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Technical Specification

“Delivery of copper 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 **4/034/2021**

ArcelorMittal Poland S.A.
Dąbrowa Górnicza



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SPECIFICATION NO. 4/034/2021

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 copper 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, *.dwt (AutoCAD ver. 13 or higher, Autodesk Design Review) is must;
4. Electrical documentation: *.zwt ; (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 LIFTING 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 Basic Engineering prepared by Primetals. 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. Preparation of detail engineering for copper staves with accessories.
2. Delivery of copper staves with accessories (one set of accessories / 1 stave at each row). Staves are used for cooling blast furnace in the following zones: tap hole area, belly and lower shaft. AMP is interested in purchase 114 pcs. of copper staves for rows: Be7-S8 and in tap hole area.
3. Supervision on copper staves installation. Contractor will cooperate with other company, which will be responsible for staves installation.



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

Stave designs should include reusing existing or new designed furnace shell holes. Contractor will follow the BE drawings.

6.2. WORKS SCOPE

6.2.1. Copper staves

1) General Scope

This technical specification describes and defines the services to be provided to AM POLAND with regard to the:

- Engineering, manufacturing and delivery of the copper staves for the row Be7, S8 and tap hole staves (TH1, TH3, TH4) in BF2.
- Including compensators, fixing elements (contractor will propose hollow bolts for tap hole area), sealing elements, backfilling strips, distance pipes, thickness measurements, pressure measurement pipes and thermocouple studs provided with guiding pipe for thermocouples (all pipes and tubes associated with these items that are inside of the furnace will be in Contractor scope of supply. Thickness measurement flange is in Contractor scope). Also, including the “state-of-art” for hot face protection for all these rows.

2) Engineering and documentation

The contractor has to explain how he will proceed to manufacture the stave coolers and how he will guarantee the tolerances.

The used solutions must incorporate the BAT's (Best Available Techniques) of the steel sector. Besides staves must implement the following design details:

The extension and deadline to submit the documentation by the Contractor shall be in accordance with the following provisions:

3) Manufactures and supplies

a) General

The successful bidder, either through its own means and/or of others, shall perform the supply and manufacture of the copper staves for the tap holes area and the rows 7, 8 and their accessories.

The Contractor is responsible for the complete supply of equipment including manufacturing, testing, painting, packing, shipping and transport to AM POLAND.

The fact that some parts of the equipment and other services related to the supply may be subcontracted will in no way diminish the Contractor's responsibility.

The name of the manufacturing unit has to be informed to AM POLAND.

The design of cooling staves shall be based on recently developed and continuously improved technique.



In total there will be:

- 30 staves manufactured for the tap holes. Those staves can be drilled or casted (hearth level)
- 42 staves manufactured for the row 7 (belly level). These copper staves will have 4 cooling channels.
- 42 staves manufactured for the row 8 (shaft level). These copper staves will have 4 cooling channels and 1 serpentine pipe in second cooling layer (serpentine pipe with maximum coverage of stove). The minimum gap between stove and shell is 25mm. Those staves shall be casted. The water flow in S8 secondary cooling layer must be the same as in S10 second layer (S10 serpentine pipe $\varnothing 42.4 \times 5.0$). The channels in the cooling stove should be spaced apart to receive the heat evenly (outermost by 20 mm to the edge, middle by 6mm.)
- And all the accessories for these staves. The drawings of accessories are not available. DE for accessories is part of the scope included in this Technical Specification.
- Contractor will deliver also accessories for 33pcs. of B06 copper staves stored in AMP's warehouse.
- The existing furnace line must be maintained

Row	Area	Type	Number of staves	Weight [kg]
H2	Taphole Staves	Type TH-A	7	1573,6
H2	Taphole Staves	Type TH-B	7	1377,3
H3	Taphole Staves	Type TH-C	4	1031,0
H3	Taphole Staves	Type TH-D	4	1031,0
H3	Taphole Staves	Type TH-E	4	1104,4
H3	Taphole Staves	Type TH-F	4	1104,4
Be7	Belly Staves	Type Be7	42	2803,0
S8	Stack Staves	Type S8	42	2935,1

Advise comments and requests from AM POLAND expressed during the design stage will be taken in account as far as possible. Implementation will not relieve the contractor manufacturing quality and planning responsibility.

The drawings made by the contractor shall be transmitted to AM POLAND for comments. Only upon receipt of released for construction drawings, the contractor shall start the actual fabrication.

Important remark:

The Contractor will report frequently to AM POLAND to assure a fluent cooperation of engineering, manufacturing and delivery and to assure the delivery time.

The Contractor will also report the way they will do and have done the quality control.

b) Fixing and sealing elements



The fixing and sealing elements are adapted to the solicitation encountered in the zone in order to assure best performance. They are designed to be fully gastight and to minimize the introduction of stresses in cooling pipes and welds.

The contractor provides design and manufacturing of all sealing and fixing elements.

c) Materials

Cu staves: Material Cu-HCP / CW021A acc. to EN 1976 for rolled staves, Cu-C Grade A acc. to 1982 for casted staves

The same quality is guaranteed for the two different production techniques.

High purity copper, purity > 99.9%

Conductivity: minimum 98% IACS for rolled staves

Conductivity: minimum 80% IACS for casted staves

Steel parts to be weld on Cu parts: Steel 35.8

d) Pipes

All pipes will have threaded ends for outside pipe connections, and must be protected by metallic caps for erection phase and storage.

The cooling pipes in casted S8 staves shall be Monel 400

e) Staves

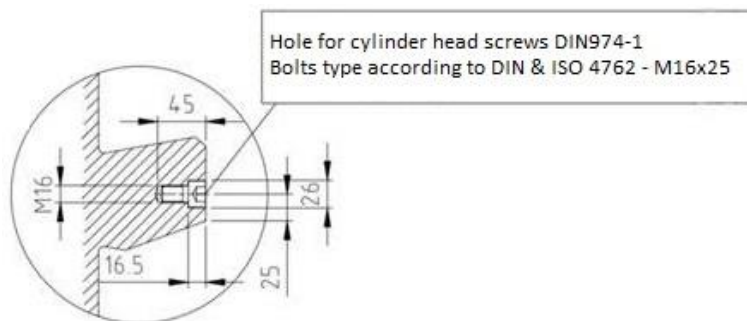
- Out-coming cooling pipes (for copper staves) have to be provided with steel sleeves to allow the welding of the compensators on site.
- The staves have to be delivered with metallic caps to protect the cooling pipes thread during transport and erection.
- Cooling channels have to be drilled from the bottom side of the copper stave. Then only plugs at the bottom are allowed (Be7). Taphole staves will need to be top drilled as per BE. Staves S8 have to be casted.
- The curvature of the staves according to the radius of the shell of the blast furnace,
- Protruding horizontal blade above the upper edge (protection steel plate on the upper edge),
- Other options of hot face protection for other rows which are also accepted:
 - Bolts in ribs
 - Proprietary technical solutions
 - Naked
- Min. thickness of cold face 15mm, min. thickness of hot face 20mm, Min. thickness of ribs 55mm. For S8 min. thickness of cold face 12mm of copper for secondary layer and 20mm for first layer, min. thickness of hot face 18mm of copper, Min. thickness of ribs 55mm.
- Cylindrical ø55 cooling channels
- Improved plug design for staves Be7 and tap holes
- Vertical slicing (3 per staves, 10mm wide)
- Helicoils installed
- Delivery of support steel plates on the cold face of staves for gunning of the joints
- Protection pipe for casted staves S8 staves (steel sleeve)



- Screw-in bolts on the hot face as additional protection
- Hot face design:

Row	Type of protection
S8	Protruding metal elements beyond the ribs outline or solution for material capture to protect the copper
	2 bolts in front of cooling channel in one rib out of 3 (8 bolts per rib). If rib in front of cooling channel is covered by protruding metal element, the bolts is not necessary in that place.
Be7	8 pcs bolts per long rib. If rib in front of cooling channel is covered by protruding metal element, the bolts is not necessary in that place.
	2 bolts in front of cooling channel in one rib out of 2 (8 bolts per rib). If rib in front of cooling channel is covered by protruding metal element, the bolts is not necessary in that place.
	Contractor propose a solution for material capture to protect the copper
	Every 3 ribs long 100mm rib. If rib in front of cooling channel is covered by protruding metal element, the bolts is not necessary in that place.
	Inclination of ribs

Bolts in rib illustration:



f) Identification of staves

All staves will be identified according the following procedure:

- At the cold side identification data engraved on a well determined location giving complete information about row n°, pattern type, n° in the given row and n° of cast of raw material.

Identification will be as follows:

- Two positions for n° of row: S2 ROW 6 / S3 ROW 9 / S4 ROW 9
- One position for the type of stave: A , B
- Two positions for n° of stave in row (01 to 42): 01
- Two positions for the number of the cast of raw material.
- At the hot side the same identification except cast number will be painted with indelible paint.
- The same identification shall be visible on the packages.

g) Tolerances on the staves



Dimensions, geometrical locations and positions of all types of holes, geometry length and shape of outlet and inlet tube will be made according the approved drawings and according the tolerances as indicated.

A template, contractor's design and delivery, will be used in the workshop to control all those dimensions and tolerances.

Special specified tolerances are as follows; as a general statement, tolerances are related to stave axes.

For drilled Cu staves:

Length	± 2 mm
Length for bended staves	± 2 mm
Width	± 2 mm
Thickness	± 2 mm
Flatness	± 2 mm/m
Distance pipe height on bolts	± 2 mm
Size of grooves	-
Dimensions of cast-in cooling channel	+/-5% cross section area
Diameter of drilled cooling channel	± 0,5 mm
Cooling channel position in stave body (in all direction)	± 1,5 mm
Straightness of cooling channel (width)	± 1,5 mm / 1.000 mm
Minimum wall thickness (hot side)	20 mm
Inlet in outlet of pipe tips measured on cold side	± 5 mm
Pipe length outside of stave, all pipes	± 5 mm
Position of outcoming pipes, in all directions at the tips	± 5 mm
Position of outcoming pipes, in all directions (at the staves body connection)	± 1 mm
Blow holes / porosities	Not allowed
Depth of thermocouple hole from the hot face	0/+2 mm
Position of instrumentation	± 1 mm
Position of fixing elements	± 1 mm
Roughness of the cut of the holes to be checked according standard EN ISO 9013 class 33	

For casted Cu staves

Length	± 5 mm
Length for bended staves	± 5 mm
Width	± 5 mm
Thickness	± 5 mm
Flatness	± 5 mm/m
Distance pipe height on bolts	± 2 mm
Cooling channel position in stave body (in all direction)	± 5 mm
Straightness of cooling channel (width)	± 5 mm
Minimum wall thickness (hot side)	20 mm
Inlet in outlet of pipe tips measured on cold side	± 3 mm
Pipe length outside of stave, all pipes	± 5 mm
Position of outcoming pipes, in all directions at the tips	± 5 mm



Position of outcoming pipes, in all directions (at the staves body connection)	± 5 mm
Blow holes / porosities	Not allowed
Depth of thermocouple hole from the hot face	0/+2 mm
Position of instrumentation	± 5 mm
Position of fixing elements	± 5 mm
Roughness of the cut of the holes to be checked according standard EN ISO 9013 class 33	

h) Measure thickness cooper bar

Cooper bar will be installed on site the contractor will supply 4 cooper bar per row.

i) Welding

Welding has to be done following officially approved welding procedures, with officially approved welders for these procedures, and with utmost care to insure fully water and gas tightness of final product. The steel sleeve on the copper pipes has to be welded on both sides in minimal two welding runs, second run to start 180° from the starting point of the first weld and with overlapping of 20 mm.

Pressure test has to be done by drilling a hole in the sleeve prior to the welding. After pressure check, a welding spot must plug the drilling. The location of the point of drilling is indicated in the drawings of details.

j) Pickling and rinsing

Due to the heating of the stove by welding tubes and stops some oxidation inside the channels occurs. An appropriate pickling has to be done afterwards to remove the oxides.

Pickling for drilled copper staves is obligatory.

k) Errors in design

If the contractor makes errors in design then the contractor shall be responsible and liable for every corrective action that may be necessary to remedy the impact of the error, both in design stage and manufacturing stage.

The approval by AM POLAND of design documents does not relieve contractor of this responsibility and obligation.

6.2.2. Supervision on copper staves erection.

Contractor will offer supervision for staves installation during BF2 repair. Offer should include 15 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

6.2.3. 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 copper staves hot face protection have to be installed in all staves as well as steel anchors (if applicable).

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,

6.2.4. 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 BE 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 detail engineering for staves was prepared and copper 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 completed documentation and 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 preparation of DE, 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 COPPER STAVES

All controls and inspections are part of CONTRACTOR's scope of work. AM POLAND or its formal designed inspector will always have the right to inspect the various manufacturing stages and witness all and any inspection and control. The contractor will inform AM POLAND of scheduled inspections with enough time in advance. Inspection release notes to continue the work shall not release or reduce CONTRACTOR's responsibility. Possible visible or invisible defaults noticed later on will be promptly corrected by the contractor up to full satisfaction and no cost to AM POLAND.

Cu-material:

- Test samples for quality control and chemical analysis will be made on each casting charge.
- Prior to prepare the charge, a spot control will be made on the copper to determine the chemical analysis.



Control of the staves:

- All the staves will be controlled by the contractor's quality assurance services on dimensions and tolerances in order to deliver the certificates. Dimensional control will be made by means of a template (design, drawings and delivery on supplier's cost). For instance, the good contact of the lugs (distance pipes) onto the shell has to be checked against a centred plate simulating the blast furnace shell. The template has to be consistent during handling, preferably made of metal sheet.
- Certificates will be transmitted one week before an eventual visit of a buyer's delegation to control staves taken at random.
- Besides the main dimensions and positions, following items have to be checked with the template:
 - The position of the ends of the out coming pipes,
 - Length of the tubes
 - Angle between tube and cold surface
 - Angles of the different interdependent surfaces,
 - Angles of the holes for thermocouple, bolts and supporting pins
- Five staves row 7 BF"2", five staves row 8 BF"2" and eight tap hole staves at random will be controlled. Depending of the results the inspection will be extend to the complete supply.
- Dimensions and tolerance control.
- The threaded ends of the copper pipes shall be checked with a Go-NoGo gauge.
- The water passages in each Stave shall be checked and any residue, chips, etc. shall be removed. Endoscope inspection is required.
- Checking the holes for pin, threaded holes for bolts and lifting eye.
- Hydraulic testing. Each stave cooler shall be hydraulically tested at 15 bar pressure during 15 minutes and 1 bar pressure during 1 minute. No pressure drop is allowed.
- Two (2) staves of each row shall be selected at random to and tested demonstrate the pressure drop (Water flow & temperature to be provided by AMP).
- Ultra sonic test for cooling channel position. Control according to indicated tolerances (± 1 mm from centerline of stave).
- All (100%) welds must be visually checked and tested via dye penetrate.
- Gas tightness control for steel sleeves welded on copper tubes for all the welds. No leakage will be allowed.
- After tightness tests, one should test whether a coil is not obstructed inside in any way whatsoever by blowing through it a polyamide ball (only S8)
- The contractor will explain how he proceeds to do this.

General appearance of the staves:

- No blow holes are allowed.
- No cracks are allowed.

Reject: If a stave cooler does not comply with the test conditions, it will be rejected and a new one will be made on supplier's expenses.

Tests and certificates

- DIN 50049.3.1B (EN 10204.3.1) for the material.
- Welding procedures.



- Inspection of welds and test by dye penetrate and ultrasonic waves.
- Pressure test for each element, 15 bar and 15 min.
- Gas tightness test for each weld of the sleeves.
- Measuring inspection certificate with indication of tolerances per stave.
- Size and straighten inspection of the cooling channel.
- Visual inspection of machined surface.
- Visual inspection of raw surface.
- Certificate of conformity for final staves.
- Weight of all staves.

12. CONTACT PERSONS

Item	Name and surname	Responsibility	Plant/Department	Phone / e-mail
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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 - BE drawings