>
Main Lifting :	Speed :	<b>0-6</b>	m / min	freq. converter
Aux. Lifting :	Speed :	<b>0-6</b>	m / min	freq. converter
Trolley travel :	Speed :	<b>0-30</b>	m / min	freq. converter
Crane travel :	Speed :	<b>0-60</b>	m / min	freq. converter

COMMENTS

Manufacturing schedule and checking points according to PP/

Scale 1/

**CUSTOMER** TENOVA (CANADA)

**PS./** GENERAL ASSEMBLY DOUBLE GIRDER CRANE 180(320)/50 f SPAN 27 m


AN: 7000)

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