TECHNICAL SPECIFICATION

for

design, delivery, dismantling, assembly and commissioning of above burden probes, In burden probe, mini probes and gas analyzer. Elements used for construction and permanently installed in a pilot (demonstration) installation.

in connection with the implementation of the Project entitled "Modeling of thermo-chemical processes in a metallurgical reactor with the use of modern automatic and IT systems." (co-financing agreement number: POIR.01.01.01-00-0118 / 18)), co-financed by the European Regional Development Fund and under the Intelligent Development Operational Program 2014-2020, sub-measure 1.1.1 "Industrial research and development works carried out by enterprises "(Competition organized by the National Center for Research and Development No. 2 / 1.1.1 / 2018) at the AMP Blast Furnace Plant in Dąbrowa Górnicza.

This specification is attached as Annex 2 to the request for proposal No. 1/0118/2021

May, 2021

1. INTRODUCTION

ArcelorMittal Poland S.A. (AMP) under the project "Modernization of the Blast Furnace No. 2" (WP # 2), is interested in introducing a mathematical model of thermo-chemical processes and devices supporting this model. The detailed scope of works being the subject of the Inquiry is presented later in this study.

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

The subject of the contract indicated in this specification concerns the project entitled "Modeling of thermo-chemical processes in a metallurgical reactor with the use of modern automatic and IT systems." (co-financing agreement number: POIR.01.01.01-00-0118 / 18)), co-financed by the European Regional Development Fund and under the Intelligent Development Operational Program 2014-2020, sub-measure 1.1.1.

Due to the obligation of the Company to apply the principle of competition, this technical specification is the subject of the contract, allowing the potential Bidders to determine the value of the contract.

This specification has been prepared with the utmost care to define a full, unambiguous and exhaustive description of the subject of the contract, so as to enable the Bidders to define all their obligations and risks, and to responsibly calculate the price and other components of the offer.

All purchases, services and delivery which are the subject of this inquiry for the determination of the value of the contract must be included and cooperate with the existing infrastructure and equipment in the Company and must meet the same technological standards. Therefore, the need to maintain the same technological conditions and the need to maintain the unification of devices resulting from the expansion of the existing infrastructure determined the provisions of this specification. The provisions used are justified by the necessity to ensure the efficient implementation of the project in question. The indications regarding the expected technical parameters and indications regarding specific types and producer names are general in nature, referring only to examples of indications of equivalent products and do not constitute the only accepted solution. On this basis, the contracting authority allows for equivalent solutions.

The tenderer is obliged to read this specification and make sure that the devices are technically feasible, as well as assume full responsibility for the guaranteed operation of the delivered devices in terms of efficiency, parameters and efficient and reliable operation.

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

The detailed scope of works being the subject of the Inquiry is presented later in this study.

1.1. OBJECTIVE OF THE PROJECT

The purpose of this project is to conduct industrial research and experimental development work, the result of which will be developing an intelligent support system for shaft-based furnace technology on mathematical models describing the two-plane development of thermo-chemical processes. As a result of the work carried out the shape of a set of measuring devices necessary for the implementation and implementation of the developed system will be defined, allowing, among others for the analysis of temperatures, gas composition or control of the correct distribution of the charge materials in the furnace throat.

The complete implementation of the project will significantly improve the efficiency of indirect reduction in the shaft of the furnace, which will translate into reduction of fuel

consumption and the consequent reduction of CO2 emissions. This will minimize the environmental impact of the process.

The devices included in this technical specification are part of the set of measuring, automation and IT devices necessary for the proper operation of the pilot installation.

1.2. CONTENT OF THE SPECIFICATION

This Specification includes information concerning the natural environment, location of the Investor in Dąbrowa Górnicza, required technical norms and standards, scope of works of the Bidder, rights of the Buyer, requirements for technical capabilities of the Bidder, preliminary schedule for the performance of works, requirements regarding availability, interchangeability, quality and safety, as well as other information required for the Technical Offer (e.g. a guarantee of operation).

2. STANDARDS, UNITS OF MEASURE, NORMS AND REGULATIONS

1) All other technical requirement must comply with the norms concerning environmental pollution, pipelines and electricity etc. as well as they should meet the engineering standards as DIN, ASME, GOST, BS i PN.
2) Building and construction designs must be based on the Polish versions of European standards.
3) Bidder's equipment and technology shall be delivered in accordance with his technological knowledge and norms generally recognized in the world and in Poland
4) Devices, materials and parts used for renovation and modernization works should meet all technical and safety standards required by the provisions of Polish law.
5) For this task, dimensions and units of the International Metric System will be used.
6) The list of legal acts in force is presented in Appendix No. 1 - Legal acts

2.1. DOCUENTATION STANDRADS

Files formats – AMP standard:
• Documents: *.doc, *.pdf, *.xls (Microsoft Word 2003, Adobe Reader, Microsoft Excel 2003);
• Schedules: *.mpp; (Microsoft Project 2003);
• Construction, mechanical documentation: *.dwg, *.dwf (AutoCAD ver. 2000 or higher, Autodesk Design Review, Model 3D – Navisworks Freedom 2018);
• Electrical documentation: *.zw1; (EPlan ver. 5.5/P8);
• Photos and images: *.jpeg;

2.2. NATIONAL AND INTERNATIONAL STANDARDS

All equipment and installations must be covered by warranty and must be executed in accordance with the valid provisions of law:

- General principles for design Risk assessment and risk reduction - PN-EN ISO 12100:2011;
- Safety of machinery. Emergency stop. Principles for design - PN-EN ISO 13850:2008;
- Machinery Directive - 2006/42/WE;
- Safety of machinery. Permanent means of access to machinery - PN-EN ISO 14122 (1-4):2010;
- Safety of machinery. Safety distances - DIN EN ISO 13857;
- Safety of machinery; minimum gaps - DIN EN 349;

- Mechanical vibrations; balances - DIN ISO 1940/1;
- Pressure Equipment Directive - 97/23/EC, PD 5500:2006, together with A3:2008;
- Low Voltage directive- 2006/95/WE;
- Fabrication/Welded Structures – DIN 8570 BF;
- Welding And Allied Processes - Recommendations For Joint Preparation - Part 1: Manual Metal-arc Welding, Gas-shielded Metal-arc Welding, Gas Welding, Tig Welding And Beam Welding Of Steels- PN-EN ISO 9692-1:2008;
- Machining – ISO 2768/IS 2102;
- Polish Civil Law;
- PN-EN for railway;
- Regulation of the Council of Ministers of November 9th, 2004, specifying the types of projects that may have significant environmental impact and the specific conditions for EIA requirement Journal of Law, No. 257, item 2573);
- § 3 .1 Decree of Ministry of Interior and Administration from June 7th, 2010 regarding fire protection of buildings as well as other objects and areas; Journal of Law no. 109, item 719;
- Dyrektywa SEVESO II
- International technical standards:
  - CEN European Committee for Standardization;
  - CENELEC European Committee for Electrotechnical Standardization;
  - DIN Deutsche Industrie Normen;
  - EN European Standard;
  - ETSI European Telecommunications Standards Institute;
  - ISO International Organization for Standardization;

In case other standards are in use different from the ones provided above, European/PN equivalents should be used in all cases

2.3. 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 Health and safety policy
ST 001 Isolation
ST 002 Confined spaces
ST 003 Working at Height
ST 004 Rail safety
ST 005 Audits
ST 006 Vehicles and driving
ST 007 Lifting equipment and operations
ST 008 Contractors
ST 009 Alert
ST 010 Safety metrics
ST 011 Incident investigation
ST 012 Working in gas hazard areas

ST 014 HIRA (Hazard Identification and Risk Assessment)
ST 015 Golden Rules
ST 018 Cargo securing
ST 201 H&S Design Specification
ST 301 Cell phones

NOTE:
In case different requirements are quoted in subsequent norms or standards compliant with those specified above, more stringent (restrictive) norms or standards shall apply!

3. ENVIRONMENT-RELATED DATA

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

4. HEALTH & SAFETY

Before starting the work, the Tenderer's representatives must obtain medical certificates confirmed by the issuance of a relevant document (Safety Passport for people performing work for AMP SA with the seal and signature of a doctor), must complete a health and safety training (Safety Manual, Operating Standards and Hazard Identification and Risk Assessment - HIRA) as well as training on fire regulations in force in a given branch of ArcelorMittal Poland SA

All employees of the Tenderer must be equipped with personal detectors for continuous measurement of the concentration of oxygen, carbon monoxide (CO) and hydrogen chloride (CH4) at each stage of the works as part of the investment.

It takes about 10 days for external companies to obtain a health and safety permit for their employees. This period should be included in the work schedule.

The procedure for obtaining the said permit is described in the Contractor's Safety Manual. During the various phases of the works, execution and delivery to the investment site in Dąbrowa Górnicza, the supplier must meet the safety requirements contained in the AMP documentation:

During the implementation of specific project phases, manufacturing and delivery to ArcelorMittal Poland S.A. Dąbrowa Górnicza Unit, the supplier has to fulfil safety requirements defined in ArcelorMittal Poland S.A. documentation:

1) Works contractors, before they start work, must receive trainings in scope of OH&S and fire protection regulations effective at AMP;
2) Works must be performed according to the technical conditions for the performance and acceptance of construction and assembly works and currently effective regulations and standards, OH&S rules and fire protection rules;
3) Regulations on personnel, vehicle and material traffic effective in the premises of AMP must be followed;
4) Works site must be secured against unauthorized third party access;
5) OH&S and fire protection for the site and works must comply with the regulations effective at AMP.
6) During each shift, at least one person trained in first aid - on behalf of the contractor
7) Work at height supervised by a camera covering the place of work (recording time 72h) and obligatorily by an observer,

8) 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 Point 1 (Investor Standards) mentioned in point 2.3.
9) In case of using forklift, jib cranes, others lifting equipment and devices, certification by Polish Technical Office UDT is a must. Others certificate are not accepted;
10) Employees, who will operate the hooks, lifting equipment must speak polish language.
11) Employees with Polish construction qualifications for the approval of scaffolding
12) 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 O2, 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.
13) The Contractor will have a H&S inspector present on site 24h/day. The inspector will be responsible for safety of the Contractor during performance of works as well as for preparation of reports from safety audits carried out jointly with AMP representatives.

5. TECHNICAL INFORMATION

5.1. AVALIBLE BASIC DOCUMENTATION

1. The documentation handed over by the Buyer may not be complete, therefore, the Bidder should base on his own inventories, examination of constructions, foundations and soil. The documentation handed over by the Buyer should not be a limiting factor concerning the commencement of works execution.

2. In the absence of archival documentation or its inconsistency with the facts, the contractor should rely on self-made inventories as well as expert opinions and technical assessments after agreeing their content with AMP.

3. AMP has a basic project on the scope of mini probes. (Attachment)

5.2. TECHNICAL INFORMATION

Operating parameters

In order to check if reactions during coke combustion and reduction of iron compounds contained in its ores are correct, the composition of blast furnace gas must be examined. Carbon (the main component of coke) and carbon monoxide (CO) as well as hydrogen (H2) generated due to the presence of water in the charge are reducing agents in this process. Slag and blast furnace gas are by-products of the process. Elements of the system installed on site are suitable for use in gas zone 1. Gas analysis cabinet is installed in the electrical control room where no gas zone is present.

- Pressure of blast furnace gas (BFG), which is a mixture of derivatives of reactions occurring in the Blast Furnace, and composition of BFG are specified within the nominal operating range of the Blast Furnace system in the table below. Nominal pressure range 3.2 bar abs. Equipment selected in a manner preventing leakage and damage at pressures up to 5.0 bar abs.
- Single-phase mixture state - gas mixture resulting from reactions occurring in the Blast Furnace

- Ambient temperature at measuring point -20 to 50°C
- Relative humidity of ambient air 79% (meteo data for Dąbrowa Górnicza)
- Protection rating required - at least IP54. Installation of gas sampling probes outdoors. Analysers installed in the eclectic control room.
- Classification Ex for measurement point 1 environment.

Process parameters of the Blast Furnace on site for minimum (min.), normal (norm.) and maximum (max) values:

Description of measurement task and process conditions on site:	
CO [%] min./**norm.**/max.	0 / **20-25** / 50
CO2 [%] min./**norm.**/max.	IBP 0 / **28-20** / 50
H2 [%] min./**norm.**/max.	0 / **5** / 10
O2 [%] min./**norm.**/max.	0 / **0** / 1
CH4 [%] min./**norm.**/max.	0 / **0** / 1
H2O [%] min./**norm.**/max.	0 / **2** / 4
N2 = 100% - (CO + CO2 + H2 + CH4 + NOx)	0 / **40-70** / 40-70
Operating temperature [degC] min./**norm.**/max.	0 / **1000** / 1100 - 1200
Pressure [bar abs] min./normal/max.	0 / **3.2** / 5
State of a single-phase gaseous mixture	Gaseous mixture with dust
Dust colour	Black (soot compounds contained)
Dust content [g/m3]	2
Water content in gas [kg/Nm3]	0.05
Ambient temperature at measuring point	-20 / 50
Classification Ex for measurement point environment	1
Length of line from the gas sampling point to sample pre-conditioning point.	40
Length of line from the pre-conditioning point to the gas analysis cabinet.	80
Installation	Rittal type cabinets
Analogue outputs	One for measured channel for gas analysis, pressure and temperature
Interface	Analogue 4-20mA, Binary and Ethernet

6. SCOPE OF WORKS

The purpose of the following technical assumptions is to present the scope of work for the turnkey installation of above-burden probes, in-burden probe, mini probes and a gas analyser for these probes along with a system for gas route switching to the analyser.

Note: Prior to the submission of the bid, it is recommended to carry out an on-site inspection.

6.1. Two above-burden probes with water spraying

Above-burden probe allows BF Operators to obtain information on Blast Furnace operating parameters such as:

- Blast furnace gas temperature
- Blast furnace gas composition

- Process gas pressure (BFG)

It is a device that collects gas samples along a radius located above the charge material and measures temperature and pressure conditions inside the furnace as well.

Knowing these parameters allows to monitor the reactions occurring in the Blast Furnace to an optimum extent: monitor furnace charging, proper distribution of material, parameters of pig iron produced, and dose fuel in an efficient manner.

6.1.1. Scope of works:

Two independent probes for measurement of composition, temperature and pressure of Blast Furnace Gas that are to be installed in the existing mounting ports constitute the subject of works.

A. Minimum parameters that each probe should meet:

a). Built-in holes for taking **eight (8) gas samples.**

b). **Eight (8) thermocouple sensors** installed for measuring temperature along the installed element.

c). Normal operating temperature: 550°C

d). Emergency operating temperature (for 10 ÷ 15 min, 5 times a year): 800°C

e). Cooling of probe body and components by means of nitrogen in a continuous manner. Dry and pure nitrogen (N2) for purging the sampling tube (gas analysis). Flow rate for each sampling line: max. 100 Nm3/h, continuous 30Nm3/h. Pressure: 7 bar abs. In order to protect the system, the Contractor shall propose to make measurements that inform and warn about incorrect operation of heat extraction and availability of cooling medium (flow rate and temperature of return gases, temperature inside the probe, pressure of return gases, other resulting from the nature of operation of equipment to be installed).

f). Installation in existing connection ports allowing retraction for inspections and potential repairs.

g). The probe must be adapted to dimensions of available port in order to ensure complete gas tightness of the blast furnace system.

h). Counterweight must be attached at the end of each probe in order to ensure that probes are balanced and to reduce stress and breaking forces as well as to enable easier removal of probe form the blast furnace. The probe itself should be designed as a self-supporting structure, supported on connectors that are load-bearing elements of the probe.

i). At the end of each probe, there must be a nozzle spraying water over the surface of material located below installed probes.

- Sprayed water should be fed through a nozzle at the end of the lance into the Blast Furnace.
- Water injection is a safety feature that must be monitored directly by the main control system. Monitoring of valve operation should be possible via the control system, supervised by the Operator of the Central Control Room (AKP)

j). It is required to select signals to monitor the parameters and the amount of injected water for spraying the material, and the availability of the water and medium system if the spraying function is not used (pressure, temperature and flow rate of water supplying each

probe for spraying). The design of the probe must guarantee resistance in connection with flow of gas and bulk materials (sinter and coke) in relation to shaft furnace charging and operating cycle, as well as effect of temperature inside the BF.

Both probes are to be mounted opposite to each other to obtain measurements of temperature and gas concentration in the entire furnace section.

B. Sampling and sample supply route

Connections for the electrical components and connectors of gas sampling route are located at the rear side of the probe to ensure service access.

The system should be mainly composed of:

- Sampling cabinet:
  - Gas route switching function
  - Switching and reverse purge for inactive gas sampling route components
  - Pre-filtering of gas sample. Coarse separation of dust fraction
  - Connectors for spraying water
  - Connectors for nitrogen for purging the gas route
  - Sensors monitoring the parameters of taken samples of blast furnace gas, nitrogen for purging, nitrogen for cooling, water for spraying
  - including connection box for power and signal cables - suitable for 8 sampling ports per probe (temperature, gas sampling, pressure)
- Gas sampling system, system for preparation and distribution of gas sample, pre-cleaned in a suitable filtering cabinet (Sampling cabinet) - adapted for 8 sampling ports per probe, thoroughly cleaned in the gas analysis cabinet. Unit for conditioning parameters of gas taken in order to ensure trouble-free operation of the entire system.

The system should meet the following requirements:

a) Each thermocouple sensor should be positioned and mounted in such a way as to ensure thermal resistance and to reduce risk of mechanical damage and the effect of abrasion with materials located in the furnace (dust carried by the blast furnace gas).

b) Gas route should enable reverse blow-off to eliminate the possibility of clogging.

c) Route of individual gas sample should be purged after the sampling cycle is completed. The first unclogging impulse should be made with high pressure of nitrogen. Once the route has been cleaned, overpressure of nitrogen should be generated before it can be reused in order to prevent dust or gas from entering a given section of the gas sampling route.

d) Components of gas sampling route are also used to measure the pressure at each sampling point during the switching cycle. One (1) measurement of overpressure inside the Blast Furnace should be made during gas sampling. Pressure measurement should be fitted with a valve system allowing for cutting off the measurement during purging with nitrogen and a manual valve allowing for disassembly. The installation should ensure isolation of pressure transducers from the temperature of blast furnace gases and dust that could accumulate in the elements involved in the pressure measurement. If necessary, system for purging the impulse tube with nitrogen, ensuring that the remaining dust is blown off and that the measuring route is unobstructed, should be installed.

e) Gas sampling system should be equipped with a main switching station and station for pre-conditioning of samples taken for further analysis in the gas analyser adjusted to measured values to obtain the highest possible accuracy for components subject to testing. Gas analysis system should be installed as close as possible to shorten the response and measurement time.

f) All elements of gas sampling system which are involved in the gas sample transmission are to be heated in order to eliminate the potential danger of condensate accumulation.

g) The entire cycle of measurement and purging should be done fully and automatically by means of system of analyser and programmable controller connected to the process network of ArcelorMittal Poland, Unit in Dąbrowa Górnicza.

h) The system should be suitable for operation:
   - Automatic: Once the initial conditions have been confirmed, the "automatic cycle start" command is triggered; measurement sequence for supplying gas samples one after the other from each sampling port in the specified order is released and activated.
   - Manual: Manual sampling operation from local control station or from the BF control room should depend on the existing configuration, and sub-sequences for automatic sampling are to be initiated by push-buttons during the manual sampling operation, i.e.:
     - calibration of gas analysers
     - activation of sampling

     Manual sampling sequence from probes should be described in the functional description

The scope of Automation (PLC, programming, SCADA visualisation in the Central Control Room of BF2, control cabinet, wiring, other necessary equipment) should be implemented as per the rules described in the Appendices:
Appendix 8 - Automation and IT Requirements
Appendix 5 - AIM Addendum to tender - automation system requirements PL V12

C. Scope of supplies/works

a. Basic engineering

- Inventory of the existing state on the basis of basic documentation - the Contractor is responsible for verification of basic documentation
- Basic documentation and functional description of technical solution concerning mechanical, electrical and automatic range (flowchart, piping and instrumentation diagram (P&ID) etc.)
- Installation and maintenance instructions. Specifications of the equipment used.
- Basic information on the location of equipment and connections to TOP points
- Documentation should be prepared in accordance with the standards set forth in this Technical Specification
- Adaptation of the system to the existing mounting connections

b. Detail engineering

- Assembly documentation, detail drawings of required system elements (supports, piping, platforms etc.)
- Electrical and automatic documentation should be provided in an open form with access codes.
- Wiring diagram, list of cables and terminal diagrams - EPLAN P8 2.7
- Full documentation necessary for prefabrication, assembly, acceptance and technical maintenance of the completed system.

c. Supplies

The Contractor shall manufacture (based on approved technical documentation) and provide the equipment described in detail in items **A and B** above, including:

- Two probes with a system for taking gas and temperature samples
  - Gas sampling ports
  - Temperature measuring devices
  - Nitrogen cooling system
  - Nitrogen purging system
  - Water injection nozzle
- Control cabinet, electrical cabinet, transducers and other necessary devices and accessories to enable proper operation of the system,
- Hose - heated and regulated to 180°C over the required length, in the required factory-adapted lengths
- Sampling and filtering cabinet
- System for taking, preparing and distributing gas samples
- PLC software

d. Disassembly

- The Contractor shall dismantle the existing above-burden probes
- The Contractor shall perform disassembly of all elements of above-burden probes that will not be used in the operation of the new probe system

e. Assembly

- The Contractor shall propose safe and efficient method of installing equipment that will not endanger persons working at the lower levels of furnace at the same time.
- The Contractor shall carry out assembly works in accordance with the technical design.
- The Contractor shall implement all systems necessary for proper operation of the measuring equipment (gas, water, hydraulic, electric system etc.) on the basis of technical documentation approved by AMP.
- The Contractor shall install all platforms required for the operation of measuring equipment and associated systems - in case the equipment are installed in a different place than provided for in this technical specification.
- The Contractor shall deliver and install all materials shown in the lists of materials in accordance with technical documentation approved by AMP, which may include:

– Any modifications to the existing structures/platforms etc. - according to the bill of materials.
– New structures/platforms - according to the bill of materials

- Flanges according to the bill of materials
- Cooling: piping (supply and return) from / to the supply system at BF point to take-over point (TOP) and nitrogen emergency cooling - according to the bill of materials.
- Electric cables, cable routes according to the bill of materials
- Piping system (hydraulic, pneumatic, lubrication) between system units.
- Modification/repair of refractory materials limited to project requirements.

f. Supervision/training/start-up

The Contractor shall perform tests confirming the efficiency and correctness of measuring equipment installation. Described in item 10 of this specification.

Acceptance tests will be deemed positive if the guaranteed parameters included in item 15 of technical specification are achieved.

The Contractor shall provide necessary training to the AMP team in the operation and maintenance of the above-burden probe system

The Contractor shall provide adequate supervision of all works carried out under the project and shall act as the Site / Works Manager. It shall also provide an OHS Inspector on its part to be present at all times during the works

6.2. One (1) in-burden probe

The main task performed by the in-burden probe is to measure the temperature, pressure, and gas temperature (CO, CO2, O2, H2, CH4, H20 and N2) inside the burden material in the shaft across the Blast Furnace radius. TMT (Tapping Measuring Technology) BF/05/L.O.I (51-00081) is the currently installed in-burden probe system.

A. Basic scope of works

The basic scope comprises the design, delivery, disassembly, assembly and start-up of measuring lance that will meet the following requirements:

a) Water cooling of probe

b) Shape - oval cross-section with screwed-on cross flaps

c) Made of heat-resistant and wear-resistant materials

d) Cross head with guide rollers

e) Probe is a movable element with a special measuring head comprising the following elements:

- Sheathed thermocouples, NiCr-Ni, 12m long, to be assembled in the measuring tube, for indicating temperatures up to 1100°C
- Cooling with 30 m³/h cooling water and 3 bar pressure at the probe level. Emergency temperature alarm. Measurement of water parameters indicating failure of the cooling system. Pressure, flow and temperature measurement.
- Measuring position limit switches for in-burden probe (min. 8)
- Cooling water control system, temperature and flow measurement in the return line, seamless pipes, stainless steel
- Limit switches for end positions of the lance (2).
- Grease distribution systems (double centreline type),

- Installation of encoder to determine the exact position of lance in relation to the traction insert system (furnace recesses) and to enable determination of sampling position in a variable manner, set via the master system
- reverse engineering of the controller software for the operation of the in burden probe in order to ensure the correct operation of the devices, probe entry / exit should be completed by Bidder

B. Sampling and sample supply route

Sampling system and sample supply system shall meet the following requirements:

- The sampling line must constitute an 'insulated electric heating system with thermostat'
- Connections are to be made of stainless steel.
- Collected and conditioned sample must be transferred to the main analyser panel by the local cleaning unit.
- Gas conditioning cabinet should be located in close proximity to the in-burden probe, but no more than 5 to 10 meters from the sampling port.
- Conditioning and filtering unit should be controlled via solenoid valves installed in the cleaning box, and the common line should be run to the main panel out to the switching station common to in-burden probe, above-burden probes and multi-point vertical probe.
- The filtering system should be equipped with elements for monitoring the quality status of filtered process gases and checking if the gas route to the analyser is not clogged.
- Valves controlling the pneumatic supply to the inflatable gate valve seal should be integrated in a separate cabinet.
- The Contractor should, as far as possible, provide for the use of elements of the existing system, including replacement elements that are available on the market.
- Piping material: stainless steel
- Electrical equipment connected to terminal boxes on the machine, ready for operation.
- reverse engineering of the controller software for in-burden probe operation in order to ensure correct operation of the equipment, probe entry/exit.

Temperature measurement:

- Temperature measurement devices for measuring gas temperature in the blast furnace shaft.
- Temperature is measured by a thermocouple built into the lance protective tube allowing servicing and replacement with the minimum involvement of the service team
- Measuring signal should be sent to the control system via the PLC controller.

C. Scope of supply:

a) Basic engineering

- Inventory of the existing state on the basis of basic documentation - the Contractor is responsible for verification of basic documentation

- Basic documentation and functional description of technical solution concerning mechanical, electrical and automatic range (flowchart, piping and instrumentation diagram (P&ID) etc.)
- Installation and maintenance instructions. Specifications of the equipment used.
- Basic information on the location of equipment and connections to TOP points
- Documentation should be prepared in accordance with the standards set forth in this Technical Specification
- Adaptation of the lance and instrumentation to the existing mounting connections

b) Detail engineering

- Assembly documentation, detail drawings of required system elements (supports, piping, platforms etc.)
- Electrical and automatic documentation should be provided in an open form with access codes.
- Wiring diagram, list of cables and terminal diagrams - EPLAN P8 2.7
- Full documentation necessary for prefabrication, assembly, acceptance and technical maintenance of the completed system.

c) Supplies

The Contractor shall manufacture (based on approved technical documentation) and provide the equipment described in detail in items **A, B** above, including:

- Lances of in-burden probe with a system for collecting gas composition and temperature profiles
  - Gas sampling ports
  - Temperature measurement port
  - Temperature measuring devices
  - Water cooling system
- Measuring position limit switches for in-burden probe (min. 8)
- Limit switches for end positions of the lance (2).
- Grease distributor systems
- Installation of encoder to determine the exact position of lance in relation to the traction insert system (furnace recesses) and to enable determination of sampling position in a variable manner, set via the master system.
- Control cabinet, electrical cabinet, transducers and other necessary devices and accessories to enable proper operation of the system,
- Hose - heated and regulated to 180°C over the required length, in the required factory-adapted lengths
- Sampling and filtering cabinet
- System for taking, preparing and distributing gas samples
- PLC software

d) Disassembly

- The Contractor shall dismantle the existing above-burden probes
- The Contractor shall perform disassembly of all elements of in-burden probe that will not be used in the operation of the new system.

e) Assembly

- The Contractor shall propose safe and efficient method of installing equipment that will not endanger persons working at the lower levels of furnace at the same time.
- The Contractor shall carry out assembly works in accordance with the technical design.
- The Contractor shall implement all systems necessary for proper operation of the measuring equipment (gas, water, hydraulic, electric system etc.) on the basis of technical documentation approved by AMP.
- The Contractor shall install all platforms required for the operation of measuring equipment and associated systems - in case the equipment are installed in a different place than provided for in this technical specification.
- The Contractor shall deliver and install all materials shown in the lists of materials in accordance with technical documentation approved by AMP, which may include:

– Any modifications to the existing structures/platforms etc. - according to the bill of materials.
– New structures/platforms - according to the bill of materials
– Flanges according to the bill of materials
– Cooling: piping (supply and return) from / to the supply system at BF point to take-over point (TOP)
– Electric cables, cable routes according to the bill of materials
– Piping system (hydraulic, pneumatic, lubrication) between system units.
– Modification/repair of refractory materials limited to project requirements.

f) Supervision/training/start-up

The Contractor shall perform tests confirming the efficiency and correctness of measuring equipment installation. Described in item 10 of this specification.

Acceptance tests will be deemed positive if the guaranteed parameters included in item 15 of technical specification are achieved.

The Contractor shall provide necessary training to the AMP team in the operation and maintenance of the above-burden probe system

The Contractor shall provide adequate supervision of all works carried out under the project and shall act as the Site / Works Manager. It shall also provide an OHS Inspector on its part to be present at all times during the works

6.3. Three mini probes / mini measuring probes

The functionality of a mini probe is similar to that of above-burden probes.

Mini probe allows BF Operators to obtain information on BF operating parameters such as blast furnace gas temperature and composition, pressure inside the BF.

It is a device that takes gas samples along a radius above the charge material and measures temperature as well.

A. Scope of delivery - mini probes:

Three independent probes for gas and temperature measurement. Each probe with built-in holes for taking **two (2) gas samples** and **two (2) thermocouple sensors** for measuring the temperature along the installed element.

Nitrogen-cooled probe body with components, seated in (existing) connection ports allowing for its retraction for inspection and potential repair.

Connection port should be adjusted to probe dimensions in order to ensure complete gas tightness of the blast furnace system. Counterweight must be attached at the end of each probe in order to ensure that probes are balanced and to reduce stresses and breaking forces as well as to enable easier removal of the probe from the Blast Furnace.

Probes are be installed on Blast Furnace 'quarters', in the areas indicated in connection with the Blast Furnace shell stress analysis. The location of probes shall supplement the measurements of in-burden probe in the other quarters.

The probe itself should be made as a self-supporting structure, supported by structural elements of the furnace shell.

Design of the probe must guarantee resistance to flow of gas and bulk materials (sinter and coke) in connection with shaft furnace charging and operating cycle.

Mini probes should be mounted on existing connection ports (made by AMP).

Connections for the electrical components and connectors of gas sampling route are located at the rear side of the probe to ensure service access.

Each thermocouple sensor should be positioned and mounted in such a way as to ensure thermal resistance and to reduce risk of mechanical damage and the effect of abrasion with materials located in the furnace (dust carried by the blast furnace gas).

B. Scope of supply - sampling and sample supply route

Gas route should enable reverse flow to eliminate the possibility of clogging of individual sampling tubes. Route of individual gas sample should be purged after the sampling cycle is completed.

The first unclogging impulse should be made with high pressure of nitrogen. Once the route has been cleaned, overpressure of nitrogen should be generated before it can be reused in order to prevent dust or gas from entering a given section of the gas sampling route.

Components of gas sampling route are also used to measure pressure at each sampling point. Pressure measurement should be fitted with a valve system allowing for cutting off the measurement during purging with nitrogen.

The installation should ensure cut-off of pressure transducers from the temperature of blast furnace gases and dust that could accumulate in the pressure measurement intermediary components.

Gas-sampling system of each probe should be equipped with a switching station and a station for pre-conditioning of samples taken for further analysis in the gas analyser adjusted to measured values to obtain the highest possible accuracy for components subject to testing.

Each switching station as part of mini probes.... Gas analysis system should be installed as close as possible to shorten the response and measurement time.

All elements located outside the furnace must be heated to eliminate the potential risk of condensation accumulation.

The entire cycle of measurement and purging should be done fully and automatically by means of system of analyser and programmable controller connected to the process network of ArcelorMittal Poland, Unit in Dąbrowa Górnicza.

Due to the need to use a programmable controller, the requirements specified in the attached AIM specification must be followed in order to be able to run the system and achieve full functionality.

C. Scope of supply

a) Basic engineering

- Inventory of the existing state on the basis of basic documentation - the Contractor is responsible for verification of basic documentation
- Basic documentation and functional description of technical solution concerning mechanical, electrical and automatic range (flowchart, piping and instrumentation diagram (P&ID) etc.). AMP shall provide conceptual documentation for the design of mini probes and their locations.
- Installation and maintenance instructions. Specifications of the equipment used.
- Basic information on the location of equipment and connections to TOP points
- Documentation should be prepared in accordance with the standards set forth in this Technical Specification
- Adaptation of mini probes and instrumentation to the existing mounting connections

b) Detail engineering

- Assembly documentation, detail drawings of required system elements (supports, piping, platforms etc.)
- Electrical and automatic documentation should be provided in an open form with access codes.
- Wiring diagram, list of cables and terminal diagrams - EPLAN P8 2.7
- Full documentation necessary for prefabrication, assembly, acceptance and technical maintenance of the completed system.

c) Supplies

The Contractor shall manufacture (based on approved technical documentation) and provide the equipment described in detail in items **A, B** above, including:

- Three mini probes with a system for taking gas and temperature samples
  - Two gas sampling ports - each
  - Two temperature measurement ports - each
  - Nitrogen cooling system
- Control cabinet, electrical cabinet, transducers and other necessary devices and accessories to enable proper operation of the system,
- Hose - heated and regulated to 180°C over the required length, in the required factory-adapted lengths
- Sampling and filtering cabinet
- Gas sampling, gas sample preparation and distribution system - separate for each probe
- PLC software

d) Disassembly

- The Contractor shall dismantle the existing above-burden probes
- The Contractor shall perform disassembly of all elements of in-burden probe that will not be used in the operation of the new system.

e) Assembly

- The Contractor shall propose safe and efficient method of installing equipment that will not endanger persons working at the lower levels of furnace at the same time.
- The Contractor shall carry out assembly works in accordance with the technical design.
- The Contractor shall implement all systems necessary for proper operation of the measuring equipment (gas, water, hydraulic, electric system etc.) on the basis of technical documentation approved by AMP.
- The Contractor shall install all platforms required for the operation of measuring equipment and associated systems - in case the equipment are installed in a different place than provided for in this technical specification.
- The Contractor shall deliver and install all materials shown in the lists of materials in accordance with technical documentation approved by AMP, which may include:

– Any modifications to the existing structures/platforms etc. - according to the bill of materials.
– New structures/platforms - according to the bill of materials
– Flanges according to the bill of materials
– Cooling: piping (supply and return) from / to the supply system at BF point to take-over point (TOP)
– Electric cables, cable routes according to the bill of materials
– Piping system (hydraulic, pneumatic, lubrication) between system units.
– Modification/repair of refractory materials limited to project requirements.

f) Supervision/training/start-up

The Contractor shall perform tests confirming the efficiency and correctness of measuring equipment installation. Described in item 10 of this specification.

Acceptance tests will be deemed positive if the guaranteed parameters included in item 15 of technical specification are achieved.

The Contractor shall provide necessary training to the AMP team in the operation and maintenance of the above-burden probe system

The Contractor shall provide adequate supervision of all works carried out under the project and shall act as the Site / Works Manager. It shall also provide an OHS Inspector on its part to be present at all times during the works

6.4. Gas composition analyser for above-burden probes, in-burden probe and mini probes - gas analysis system

Due to the need to use a programmable controller, the requirements specified in the attached AIM specification must be followed in order to be able to run the system and achieve full functionality.

Above-burden / in-burden probe analyser with gas sample preparation system and filters for measuring CO/CO2/O2/H2/CH4/H2O/N2, adapted to the sampling system.

In order to check if reactions during coke combustion and reduction of iron compounds contained in its ores are correct, the composition of blast furnace gas must be examined. Carbon (the main component of coke) and carbon monoxide (CO) as well as hydrogen (H2) produced by the presence of water in the furnace charge are reducing agents in this process. Slag and blast furnace gas are by-products of the process.

A. Central gas route switching station

a) Sampling system in the form of a switching station supplied with process gases taken from elements at the points of above-burden probes, in-burden probe, above-burden mini probes, multi-point vertical probe (MPVP). MPVP shall be implemented in another project task. MPVP probe shall be responsible for measuring temperature and pressure and for taking gas sample for gas analyser. The sampling system should be prepared for gas sampling and connections for ten future temperature measurements, and pressure measurements.

b) Gas samples should be continuously collected by a probe with filtration and reverse blow-off system. The system should be designed in such a way to continuously collect gas via one selected gas route/path combination. Inert gas (nitrogen) overpressure should be generated in other elements that are not involved in the sampling process at a given moment.

c) Breakdown of gas route elements and functional grouping:

- Above-burden probe #1 – eight gas route connection ports (sampling device side), intermediate switching gas station, one output point to the main switching station
- Above-burden probe #2 – eight gas route connection ports (sampling device side), intermediate switching gas station, one output point to the main switching station
- In-burden probe - one gas route connection port (sampling device side), in connection with gas sampling along the BF radius, samples are to be supplied every specified distance, one output point to the main switching station
- Above-burden mini probe #1 - two gas route connection ports (sampling device side), one output point to the main switching station. Gas route output should be executed as an intermediate switching valve station enabling a gas sample to be taken through one gas route, with simultaneous pressure measurement with the other gas route port. After the end of the cycle, the pressure measurement function should be interchanged with the gas sampling function. After completion of the measurement, the system should be purged, with a constant overpressure built up.
- Above-burden mini probe #2 - two gas route connection ports (sampling device side), one output point to the main switching station. Gas route output should be executed as an intermediate switching valve station enabling a gas sample to be taken through one gas route, with simultaneous pressure measurement with the other gas route port. After the end of the cycle, the pressure measurement function should be interchanged with the gas sampling function. After completion of the measurement, the system should be purged, with a constant overpressure built up.
- Above-burden mini probe #3 - two gas route connection ports (sampling device side), one output point to the main switching station. Gas route output should be

executed as an intermediate switching valve station enabling a gas sample to be taken through one gas route, with simultaneous pressure measurement with the other gas route port. After the end of the cycle, the pressure measurement function should be interchanged with the gas sampling function. After completion of the measurement, the system should be purged, with a constant overpressure built up.

- Multi-point vertical probe (device supplied in connection with other scope of works) - one gas route connection port (sampling device side), one output point to main switching station
- Main switching station - Input side that guarantees the formation of a continuous gas sampling route for elements in the above scope, including the following:
  - Seven input points (above-burden probes, in-burden probe, mini probes and multi-point probe)
  - Process connection allowing to connect standard gases to the analyser in order to check the calibration along the sampling section
  - Gas route output of the gas analysis cabinet shall be made in redundant form, cyclically switched. Sampling on one route means that the other is purged with nitrogen and/or constant overpressure after purging is generated in it
  - Equipped with the first stage of filtration
  - Gas flow monitoring
  - Gas pressure monitoring
  - Gas temperature monitoring
  - Monitoring of filtration system clogging
  - Reducer of pressure and flow of necessary amount of gas
  - Heated elements guaranteeing that the temperature is maintained to prevent the formation of condensation (+150 … +180°C)
  - Possibility of automatic (cyclically set) or manual selection of gas route in the operating cycle for each route (independent determination of the sampling impulse, determination of sequence in the cycle, remaining purge time, determination of the minimum purge time)

d) After pressure reduction, gas sample shall be transported continuously to the analyser where the second filtration level shall be located.

e) Laser analyser that does not require regular calibration

f) Valve system installed in the gas analysis cabinet allowing for automatic switching of auto-calibration route and/or checking by means of standard gases:

- Activation of auto-calibration manually
- Activation of auto-calibration automatically
- Determination and activation of auto-calibration switching cycle
- System for monitoring the amount of standard gases connected and the need to replace cylinders with standard gases

B. Gas analyser

Gas analyser should meet the following parameters:

a) Measurement of CO/CO2/O2/H2/CH4/H2O/N2
   - 15-35% vol. CO

- 0-25% vol. CO2
- 0 - 1 % vol. O2
- 0 - 10 % vol. H2
- 0 - 1 % vol. CH4
- 0 - 5 % vol. H2O
- 40 – 70 % vol. N2

b) Possibility of supplying standard gases directly to the analyser as well as at the level of sampling probe - additional manual valve system
c) Due to the research nature of the projects, it is necessary to be able to change the threshold values for measured values (dual-range operation of the analyser, or free change of MAX and MIN threshold values of measured gas concentrations)
d) installation of gas analyser together with sample preparation station and upgrade of sample supply route (prefabrication of gas analysis cabinet at the contractor of system)
e) The sampling system should be duplicated to ensure measurement redundancy and reliability between the switching station and connection of gas analysis cabinet with the possibility of cyclic or manual switching of gas route operation. In addition, the unused gas route should be purged with nitrogen during shutdown. After purging a section, the system should be filled with gas for purging with constant overpressure generated, monitored by means of a pressure switch.
f) Measurements of all components in one enclosure
g) suitable for measuring flammable and toxic gases
h) Measuring method: Optical Feedback Cavity Enhanced Absorption (OF-CEAS)
i) use of self-monitoring function to indicate the need for maintenance intervention
j) integrated internal auto-calibration cell or function cell with standard gas to eliminated the need for use of standard gases
k) digital inputs/outputs with possibility of expansion
l) RS485 / Ethernet communication port
m) Gas sample pressure in the range 0.5 to 1.5 bar
n) Power supply 230V 50Hz
o) Measurement of CO/CO2/O2/H2/CH4/H2O/N2:
p) Sampling method: extraction
q) Analogue output 4-20mA for each measured component
r) Relay outputs for monitoring device status
s) Checking the analyser zero point by connecting inert gas, at the analyser itself. In addition, the use of pure nitrogen at the in-burden and above-burden probes in order to check the integrity of sampling route. Checking shall be done using an additional function triggered by the master system operator - on demand
t) Process gas connectors including valve system for annual testing with standard/test gas and inert gas
u) Gas flow measured between 5 – 20 l/h. It should be possible to throttle the excess volume of gas. Volume of flow required for proper analysis with alarm thresholds for minimum and maximum values exceeded.
v) Filtration system to protect the analyser and measuring cell from contamination, including system to monitor clogging of gas sampling route. There are soot compounds in the gas which can contaminate the filtration system

w) Set of necessary connectors
x) complete and installed gas analysis cabinet enabling proper functioning of gas analyser (prefabrication at the supplier)
y) Complete and installed intermediate gas transmission elements along the entire length of the system
z) Linearity: 1% of the range
aa) Repeatability: 1% of the smallest measuring range

C. Scope of works

- Supply of modular gas analysis system - Analyser
- Delivery and installation of gas transmission system routes, heated along the entire length. Switching-intermediate elements with maintaining the set temperature of gas sample (150 – 180°C).
- Built-in pump for supplying measured or standard gas to analyser cell in case of insufficient overpressure in the Blast Furnace
- Flow detector for monitoring abnormal gas flow rate
- Additional shut-off valves, pressure reducing elements
- Connection for standard/test gases outside gas analysis cabinet
- Delivery/feeding of standard gases should be also possible at the sampling point and at gas route switching stations
- Standard gases are to be stored and permanently connected in the gas analysis room. Condition and quantity of standard gases required for monitoring
- Auto-calibration and auto-checking function can be performed using standard gases in a cyclic manner or remotely at the operator's command.
- Linearity: 1% of the range
- Repeatability: 1% of the smallest measuring range
- Accuracy (abs) of the gas analyser 0,01%

6.5. Analysis system - Additional information

6.5.1. Gas analysis system is to be installed and supplied in a cabinet together with the necessary electrical equipment.

Estimated length of gas analysis heating hoses:

- Up to 40m - connection between sampling device and switching station for each unit separately (in-burden probe, above-burden probes). Additional heating hoses between above-burden probes and local switching box depending on the installation location
- Up to 80m - redundant route between the switching (main) station and gas analysis cabinet.

The diagram below is given for illustrative purposes. The Supplier shall analyse the possibility of installing optimal gas sample switching system in terms of system complexity as well as guarantee the number of samples to be taken

Fig. Proposed gas route based on the current system

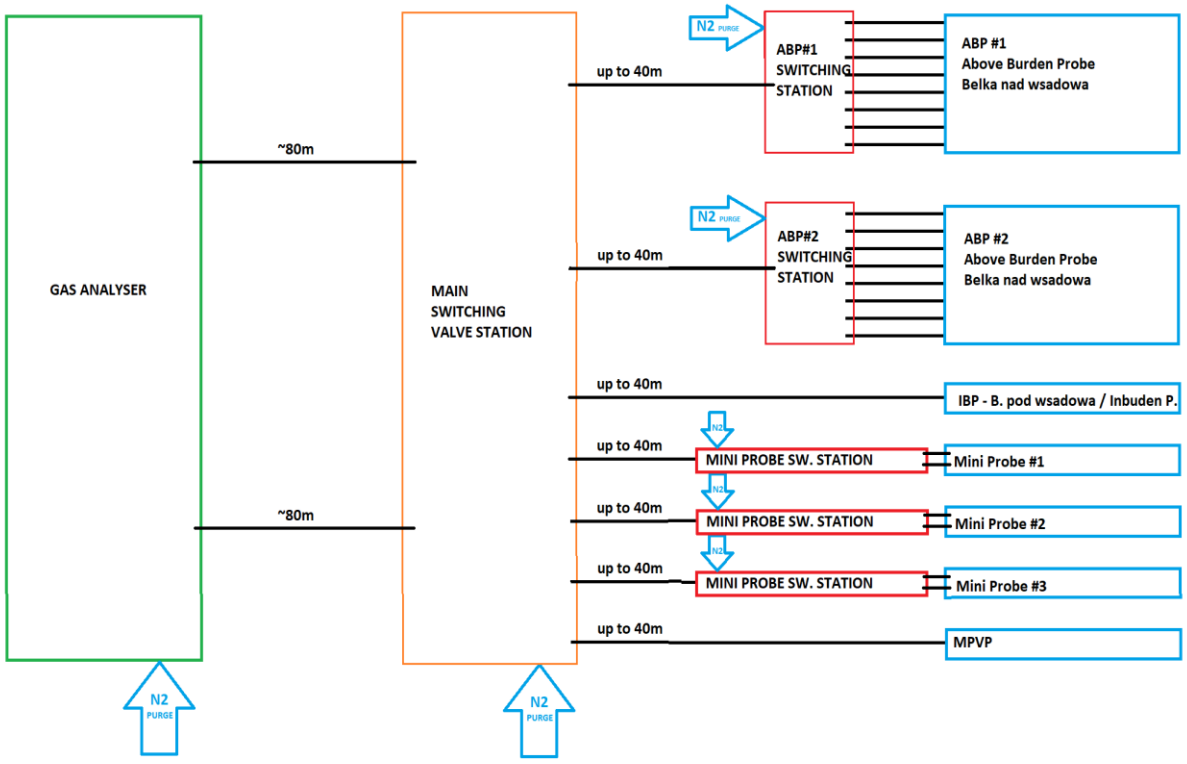

Fig. Proposed gas route based on the current system

Protection rating should be selected according to the positioning of elements involved in the operation of the system for temperature and pressure measurement, and gas analysis with the possibility of installation in the first gas zone (EX 1 zone for all elements installed at the facility). Due to possible dust, it should be possible to connect nitrogen purging for elements involved in the measurements of components in order to generate overpressure. In addition, nitrogen used should be measured in order to create a component of balance of media introduced into the BF depending of location of installed equipment.
In-burden probe, two above-burden probes, three mini probes, gas sample switching system, elements of electrical system, elements of probe temperature measurement, sampling route along the entire length as the complete measurement system, consistent throughout the entire installation range controlled by a master controller.

- Atmosphere monitoring equipment in the gas analysis cabinet and rooms designated for the installation of system components for toxic gases which are dangerous to human health and life in connection with the gases sampled.
- Monitoring of ambient conditions in the cabinet/container by means of analogue measurements (temperature, pressure, toxic gases)
- Monitoring of electrical protection tripping parameters and power supply parameters in the form of status signals
- Connection and adjustment of the existing heated hose and sampling. If it is not possible to use the existing heating line between the main switching station and analyser, new route, taking into account necessary redundancy of the gas path, should be installed
- Equipping the gas analysis cabinet with the elements necessary for monitoring the parameters of a gas sample taken.

- Supplied auxiliary utilities (water, nitrogen, electric energy) measured on a continuous manner, additional impulse
  - Cooling water flow rate, pressure, temperature - system for monitoring input and output to each cooled unit individually in order to eliminate potentially dangerous and uncontrolled water leaks into the Blast Furnace.
  - Flow rate, pressure, temperature of water injected into the Blast Furnace using individual above-burden probes.
  - Flow rate, pressure of nitrogen for cooling and purging for individual sampling points. (two above-burden probes, in-burden probe, three mini probes, switching station, gas analysis cabinet, other acceptances). Measurement necessary to obtain balance of nitrogen introduced additionally during the measurement

6.5.2. Programmable controller and electrical equipment:

The supplier shall provide a programmable controller along with a functional description. Installation and delivery with a new control cabinet in place of the currently used measurement control system inside the furnace. The controller should be able to handle all valve system responses for gas route switching, generation of overpressure with nitrogen and purging. The main tasks to be ensured by the system are free switching and supervision of measurement route switching cycle as well as possible selection by the operator of the elements used.

Main process components measured are as follows:

- Three mini probes:
  - Temperature in the furnace for each of the measuring points
  - Pressure in the furnace
  - Delivery of gas sample to the analyser
  - Monitoring of media cooling the system - balance
  - Monitoring of media purging the system - balance
- Two above-burden probes
  - Temperature in the furnace for each of the measuring points
  - Pressure in the furnace
  - Delivery of gas sample to the analyser
  - Monitoring of media cooling the system - balance
  - Monitoring of media purging the system - balance
- In-burden probe
  - Temperature in the furnace for each of the measuring points
  - Pressure in the furnace
  - Delivery of gas sample to the analyser
  - Monitoring of media cooling the system - balance
  - Monitoring of media purging the system - balance

  - As far the in-burden probe is concerned, the control system is also subject to upgrade due to the delivery of new components. Upgraded

- MPVP – Vertical probe. MPVP probe - to be delivered later on - will be adopted by AMP. The gas sampling system and the future control system should enable the connection of this probe at a later date. Controller, electrical installation should provide for a reserve as in the case of above-burden probe in order to connect electrical signals at a later date.
  - Temperature in the furnace for each of the measuring points
  - Pressure in the furnace
  - Delivery of gas sample to the analyser
  - Monitoring of media cooling the system - balance
  - Monitoring of media purging the system - balance
  - As far the in-burden probe is concerned, the control system is also subject to upgrade due to the delivery of new components. Upgraded
- Switching station:
  - Temperature in the furnace for each of the measuring points
  - Pressure in the furnace
  - Delivery of gas sample to the analyser
  - Monitoring of media cooling the system - balance
  - Monitoring of media purging the system - balance
  - Monitoring of valves allowing to switch gas route at the optimum time of furnace operation.
  - Monitoring of system flow capacity (clogging)
- Other control and measurement elements resulting from the entire measuring system

It is also necessary to perform reverse engineering of the controller software on the basis of the existing controls of gas route switching system, conditioning, collection of process measurement values, measurement values for correct operation of the equipment, entry/exit of the in-burden probe, maintaining correct operating parameters of the entire system.

The existing retraction element of the in-burden probe together with the hydraulic system should be also adapted as part of the controller.

To provide a possibility of local control, a touch panel (consistent with the guidelines) should be provided at the gas analyser

The scope of Automation (PLC, programming, SCADA visualisation, control cabinet, wiring) should be implemented as per the rules described in the Appendices:

Appendix 8 - Automation and IT Requirements

Appendix 5 - AIM Addendum to tender - automation system requirements PL V12

Additional information:

a. The attached drawings from the conceptual documentation are indicative only; however, AMP accepts deviations from the solutions described in the study provided that the new solution will achieve the project objectives, performance parameters and adaptations to the standards used in AMP.

b. The Contractor is required to provide services of an interpreter who should be present on site during the entire disassembly / installation / commissioning phase (24/7).

c. Storage of material. The Contractor is responsible for the storage and safety of materials supplied. AMP can provide open space based on the requirements given. The contractor may prepare a temporary storage area by mutual agreement with AMP.

d. Pre-assembly and prefabrication area - to be agreed with AMP.

e. Enclosure of all electrical and switching cabinets using monitored overpressure with nitrogen to prevent the ingress of dust.

f. Dismantling of current devices. All disassembled elements should be handed over to maintenance services

7. OFFER-RELATED REQUIREMENTS

7.1. Technical offer should include:

1. General description and information about the service offered;
2. Scope of works under the bid (with defined quantity);
3. List of elements/works and quantity;
4. Exclusions (work to be performed by the buyer);
5. Offer will contain detailed responsibility matrix between ArcelorMittal and Contractor with division on engineering, materials delivery, dismantling, assembly, tests and commissioning for particular chapters in offer to be sure, that both parties have the same understanding of scope;
6. Contractor is obligated to secure all necessary heavy equipment (cranes; forklifts; excavators; etc.)
7. Contractor is obligated to deliver logistics plan and layout of works including all crane operations. Possible crane location areas will be defined by AMP.
8. Necessary drawings
9. Works schedule on a weekly basis and daily basis (for installation and commissioning period) with the milestones;
10. Confirmation of guaranteed parameters;
11. Performance Guarantee Test procedure (proposal for AMP approval before Contract)
12. Quality Control Plan
13. References (buyer's name, location, value and year);
14. List of potential sub-contractors for AMP approval;
15. List of utility media requirements with parameters (nitrogen, oxygen, compressed air, instrument air, service water, steam, etc.)
16. Spare parts list for two years of normal operation and commissioning
17. Declaration that Contractor's knowledge, experience and site visit are sufficient to perform the whole scope of work;

18. Declaration that the whole scope of work will comply with good construction practices and with the effective law;
19. Bid validity period;
20. The Tenderer will provide references or his own declaration regarding the delivery of the installations described in the Technical Specification. (buyer name, location, year) - during the last 10 years
21. Other information disclosed by the Contractor which does not include any cost data that could influence the quality of the offer.

7.2. 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.

7.3. The offer must contain a description of how the work will be organized, together with the anticipated human resources, heavy equipment for specific work groups. The contractor will present a plan for the organization of works, including places of work and storage of structural elements

7.4. 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.

7.5. Indication of subcontractors or partners in the case of a consortium, together with an indication of the relevant work packages

7.6. 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.

8. REQUIRED CONTENT OF THE TECHNICAL DOCUMENTATION SUPPLIED BY SERVICE PROVIDER

1. Preparation of the complete designs: technical, executive and post-completion designs of the converter in the full scope and in all branches (taking into account purchasing, deliveries, unloading activities (including local), dismantling, assembling and others) for all necessary components in accordance with the technical data and basic requirements included in these technical conditions as well as technological knowledge and the experience of the bidder;
2. Complementary documentation, drawings of the systems and auxiliary facilities (supporting structures, piping, valves, TOPs, fittings and automation etc.);
3. The engineering shall include solutions which meet safety standards valid in AMP (anchoring points, barriers, platforms, lighting, markings visible to the crane operator etc).
4. Making of the inventory of the existing documentation and the post-completion documentation versus the documentation stored in the archive;
5. Providing the author's supervision including consultations on the construction site, additional drawings, sketches and oral explanations (number of hours to be provided).
6. Expertise and construction arrangements (if necessary);
7. Arrangements and possible consultations in the state offices for example obtaining all necessary acceptance by UDT(if necessary);
8. In the absence of archival documentation or its inconsistency with the facts, the contractor should rely on self-made inventories as well as expert opinions and technical assessments after agreeing their content with AMP.
9. Markings of all the installed elements as per WCM requirement (World Class Manufacturing)

10. Energy cut-off points compliant with LOTO system and AMP standard – Isolation,
11. Preparing and arranging, together with ArcelorMittal Poland, the schedule, BIOZ plan (Safety and Health Protection), POR (Works Execution Plan);
12. The bidder shall submit to ArcelorMittal Poland SA, by the date agreed on together, the complete working documentation and as-built documentation in the soft version (electrical documentation in EPlan p8 2.7, the rest in AutoCad in 3D (three-dimensional) + .pdf) and 3 sets of hardcopies and e-version;
13. The bidder shall submit the complete working documentation and as-built documentation in a flawless state that will allow for analysis and copying. The bidder shall be liable for any delays resulting from to the low quality of the drawings or documents that may be returned to the bidder due to inability to analyze and accept them.
14. The technical documentation submitted by the bidder must include:
    a) All diagrams, drawings, calculation together with material lists;
    b) List of parts and materials necessary for the project execution;
    c) Requirements regarding qualifications of the people participating in designing works;
    d) Requirements concerning the use of materials, their certificates
    e) Scope of necessary examinations and acceptance levels;
    f) List of works and bill of quantities (only for not "turnkey" part);
    g) Information on the possible additional examinations carried out by UDT (Office of Technical Inspection) audits;
    h) Operation and Maintenance Documentation (DTR)
15. The bidder will attach other drawings and documents, analysis required as a necessary in order to analyze the project;
16. The bidder shall be solely responsible for the accuracy of information and dimensions included in the documents, and shall be responsible for any losses resulting from misinformation;
17. Metric system shall be used for drawings and technical documentation;
18. Complete documentation shall be prepared in Polish;
19. The bidder consent to take part in the coordination meetings within the time frames defined by AMP;
20. The bidder consent to preparation of reports and schedules as per AMP requirements,
21. Protection installation and evacuation roads in accordance with AMP instructions,
22. Compliance certificates for the machines and entire installation;
23. Anticorrosive protection to be agreed upon with AMP
24. Final report.

9. COMMERCIAL OFFER REQUIREMENTS

Offer must include:
a) the costs of making your employees and equipment comply with the Occupational Health and Safety standards effective at AMP.

b) Cost division into: engineering, deliveries, disassembly, assembly and installation, software, commissioning and trainings – price format.xls
Other Requirements concerning commercial offer will be submitted by Investment Purchasing Office of ArcelorMittal Poland.

10. SUPERVISION AND ASEMBLY, TESTS AND COMMISSIONING

10.1. The Contractor shall deliver all materials necessary to execute works along with the necessary tools and specialized equipment (including e.g. social facilities for employees, necessary media (apart of those made available by AMP) technical gases, lifting equipment, transportation equipment and others).

10.2. The Contractor shall undertake to execute ordered works in accordance with arrangements made during the contract finalization. The contractor will also act as the site manager/site supervisor, and will ensure the presence of H&S coordinator (additional certificates are not required – can be the Site Manager as well) during the whole time of works.

10.3. The Contractor shall undertake to install the whole equipment, to commission and hand over the installation, and to carry out trainings for AMP.

10.4. Commissioning

a. Cold commissioning

Cold commissioning (partial) of the equipment will be carried out after finalizing works on a specific section, removing of possible defects and deficiencies, after executing possible additional works that resulted during investment works, fulfilling Buyer's safety requirements, after information given by the Contractor that the facility is ready for cold commissioning and after agreeing on its conditions and date with the Buyer.

b. Hot commissioning

Hot commissioning will be carried out after finalizing all works, executed cold commissioning (partial), removing of possible defects and deficiencies, after executing possible additional works resulted during investment works, fulfilling Buyer's safety requirements, after information given by the Contractor that the facility is ready for hot commissioning and after agreeing on it conditions and date with the Buyer.

10.5. The installation will be handed over after 30 days of normal fault-free operation, what will be the basis for signing the Provisional Acceptance Certificate (PAC protocol) for specific equipment group and/or the entire investment scope.

11. WORK SCHEDULE

The Contractor should deliver the draft works schedule for Investor's consultation and approval.
Note 1: 2 or 3-shift work system must be planned. Work to be performed 24h/day
Note 2: Detailed works schedule will be coordinated with the potential Contractor implementing other works.

As in the area of work where other installation works will be performed, the contractor should include the coordination of works with other companies in the assembly and acceptance works schedule

11.1. 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.

11.2. 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 the stages of organization and securing of the site/works , arranging all the matters related to getting Investor's OH&S Office clearance for the works to be done on their premises, purchasing and prefabrication, erection, tests and commissioning, and putting into operation. This schedule should also include the description (specification) of the so-called critical path tasks and the so-called investment milestones.

11.3. MAIN MILESTONES

a) Handover of basic engineering (BE) of the entire system: 10 weeks after signing of the Contract
b) Handover of detail engineering (DE) of the entire system: 25 weeks after signing of the Contract
c) Prefabrication of equipment: 44 weeks after signing of the Contract
d) Completion of preparatory works: 44 weeks after signing of the Contract
e) Industrial commissioning of the system: 100 days after BF2 shutdown
f) System reliability test for 7 days: 1 month after commencement of industrial start-up
g) Verification of achievement of guaranteed parameters: 3 months after putting BF2 into operation
h) Signing of PAC: 4 months after putting BF2 into operation

12. DELIVERY AND QUALITY GUARANTEE

a) 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.
b) The Contractor will guarantee the use of the state-of-the-art solutions.
c) 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.
d) 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.
e) The minimum warranty period expected by the Investor is 24 months from the moment of signing the Preliminary Acceptance Certificate.

13. RIGHTS FOR CUSTOMER

a. All valuable materials /scrap/objects of archaeological value recovered or found during works performance are the customer’s property and will be handed over to them.
b. 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.

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

1. Passing the functional test of control and automation of all systems of the measurement system with the achievement of full functionality
2. Compliance and correctness of the work performed with the technical documentation
3. Compliance and correctness of the installation with the technical documentation
4. Visual assessment of the correctness of the performance of all works by both parties, completed with the signing of the final PAC protocol.
5. Guaranteeing the completion of the complete measurement cycle from all gas sampling points within two hours and 30 minutes
6. Analyzer gas measurement linearity in the installed system: ≤1% of the measurement range
7. Repeatability of the analyzer gas measurement in the installed system: +/- ≤1%
8. Accuracy (abs) of the gas analyzer 0,01%

15. CONTACT PERSONS

	Name and surname	Responsibility	Plant/Department	Phone / e-mail
1	Robert Popławski	Project Manager - Engineering	ArcelorMittal Poland S.A. Al. J. Piłsudskiego 92 41 – 308 Dąbrowa Górnicza	+48 668 395 180 Robert.Poplawski@arcelormittal.com
2	Marcin Rabenda	Technical leader		+48 664 418 122 marcin.rabenda@arcelormittal.com
3	Marta Bodnar	Buyer		+48 668 562 376 Marta.Bodnar@arcelormittal.com

16. OTHER TOPICS (NOT DISCUSSED ELSEWHERE)

16.1. OBLIGATORY CONTRACT LANGUAGE

a) Official language of the contract (technical documentation, masks, appliances, schematics, service manuals, plan of the work organization, supervision of the Contractor, the contracts and agreements with the staff of the Buyer, contracts and agreements with public institutions, etc.) is the Polish language (the issue of documentation and as-built documents etc. as per Tech. Spec.- in Polish and English). Translation costs of all documentation and simultaneous translation during realization of the investment covered by the Tenderer/Contractor

b) Contractor's personnel and all personnel who will be in touch with AMP DG are required to have or acquire Polish language skills which will enable them to understand spoken and written instructions (safety, work organization, etc.…).

16.2. WASTE DISPOSAL

Contractor is responsible for the disposal of waste generated as a result of investment works. All waste products, which will be produced during the works, should be removed to the industrial waste storage area.
The only exception is scrap of non-ferrous materials and iron scrap which must be sorted so that it can be used as charge material and handed over to the Investor.

Total cost of disposal and sorting into charge scrap groups will be borne by the Contractor. Below you can find the list of waste codes (according to Polish law), referring to the most frequent types of waste to be generated in the course of the Investment:

- Scrap of ferrous metals waste code 160117, 170405, 191001.
- Scrap of non-ferrous metals waste code 160118, 170401, 170402.
- Scrap of mixed metals waste code 170407.
- Ceramic waste waste code 161103, 161104.
- Concrete and debris waste waste code 170101.
- Electrical cables waste code 170411, 170604.
- Oils, greases waste code 130110, 130208.
- Electric motors scrap waste code 160216.
- Other waste individual waste codes.

16.3. ANALYSES AND MEASUREMENTS

There are analyses and measurements for proposed solutions provided below that should be carried out within the investment project by the Bidder/Contractor at his cost:

- Inventory geodetic measurements,
- Operational geodetic measurement,
- Post completion geodetic measurements,
- Measurements on installations

16.4. PROPERTY PROTECTION OF THE BIDDER/CONTRACTOR

During the Investment, the Contractor shall be responsible for the protection of own and subcontractors property, parts, components and the entire equipment necessary to execute the Investment, stored in the perimeter of the Buyer till the commissioning and hand-over to the Buyer

17. APPENDICES

Appendix 1. Legal Acts

Appendix 2. Location and environmental data

Appendix 3. LOTO

Appendix 4. Visual management

Appendix 5. AIM Addendum to tender – automation system requirements EN V12

Appendix 6. Mini probe documentation

Appendix 7. TOP

Appendix 8. Automation and IT requirements

Appendix 9. Utilities