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Technical Specification

“Delivery of cast iron cooling staves for Blast Furnace no. 2 in Dąbrowa Górnicza”

concerns the project entitled “Development and demonstration of an intelligent cooling system for a metallurgical unit by closing and integrating water circuits, increasing the operational reliability of the metallurgical process and improving the efficiency of industrial cooling water use.” (project no. POIR.01.01.01-00-0034/18), co-financed from the funds of the European Regional Development Fund and as part of the Smart Growth Operational Program 2014-2020, sub-measure 1.1.1 (the call for proposals organized by the National Centre for Research and Development, no. 2/1.1.1/2018)

This specification is attached as Annex 2. to the request for quotation no **3/034/2021**

ArcelorMittal Poland S.A.
Dąbrowa Górnicza



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SPECIFICATION NO. 3/034/2021

1. INTRODUCTION

ArcelorMittal Poland S.A. (AMP), as part of its project "Modernization of Blast Furnace No. 2" is interested in purchase and delivery of cast iron cooling staves for Blast Furnace No. 2 (BF#2). Detailed scope of the works covered by this Request for Quotation is given below.

ArcelorMittal Poland S.A. (AMP) operates in various branches in Poland, mainly concentrating steel production in Krakow and in Dąbrowa Górnicza and other important production units that are responsible for the production of various types of steel products in Poland.

The subject matter of the contract indicated in this specification concerns the project entitled "Development and demonstration of an intelligent cooling system for a metallurgical unit by closing and integrating water circuits, increasing the operational reliability of the metallurgical process and improving the efficiency of industrial cooling water use." (project no. POIR.01.01.01-00-0034/18), co-financed from the funds of the European Regional Development Fund and as part of the Smart Growth Operational Program 2014-2020, sub-measure 1.1.1 (the call for proposals organized by the National Centre for Research and Development, no. 2/1.1.1/2018)

The subject of the contract is the purchase and delivery (in accordance with DDP INCOTERMS 2010) of cooling staves for blast furnace no 2 located in Dąbrowa Górnicza.

Due to the Company's obligation to apply the competition principle, this technical specification constitutes a detailed description of the subject matter of the contract allowing for the preparation of tenders by the Bidders.

This specification has been drawn up with the utmost care in order to provide a full, unambiguous and exhaustive description of the subject matter of the contract so as to enable economic operators to determine all their obligations and risks and to calculate the price and other elements of the offer in a responsible way.

All of the purchases, services and supplies which are the subject of this enquiry must be incorporated and cooperate with the existing infrastructure and equipment in the Company and also must meet the same technological standards. Therefore, the need to maintain the same technological conditions and the need to maintain the unification of equipment resulting from the expansion of the existing infrastructure have determined the provisions of this specification. The provisions applied are justified by the need to ensure the smooth running of the project. The provisions indicated do not impose an obligation on Economic Operators to apply the solutions indicated but only inform about minimal parameters and standards. Using certain types of solutions is not obligatory but only exemplary. The indications in relation to the expected technical parameters, as well as indications concerning specific types and manufacturers' names



are of a general nature, referring only to sample indications of equivalent products and do not constitute the only acceptable solution. On this basis, the contracting authority shall accept equivalent solutions.

Bidders are expected to submit an offer taking into account the requirements of this Technical Specification.

The offer must be complete in all respects and must include all components/devices necessary to achieve the sound design, operation and maintenance of the installation.

The Bidder must read this specification and ensure that the installation is technically feasible and also accept full responsibility for the guaranteed performance of the delivered equipment in terms of efficiency, performance, smooth and reliable operation in case of change of staves design.

The detailed scope of the work subject to the Enquiry is presented later in this paper.

1.1. PROJECT OBJECTIVE

The aim of this project is to conduct industrial research and experimental development works, the result of which will be the development of an innovative technical and technological solution in the field of cooling of metallurgical production units (along with a demonstration cooling installation). This subject of the contract will be part of the cooling system. Achieving the project objectives will allow for: lowering CO₂ emissions, lowering fuel consumption, lowering electricity consumption and reducing the amount of cooling water - this will minimize the impact of the process on the environment.

1.2. SPECIFICATION CONTENT

This specification provides the environment-related data, information on Investor's location in Dąbrowa Górnicza, required technical norms and standards, technical data of BF#2 in operation, scope of Contractor's works, Customer's rights, requirements related to Contractor's technical potential, preliminary works schedule, requirements related to availability, replaceability, quality and safety and other information as required for the purposes of the Technical Offer (e.g. function guarantee).

2. STANDARDS, UNITS OF MEASURE, NORMS and REGULATIONS

- 1) All other technical requirements should comply with the standards applied by ArcelorMittal Poland S.A., and should meet engineering standards such as DIN, ASME, GOST, BS and PN.
- 2) Contractor's devices and technologies will be supplied based on the Contractor's knowledge of technology and standards effective world-wide and in Poland.
- 3) Devices, materials and parts used for the repair and revamping works should meet all technical and safety standards required by Polish law.
- 4) Project information is given in units and dimensions of the international metric system.
- 5) List of actual legal acts is presented in appendix 1.

2.1. DOCUMENTATION STANDARDS



File formats - AMP standard:

1. Documents: *.doc, *.pdf, *.xls (Microsoft Word 2010, Adobe Reader, Microsoft Excel 2010);
2. Time schedules: *.mpp; (Microsoft Project 2010);
3. Mechanical documentation: *.dwg, *.dwf (AutoCAD ver. 13 or higher, Autodesk Design Review) is must;
4. Electrical documentation: *.zw1 ; (EPlan ver.5.5/P8);
5. Pictures, images: *.jpeg;

2.2. INVESTOR'S STANDARDS

The Contractor is required to be familiar with and respect Investor's standards, in particular H&S standards and performance standards (Investor's standards are available at www.arcelormittal.com/poland, tab "FOR CONTRACTORS"). Furthermore, Investor's standards are enclosed with the Contractor's Safety Manual and will be provided to the Contractor by the Investment Purchasing Office. The Contractor is obliged to respect and follow them at all times on a regular basis at all stages of the investment:

- ST 000 H&S Policy
- ST 001 Insulation
- ST 002 CONFINE SPACE
- ST 003 WORK AT HEIGHT
- ST 004 SECURE OF TRAIN RAILS
- ST 005 Audits
- ST 006 VEHICLES AND ROAD TRAFFIC
- ST 007 OVERHEAD CRANES AND LIFING EQUIPMENT
- ST 008 Contractor
- ST 009 Alarm
- ST 010 Safety indicators
- ST 011 Incident/Accident investigation
- ST 012 WORK AT GAZ HAZARDOUS AREA
- ST 014 HIRA (ang. Hazard Identification and Risk Assessment)
- ST 015 Golden Rules
- ST 018 Loading protection
- ST 201 H&S specification
- ST 301 Mobile phones

NOTE: In case norms/standards define different requirements for the same topic which comply with the requirements above, the stricter norms/standards should be applicable!

3. ENVIRONMENT- RELATED DATA

Investor's local environmental data for Dąbrowa Górnicza location, defined for project purposes, can be found in appendix 2 "Location and environmental data".

4. TECHNICAL INFORMATION:

4.1. AVAILABLE BACKGROUND DOCUMENTATION



- 1) Investor has Detail Engineering prepared by Biprohut. It is attached to RFQ.
- 2) Background technical documentation is available in softcopy (PDF) or paper version. The cost of printing out the documentation necessary for Bid preparation is to be borne by the Potential Contractor.
- 3) Documentation provided by the Investor may not be complete, documentation provided by the Investor should not restrict the launch of works.

5. HEALTH & SAFETY

During the implementation of specific project phases, manufacturing and delivery to ArcelorMittal Poland S.A. Dąbrowa Górnicza Unit, the supplier has to fulfill safety requirements defined in ArcelorMittal Poland S.A. documentation. For this scope, below points mainly refer to site visits and supervision during staves installation:

- 1) Works contractors, before they start work, must receive trainings in scope of OH&S and fire protection regulations effective at AMP;
- 2) Regulations on personnel, vehicle and material traffic effective in the premises of AMP must be followed;
- 3) OH&S and fire protection for the site and works must comply with the regulations effective at AMP.
- 4) During investment realization period at AMP site, supplier must respect and apply all H&S rules mentioned in H&S book, including all appendix described in Investor Standards mentioned in point 2.2.
- 5) Necessity to equip of all employees i.e. fire protection clothes, proper shoes, helmet with 4-point belt locked under the chin, safety glasses, gas detector CO and CO₂, in case of working at height - (individual) harness with safety ropes, shock absorber and other equipment which will be agreed during elaboration of project documentation or during execution at site.

6. CONTRACTOR'S SCOPE OF WORK

6.1. WORKS OBJECT

The purpose of these technical assumptions is to present the scope of works related to:

1. Delivery of cast iron staves with accessories (one set of accessories / 1 stove at each row). Staves are used for cooling blast furnace in the following zones: hearth, tuyeres line and shaft. AMP is interested in purchase 90 pcs. of cast iron staves.
2. Supervision on cast iron staves installation. Contractor will cooperate with other company, which will be responsible for staves installation.

Cooling agent to be used: chemically treated soften water in a closed circuit with forced circulation.

Contractor will follow the DE Biprohut drawings

6.2. WORKS SCOPE



6.2.1. Cast iron staves

1) Design & scope of delivery

New type cooling staves are designed as cast-iron staves with embedded pipes (referred to as coils) through which water flow takes place.

At stove outlet there is a protective pipe for coils.

Cooling staves in the area of blast furnace shaft from the inside (BF inside) are provided with a surface having horizontal “swallow-tail” shaped recesses where ceramic bricks will be laid.

Cooling staves in the area of blast furnace hearth bottom and hearth are provided with a smooth surface (without recesses).

Contractor will offer delivery of: cast-iron staves (with refractory inserts), compensation system, mounting system (contractor will propose hollow bolts for tap hole 2 area for the purpose of grouting), casing, backfilling strips, pressure and temperature measurement pipes (all pipes and tubes associated with these items that are inside of the furnace will be in Contractor scope of supply), templates and gauges for inspections purposes, all patterns (Although patterns will be used in the preparation of moulds for the casting of staves these patterns are not supplied to AMP).

Contractor will deliver cast-iron staves in amounts as in the table below, the weight of staves has been estimated and may differ from actual weight.

Item No.	Pieces	Stave weight [kg]	CI weight [kg]	CI weight [kg]
Chłodnica płytowa - rząd XVII - zamykająca	1	3270	2995	2995
Chłodnica płytowa - rząd XVII z króćcem dla termopary	1	3372	3095	3095
Chłodnica płytowa - rząd XVII	1	3372	3097	3097
Chłodnica płytowa - rząd XVII	1	3372	3097	3097
Chłodnica płytowa - rząd XVII - przy włączu fi800	1	3308	3035	3035
Chłodnica płytowa - rząd XVII - pod włączu fi800	1	1326	1172	1172
Chłodnica płytowa - rząd XVII - przy włączu fi800	1	3308	3035	3035
Chłodnica płytowa - rząd XVII	1	3372	3097	3097
Chłodnica płytowa - rząd XVII	1	3372	3097	3097
Chłodnica płytowa - rząd XVII - przy włączu fi800	1	3308	3035	3035
Chłodnica płytowa - rząd XVII - pod włączu fi800	1	1326	1172	1172
Chłodnica płytowa - rząd XVII - przy włączu fi800	1	3308	3035	3035



Chłodnica płytowa - rząd XVII	1	3372	3097	3097
Chłodnica płytowa - rząd XVII	1	3372	3097	3097
Chłodnica płytowa - rząd XVII - zamykająca	1	3270	2995	2995
Chłodnica płytowa - rząd XVII	1	3372	3097	3097
Chłodnica płytowa - rząd XVII z króćcem dla termopary	1	3372	3095	3095
Chłodnica płytowa - rząd XVII	1	3372	3097	3097
Chłodnica płytowa - rząd XVII	1	3372	3097	3097
Chłodnica płytowa - rząd XVII - przy włączaniu fi800	1	3308	3035	3035
Chłodnica płytowa - rząd XVII - pod włączaniem fi800	1	1326	1172	1172
Chłodnica płytowa - rząd XVII - przy włączaniu fi800	1	3308	3035	3035
Chłodnica płytowa - rząd XVI - zamykająca	1	3447	3166	3166
Chłodnica płytowa - rząd XVI	1	3549	3268	3268
Chłodnica płytowa - rząd XVI - zamykająca	1	3447	3166	3166
Chłodnica płytowa - rząd XVI	1	3549	3268	3268
Chłodnica płytowa - rząd XVI	1	3549	3268	3268
Chłodnica płytowa - rząd XVI	1	3549	3268	3268
Chłodnica płytowa - rząd XI	1	3280	2850	2850
Chłodnica płytowa - rząd XI	1	3280	2850	2850
Chłodnica płytowa - rząd XI	1	3280	2850	2850
Chłodnica płytowa - rząd XI	1	3280	2850	2850
Chłodnica płytowa - rząd XI z króćcem dla termopary	1	3282	2850	2850
Chłodnica płytowa - rząd XI	1	3280	2850	2850
Chłodnica płytowa - rząd XI	1	3280	2850	2850
Chłodnica płytowa - rząd XI	1	3280	2850	2850
Chłodnica płytowa - rząd XI - zamykająca	1	3200	2770	2770
Chłodnica płytowa - rząd XI	1	3280	2850	2850
Chłodnica płytowa - rząd XI	1	3280	2850	2850
Chłodnica płytowa - rząd XI	1	3280	2850	2850
Chłodnica płytowa - rząd XI	1	3280	2850	2850
Chłodnica płytowa - rząd XI	1	3280	2850	2850
Chłodnica płytowa - rząd XI	1	3280	2850	2850
Chłodnica płytowa - rząd XI	1	3280	2850	2850



Chłodnica płytowa - rząd XI z króćcem dla termopary	1	3282	2850	2850
Chłodnica płytowa - rząd XI	1	3280	2850	2850
Chłodnica płytowa - rząd XI	1	3280	2850	2850
Chłodnica płytowa - rząd XI - zamykająca	1	3200	2770	2770
Chłodnica płytowa - rząd XI	1	3280	2850	2850
Chłodnica płytowa - rząd XI	1	3280	2850	2850
Chłodnica płytowa - rząd XI	1	3280	2850	2850
Chłodnica płytowa - rząd XI	1	3280	2850	2850
Chłodnica płytowa - rząd XI	1	3280	2850	2850
Chłodnica płytowa - rząd XI z króćcem dla termopary	1	3282	2850	2850
Chłodnica płytowa - rząd XI	1	3280	2850	2850
Chłodnica płytowa - rząd XI	1	3280	2850	2850
Chłodnica płytowa - rząd XI	1	3280	2850	2850
Chłodnica płytowa - rząd XI - zamykająca	1	3200	2770	2770
Chłodnica płytowa - rząd XI	1	3280	2850	2850
Chłodnica płytowa - rząd XI	1	3280	2850	2850
Chłodnica płytowa - rząd XI	1	3280	2850	2850
Chłodnica płytowa - rząd XI	1	3280	2850	2850
Chłodnica płytowa - rząd XI	1	3280	2850	2850
Chłodnica płytowa - rząd XI z króćcem dla termopary	1	3282	2850	2850
Chłodnica płytowa - rząd XI	1	3280	2850	2850
Chłodnica płytowa - rząd XI	1	3280	2850	2850
Chłodnica płytowa - rząd XI - zamykająca	1	3200	2770	2770
Chłodnica płytowa - rząd XI	1	3280	2850	2850
Chłodnica płytowa trzonu rząd I, II, III - zamykająca	1 0	1925	1800	1800 0
Chłodnica płytowa trzonu rząd IV - zamykająca	5	1350	1267	6335
Chłodnica płytowa przy otw. spustowym (lewa)	2	4006	3800	7600
Chłodnica płytowa przy otw. spustowym (prawa)	1	4006	3800	3800
Chłodnica płytowa obok otworu spustowego	2	1630	1550	3100



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Support steel plates (backing plates) can be supplied loose for installation on site. Contractor will deliver mounting elements including compensators, fixing elements, sealing elements, SiC bricks.

Contractor will prepare schedule for the offer including production schedule and delivery.

2) Material

2.1.Coils

At the stage of the offer Contractor will propose solutions for coils: protection coating, etching and passivation. For all of these methods there is a necessity to get ArcelorMittal Poland approval. ArcelorMittal Poland accept the pickling and passivation of pipes before casting process. Coils should be made of seamless pipes for boilers, according to DIN standard proposed by Contractor and accepted by ArcelorMittal Poland. Dimensions of the pipe have to be taken from DE drawings delivered by ArcelorMittal Poland with this RFQ.

Pipes for coils must have material attestation and are subject to selection. Their surface must be smooth, without cracks, roll-ins, mechanical damage or corrosion, and without any signs that they have been repaired by a manufacturer.

What is allowed without necessary removal are single small scratches and outer surface irregularities and marks left by straightening on skew roller type straightener if they are not more than 0.2 mm deep.

2.2 Cooling stave casts

All cooling staves should be made of spheroid ferritic cast-iron (EN-GJS-400 15 (GGG40)) according to DIN EN 1563 standard, having the following composition and properties:

C = 3.3% ÷ 3.7%

Si = 1.8% ÷ 2.2%

S = max 0.02%

P = max 0.10%

Mn = max 0.3%

Mg ≥ 0.04 - 0.080%

Cr: <0.06%

Rm = ca. 370 MPa tensile strength

Ro2 = ca. 250 MPa yield strength

A5 above 11% elongation

Any deviations from the cast iron chemistry require acceptance from the ArcelorMittal Poland and the Engineering Office.



Contractor will explore the market for the use of cast iron with a better thermal conductivity coefficient in cast iron slabs - for example, grades with silicon (1.5%) and a perlite content of 8% in the material structure.

3) Manufacture and acceptance

3.1. Coils

Coils must be made according to documentation. The following dimension tolerances are acceptable:

Width tolerance according to Detailed Engineering

Length tolerance according to Detailed Engineering

After coil bending, pipe bends to be tested by ultrasounds (15%, acc. to QCP).

It is allowed to join coils if:

- total coil length is greater than maximum pipe lengths available in the market as a standard,
- it is required by coil bending technology.

After bending, a coil should undergo a water pressure test at 1.5 MPa (15 bar) for a period of 5 minutes. In case of any leaks, a coil is not suitable for use.

After tightness tests, one should test whether a coil is not obstructed inside in any way whatsoever by blowing through it a polyamide ball.

Then pipe ends φ_z (dimension from DE delivered by AMP) should be put on the coils in the places as outlined in the coil drawings. Pipe ends should be placed centrally relative to a coil and kept in position by three spot welds. Space between pipe end and coil should be filled in with fibrous insulation material proposed by Contractor and accepted by ArcelorMittal Poland.

A pipe end prepared this way must be transferred to a manufacturer of cooling staves.

3.2 Coils coating with a coat

For cooling staves coils should be covered with an Al_2O_3 and ceramic coat. Due to weak coating strength, it must be applied in the casting shop directly before pouring cast iron over the coils.

Before coating is applied, coils must be cleaned by shot-blasting according to standard proposed by Contractor and accepted by ArcelorMittal Poland. Immediately after shot blasting a coil must be coated to prevent any surface rust. Coating method will be agreed between customer and contractor.

Coating thickness must be from $0.25 \div 0.55$ mm. While coating application and coil transportation special precautions should be taken due to the fact that the coating is not resistant to impact or scratches.

Coating manufacturer is required to provide the following coating parameters:

- coating thickness
- melting point
- heat conductivity (optional, depending on the manufacturer's possibility)



and acceptance procedure for the coatings.

3.3 Acceptance Certificate

Acceptance conditions:

Ceramic coating quality should be defined in following steps:

- visual inspection
- coating thickness measurement

Visual inspection of coating quality involves checking whether there are no surface defects or any coating damage in 100% of coils.

Surface defects should be understood as gas pores, cavities, cracks and delaminations. Such defects eliminate a coil and it must not be used for the process of cast iron pouring over. Coating color and color homogeneity should be checked. Graphite color and coating hardness are a sign that moisture from an adhesive agent has evaporated.

Coating thickness to be measured by a thickness gauge A-91 or B-60.

Correct ceramic coating should be from 0.02 μm to 0.04 μm thick.

For coils coated with oxides, acceptance procedure should be as defined under 3.2. 100% of coil surfaces to be checked.

3.4. Cooling staves

Before coils are laid, a visual check should take place as to whether coil coatings have not been damaged in transportation.

Casts should be made according to structural drawings, maintaining width tolerance and length tolerance according to standard proposed by Contractor and accepted by Customer.

Casting radiuses which are not specified there should be made as $R = 10 \text{ mm}$, and stave contour radiuses should be as $R = 30 \text{ mm}$ except the front edge (from the side of coil outlets). Cast staves should be removed from molds after cooling to a temperature of 500°C . While casting, cast iron samples are to be taken according to standard, proposed by Contractor and accepted by Customer, from each ladle used for casting.

Casting should be done in a cautious way, without cracks or pits on the cast or without coil melting.

Riser heads for cooling stave mounting bolts must be solid and smooth.

Dimensions of all cooling staves must be checked with a documentation by a manufacturer.

Coils in molds should be put on supports to prevent their bending while casting.

No internal or external defects on the side and inside surface (where recesses are) of a cooling stave are acceptable. The acceptable ones may be located on the outer surface of an unprocessed stave (on the coil outlet side):

according to manufacture defect class according to standard proposed by Contractor and accepted by Customer;



unprocessed surface defects according standard proposed by Contractor and accepted by Customer;

Each stave should be marked with a separate row and position number painted clearly in a bright paint on both stave sides.

3.5 Cooling stave checking

- Contractor will allow Customer the possibility of manufacturing inspection;
- cast staves must undergo inspection and dimensions check with templates checking dimension tolerances;
- all staves must be checked in respect of contact with the contact surface using a template. The condition is fulfilled if three or four riser heads for bolt touch a template. If three riser heads touch a template, some rework by grinding should be done until a distance between a template and a riser head for bolt is less than 3 mm. Parallel, wall thickness tolerance of ± 6 mm is to be checked.
- after casting a coil should be rechecked for whether it is not obstructed in any way whatsoever by blowing through it a polyamide ball diameter,
- cast stave must undergo a pressure test by supplying water at 1.5 MPa (15 bar) to coils and sustaining this condition for around 5 minutes. During the test a stave must not show any symptoms of sweating, leakages or pressure drop
- after positive test results, inside coil walls should be degreased, pickled and passivated as specified under items 2 and 3 of standard proposed by Contractor and accepted by Customer, and then compressed air should be blown through and the coils should be secured against obstruction by plugging coil ends.
- The dimensions of “swallow tail” shaped recesses must be checked with a template.

A stave prepared in such a way can be transferred for shipment.

In case a stave does not meet the required conditions, a cast must be destroyed in a permanent way.

The customer will perform non-destructive test on randomly chosen cooling staves, that is will check cast iron structure, stresses and internal cast defects.

The Customer will perform destructive test on one stave. The Customer will pick the way of section cutting. In case a stave does not meet required conditions, a customer has right to reject all lot.

All the aforesaid requirements are subject to In-Plant Technical Inspection in the course of technical acceptance procedures.

Each stave should be provided with attestation specifying the following:

- cast iron chemistry test results,
- mechanical properties test results measures on samples from every ladle,
- results of pipes attestation tests,
- results of coil bend ultrasound tests,
- pressure test results,



- results of a visual inspection of a stave,
- results of dimension tolerances measurements for cooling staves.

6.2.2. Identification of staves

Staves identification will be agreed with Contractor after contract placement.

6.2.3. Supervision on cast iron staves erection.

Contractor will offer supervision for staves installation during BF2 repair. Offer should include 7 days of supervision (24h/day, 7 days/week).

Contractor will cooperate with other company, which will be responsible for staves installation.

Technical scope of supervision:

1. Inspection of staves accessories and staves before installation:

- Inspection of gaskets,
- inspection of hot face elements,
- inspection of PINs,
- Inspection of threads,

2. Inspection during installation

- Inspection of shell openings,
- Inspection of lifting operation and installation of stave in proper position on shell,
- Inspection of staves fixing operation,
- Inspection of gap between cooling inlet/outlet and shell opening,
- Inspection of PIN ring and welding process
- Inspection of gaskets after stave installation
- Inspection of backfilling /ramming strips installation

6.2.4. Transportation

Contractor will ensure transport from place of manufacturing to Dąbrowa Górnicza. Bidder will confirm its proposed shipping routes based on DDP delivery to DG site.

Before the delivery SiC bricks have to be installed in all staves.

During the transportation staves need to be protected against dislocation. Particular plates have to be separated by means of wooden spacers.

During the loading operation it should be checked if the coil inlets are appropriately blinded (caps) and the ends not damaged.

- delivery in containers max. 20 ft or trucks,
- staves secured against displacement,



- attaching staves to the container, easy to remove from containers (disconnecting, cutting off),
- staves fastened (attached) to wooden pallets,
- staves on pallets with the possibility of unloading with a forklift,
- staves accessories in packages max. 3.5 t,
- one type of accessories in one box,
- protect/plug holes for bolts or measurements,
- shipment of containers to the Blast Furnace Plant in the morning, successively approx. 8 - 10 containers a day, detailed determination of deliveries and the number of containers, after customs clearance, notification of drivers,

6.2.5. Binding rules and standards

All Standards (DIN, EN, ISO, PN) needed to be proposed by Contractor at the stage of offer and accepted by Customer.

6.3. OFFER-RELATED REQUIREMENTS

- 1) Technical offer should include:
 - a. General description and information about the service offered;
 - b. Scope of works under the bid (with defined quantity);
 - c. List of elements/works and quantity;
 - d. Exclusions (work to be performed by the buyer);
 - e. Responsibility matrix (i.e. division of work which clearly specifies Seller's and Customer's scope);
 - f. Necessary drawings (examples for deviating solutions from DE should be provided).
 - g. Works schedule (on a weekly basis at least) with the milestones;
 - h. Performance parameters (performance parameters acc. to QCP);
 - i. Submission of at least 1 credential issued by company for whom cast iron staves were delivered as a General Bidder from the last 5 years (name of the purchaser, location, value, year, description of staves, quantity). If it is not possible to provide a reference certificate, submit a declaration containing a reference list with a list of deliveries of cooling staves in the last 5 years. The list must contain: buyer's name, location, value, year, staves description, quantity and contact details of the buyer's representative (name, email address, telephone number) enabling AMP to validate the information contained in the reference list.
 - j. List of spare parts for at least two years of normal operation and for commissioning;
 - k. Declaration that Contractor's knowledge, experience and site visit are sufficient to perform the whole scope of work;
 - l. Declaration that the whole scope of work will comply with good construction practices and with the effective law;
 - m. Information on labor consumption related to task performance, in the break-up into individual areas;



- n. Bid validity period;
 - o. List of potential subcontractors for AMP approval
 - p. **Other information disclosed by the Contractor which does not include any cost data that could influence the quality of the offer.**
- 2) Supplier will present in detail all the elements of their offer which vary from the technical conditions set forth here if they are not able to fully meet all conditions.
 - 3) The offer in the final part must contain an index of all changes that will appear in the content as a result of technical meetings, arrangements. The index must contain a brief description of the change and the locations of the change in the offer text.
 - 4) Indication of subcontractors or partners in the case of a consortium, together with an indication of the relevant work packages
 - 5) The commercial part will have a price breakdown consistent with the breakdown of the request for quotation, including additionally for the supply of materials and labor.
 - 6) Final offer must be prepared in English and Polish languages.

6.4. REQUIRED CONTENT OF THE TECHNICAL DOCUMENTATION SUPPLIED BY SERVICE PROVIDER:

- 1) Works schedule;
- 2) Manufacturing inspection documentation.
- 3) Quality Assurance Plan for Investor's approval;
- 4) Division of works into tasks being the responsibility of the Contractor and Customer;
- 5) List of spare part for 2 years period of standard operation
- 6) Minimum monthly progress reports prepared according to the Customer's guidelines and defining the percentage of works done relative to the plan;
- 7) Final report.

7. WORKS PERFORMANCE DEADLINE, IMPLEMENTATION STAGES

Contractor is obligated to perform the task no later than:
within 42 weeks from Contract signature - delivery of cooling staves to AMP.

8. WORKS SCHEDULE

The Contractor should deliver with the offer the draft works schedule for Investor's consultation and approval.

In time schedule all important milestones will be highlighted including start of manufacturing, FAT, start and finish of shipment.

8.1. PRELIMINARY SCHEDULE

The offer should include a preliminary schedule with specific time slots in which the Contractor will provide the Investor with drawings, documents and other materials,



as well as time slots for the implementation of the specific Investment phases. Schedule dates will be guaranteed by the Contractor and will be subject to specific commercial clauses in the Commercial Offer.

8.2. DETAILED SCHEDULE

Detailed schedule of the works scope should be provided for approval by the Investor as part of Contractor's work performance, taking into consideration all stages of the contract execution. This schedule should also include the description (specification) of the so-called critical path tasks and the so-called investment milestones.

9. RIGHTS OF THE CUSTOMER

- 1) All valuable materials /scrap/objects of archeological value recovered or found during works performance are the customer's property and will be handed over to them.
- 2) Customer reserves the right to restrict access to the plant for any person associated with the Contractor found to be e.g. under the influence of alcohol or in a condition that may create a threat to themselves and other people performing work or a group of people. Detailed information will be presented in Health & Safety Policy applied at ArcelorMittal. This policy shall constitute an integral part of the contract concluded with the Contractor.

10. DELIVERY AND QUALITY GUARANTEE

- 1) Delivered solutions will be free of any defects being the result of faulty engineering, materials and/or poor quality of manufacturing. The Contractor will guarantee the delivery by the date and in the form as defined in the order.
- 2) The Contractor will guarantee the use of the state-of-the-art solutions.
- 3) The Contractor will guarantee high quality of the structural solutions, high quality of materials in the proposed solutions and high quality of performance for all individual and assembled elements of equipment parts, specific machines and equipment, offered by them on the basis of the required performance guarantees defined in the specification of the offer.
- 4) Performance guarantee will cover all individual elements and weighing and metering systems, as far as their accuracy, nominal values/capacity and integrated operation are concerned.
- 5) The minimum warranty period expected by the Investor is 18 months from the moment of signing the Preliminary Acceptance Certificate.

11. PERFORMANCE PARAMETERS AND CONDITIONS FOR PAC (PROVISIONAL ACCEPTANCE CERTIFICATE) SIGNING

INSPECTION AND TEST PLAN FOR CAST IRON STAVES



Part of position	Test Item	Test Frequency	Acceptation Standard	Method or tool	Anomalies treatment	Report
Cooling pipe	Chemical composition & mechanical properties	Two samples of each type/bach	Steel grade: 10 (acc. GB/T8163-1999) $\sigma_s \geq 205\text{MPa}$, $\sigma_b \geq 335\text{MPa}$, $\delta_5 \geq 30\%$	Tensile test Chemical analysis	Reject	Y
	Tube size	Two check of each type/batch	(acc. GB/T8163-1999) Outside diameter: $\pm 1\%$ Wall thickness: $\pm 12,5\%$	Slide caliper	Reject	Y
	Bending of pipes - Shape & dimensions	100%	According to bending drawing	Jig	Check jig and repair mould	Record
	Bending of pipes - Bending radius	One check of each type	R ± 5	Template	Repair mould	Record
	Ball test	100%	Straight pipe: 80%XØi Serpentine pipe: 65% XØi	Plastic ball	Reject	Record
	Wall thickness of bending area	15% of each type	$t_b \geq 80\% \times t$	UT	Reject	Y
	Cracks on bending area	100%	No cracks	MT	Reject	Y
	Cracks on the whole pipe	100%	Pressure test 15 bars held for 5min, no pressure drop	-	Reject	Record
	Sand blasting (SB)	100%	Min. Sa 2.5	Compare with standard sample	Sand blast again	Record
	Dry coating thickness measure and report: <ul style="list-style-type: none"> 4 points every 300mm on straight part and 4 points on each bend for straight pipe 4 points on each bend and 4 points between bends for serpentine pipe 	100%	1 st coat Al 0.05-0.15mm (2 nd coat Ceramic 0.20-0.40mm) Total: 0.25-0.55mm Do coating within 4 hours after sand blasting	Thickness detector	Reject	Y
Protecti on Tube	Chemical composition & mechanical properties	Two samples of each type/bach	Steel grade: 10 (acc. GB/T8163-1999) $\sigma_s \geq 205\text{MPa}$, $\sigma_b \geq 335\text{MPa}$, $\delta_5 \geq 25\%$	Tensile test Chemical analysis	Reject	Y
	Pipe size	Two check of each type/batch	(acc. GB/T8163-1999) Outside diameter: $\pm 1\%$ Wall thickness: $\pm 12,5\%$	Slide caliper	Reject or discuss	Y
	Widening of pipe opening, dimensions	100%	According to drawing	Measure	Repair and remanufacturing	Record
	Cracks on pipe widening	100%	No cracks	MT	Reject	Record
	Sand blasting (SB)	100%	Min. Sa 2.5	Compare with standard sample	Sand blast again	Record
	Dry coating thickness measure and report: 2 points on cast-in area for both internal and external of the tube	100%	1st coat Al 0.05-0.15mm (2nd coat Ceramic 0.20-0.40mm) Total: 0.25-0.55mm Do coating within 4 hours after sand blasting	Thickness detector	Too thin: More coating Too thick: 1. Only local: AMP decides 2. Large area: sand blast again and re-coat	Y
Thermo couple tube	Dry coating thickness	100%	Sane as protection tube	Thickness detector	-	-
Lifting lug & threaded block	Dry coating thickness	100	1st coat Al 0.05-0.15mm (2nd coat Ceramic 0.45-1.25 mm) Total: 0.50-1.40mm	Thickness detector	-	-
	Seal between protection pipe and cooling pipe	-	Ceramic fibre rope, asbestos free	-	Reject	Record



Stave cooler	Casting temperature	Each pouring	Target pouring temperature: EN-GJS-400 (GGG40): 1260-1290 °C	-	Adjust	Y
	Pouring duration	Each pouring	-	Stopwatch	-	Record
	Knock-out temperature	Each stave	Max. 500 °C	-	Adjust	Record
	Nitrogen protection	Each cooling pipe	4-5 m ³ /h on each pipe during casting for 30min, and then sand caps to be installed after casting	Flow meter	Adjust flow	-
	Mechanical properties	One for each heat	For EN-GJS-400 15 (GGG40) $\sigma_b \geq 370\text{MPa}$, $\delta \geq 11\%$	Tensile test	If any of test fail, re-test. If small deviations, concession request.	Y
	Metallurgical analysis	One for each heat	For EN-GJS-400 15 (GGG40): Ferrite content $\geq 90\%$, Graphite size > 4, Graphite type min. 80% type V+VI	Polished and etched samples	Concession request if small deviations	Y
	Chemical composition	One for each heat	For EN-GJS-400 15 (GGG40): C: 3.30-3.70% Si: 1.80-2.20% Mn: $\leq 0.30\%$ P: $\leq 0.10\%$ S: $\leq 0.02\%$ Mg: 0.040-0.080% Cr: <0.06%	Spectrometer and/or wet analysis	Chemical analysis shall be considered subordinate to mechanical properties and metallographic requirements. These figures are a target chemical composition. They are not the reason for rejection if the mechanical properties and microstructure are OK.	Y
	Hydrostatic pressure test of pipes	100%	15 bars held for 15minutes, no pressure drop allowed	-	Reject	Y
	Ball test	100%	Straight pipe: 75% $X\phi_i$ Serpentine pipe: 60% $X\phi_i$	Plastic ball	Re-test after pickling. Reject if fail.	Y
	Surface quality	100%	Hot face: Max. 5mm deep and less than 1% of surface Cold face: Depth: Max. 15mm deep just above pipes and max. 30 mm between pipes and on pipe boss and bolt boss Area: Max 5% of surface on single pipe boss and bolt boss, max. 15% of that boss area	VT	Within tolerance - remove defects by grinding/chiseling Out of tolerance - reject. Welding and resin repair is not allowed without AMP's approval.	-
Position of cooling pipes inside stave along the thickness direction (4 points per straight pipe and 4 points per serpentine pipe)	100%	Tolerance (check from cold face): $\pm 15\text{mm}$ (for stave thickness >160mm) $\pm 10\text{mm}$ (for stave thickness $\leq 160\text{mm}$)	UT	Reject/Concession request if small deviations	Y	
Internal quality Detection and determination of internal shrinkage from hot and cold face	10% of each type	GGG40: <50% loss in attenuation Through transmission achieved	UT	Reject/discussion. Check another 10% of the staves.	Y	



			Internal defects: max. 5% cold face surface area			
	Dimension and position tolerance	100%	<ol style="list-style-type: none"> 1. Length +5/-10mm 2. Width ±6mm 3. Grooves size 0/+3mm 4. Distance between inlet and outlet of pipes: Vertical +0/-10mm 5. Pipe deviation on tips: ±10mm in all directions 6. Fixing element centerline: ±2mm 7. Position of thermocouples: ±3mm 8. Lugs touching the shell +0/+5mm 9. Free lugs +0/-5 mm 	Template	Discuss	Y
			<ol style="list-style-type: none"> 1. Thermocouple well to hot face: ±3mm 	Ruler/Template	Discuss	Y
			<p>Hole diameters on template:</p> <ol style="list-style-type: none"> 1. Hole for protection tube: +14mm 2. Hole for thermocouple tube: +8mm 3. Hole for screw hole: +8mm 	Ruler	Re-fabrication of template	-
Stave cooler	Welding of rings between cooling and protection tube	100%	EN 1291, level 3	MT	Grinding & re-welding	Y
	Bolt anchors - after casting	100%	According to drawing	Thread gauge/bolt	Repair / Discuss	Y
	Lift lugs test - before casting	100%	Check for cracks	MT	Reject	Y
	Lift lugs loading test - after casting	10% of each row	Load: 2 times stave weight	-	If any lifting lug fails, all lugs should be tested	Y
	Lift lugs visual inspection - after casting	100%	No grinding mark	VT	If with grinding mark, then loading test	Y
	Pickling & passivation of cooling pipes	100%	No presence of scale cinder and cover the pipe end with plastic cap after pickling	Endoscope	Re-pickling	-
	Destructive test	As agreement	<ul style="list-style-type: none"> • Extraction test of cooling pipes • Mechanical properties of cooling pipes: elongation >20% • Position of cooling pipe: 			Y



			<p>± 15mm (for stave thickness >160mm)</p> <p>±10mm (for stave thickness ≤160mm)</p> <ul style="list-style-type: none"> Recarburization of cooling pipes: Carburization depth: ≤0.80mm Recarburization of protection pipes: Carburization depth: ≤0.80mm 			
Packing	Cleanness inside pipes and holes (thread holes, protection tubes and cooling pipes)	100%	No spoil and covered with plastic caps	VT	Cleaning & covering	-

12. CONTACT PERSONS

Item	Name and surname	Responsibility	Plant/Department	Phone / e-mail
1	Marek Berliński	Support Manager - Technical Leader	BF Plant AMP DG, Al. J. Piłsudskiego 92 41 - 308 Dąbrowa Górnicza	+48 795 525 180 Marek.Berlinski@arcelormittal.com
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4	Marta Bodnar	Lead Buyer - Purchasing Office	EPO Al. J. Piłsudskiego 92 41 - 308 Dąbrowa Górnicza	+48 668 562 376 Marta.Bodnar@arcelormittal.com

13. OTHER TOPICS (NOT DISCUSSED ELSEWHERE)

13.1. CONTRACTOR'S PROPERTY SECURITY

In the course of the Investment's duration, the Contractor is responsible for securing their own property and the property of their subcontractors, parts, subassemblies and entire equipment stored in the Investor's premises and planned for project purposes in the period of commissioning and hand-over to the Investor. (Point refers to supervision on staves installation, not related with securing of stored cooling staves in AMP warehouse).



14. APPENDICES

1. Appendix 1 - Legal acts
2. Appendix 2 - Location and environmental data
3. Appendix 3 – drawings
4. Appendix 4 – table with information about the accessories