

**Bergamo April 29<sup>th</sup> , 2025**

**PROPOSAL PI-25-0073  
Rev. 1**

**Technical Specification**

**For no. 1**

**AIR SEPARATION UNIT – DRGAP 33.000 TYPE**

**FOR: US STEEL**

**REF: AIR SEPARATION UNIT NO. 10 - SLOVAKIA**

## **FOREWORD**

**SIAD Group** is one of the main industrial groups in Europe, founded in Bergamo, Italy in 1927 and is today a leader in the manufacturing and supply of Technical Gases, Engineering and Manufactured Equipment, Welding, Industrial Goods, Healthcare and Services.

**SIAD Macchine Impianti, S.p.A (Hereinafter “SIAD MI” or “Seller”)** is the Group subsidiary dedicated to the Engineering and Equipment sector. With a history of focusing on international markets, SIAD MI is global leader in the engineering and manufacturing of Air Separation Units (ASU) for the production of gaseous and/or liquid Oxygen, Nitrogen, and Argon. The Company also engineers and manufactures high quality reciprocating compressors and which along with the air separation plants has become a point of reference for the industrial gases, petrochemical, chemical, and oil and gas upstream/downstream industries.

This document describes the **SIAD MI’s** proposal to provide :

no. 1 ASU – DRGAP 33.000 TYPE

To:

**US STEEL (Hereinafter “Buyer”)**

to be installed in **KOŠICE- SLOVAKIA**.

This proposal presented as a confidential document and the recipients are held to make use of it only for the foreseen purpose and not to delivery either the document or any copy of it to other parties without the written consent of SIAD.

Drawings and documents supplied either with this proposal pursuant to any subsequent contract, shall be treated as confidential and shall not, without SEH's consent, be used for any other purpose but the evaluation of this proposal the execution of any subsequent contract, nor shall they be communicated to any third party without such consent being obtained in writing.

# Air Separation Units for the production of Oxygen, Nitrogen and Argon

Guaranteed continuous supply of oxygen, nitrogen and argon of the highest purity.

Complete compliance with local and/or international standards.

Tailor-made solutions to meet any production requirement.

SIAD Macchine Impianti has developed its own processes for the selection and dimensioning of equipment and the most flexible technical solutions. Our strong point is the fact that we are able to coordinate customer's requests with our company experiences and provide tailor-made solutions based on continuous monitoring of project development. This is achieved thanks to a flexible, expert design team and a network of efficient staff members distributed throughout the world.

## Technical standard

- The experience of SIAD Macchine Impianti engineers, at the service of our customers, has created a certified standard which is adaptable to the various requirements of small, medium and large-sized industry.

## Engineering services

- Feasibility studies;
- commissioning supervision;
- erection, start up and performance testing;
- remote control.

## Technical features

Air Separation Units using cryogenic technology for the production of industrial gases in liquid and gaseous form.

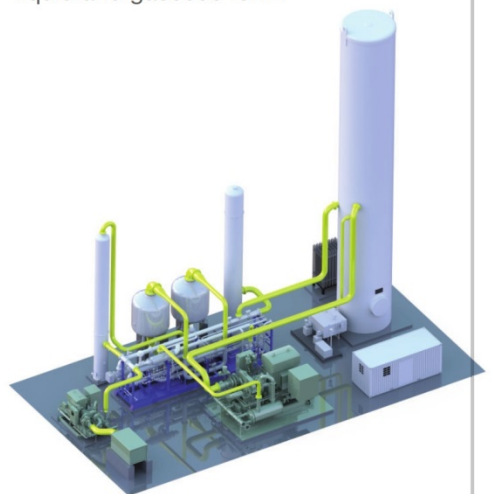
Oxygen Nitrogen Argon ASU	
Capacity	- Oxygen from 25 Nm <sup>3</sup> /h to 60 000 Nm <sup>3</sup> /h (0.8 - 2 050 TPD) - Nitrogen from 75 Nm <sup>3</sup> /h to 180 000 Nm <sup>3</sup> /h (2.3 - 5 400 TPD) - Argon recovery 92%
Purity	- Oxygen 99.95% and beyond - Nitrogen < 1 ppm O <sub>2</sub> - Argon < 1 ppm O <sub>2</sub>

Oxygen Nitrogen ASU	
Capacity	- Oxygen from 25 Nm <sup>3</sup> /h to 60 000 Nm <sup>3</sup> /h (0.8 - 2 050 TPD) - Nitrogen from 75 Nm <sup>3</sup> /h to 180 000 Nm <sup>3</sup> /h (2.3 - 5 400 TPD)
Purity	- Oxygen 99.9% and beyond - Nitrogen < 1 ppm O <sub>2</sub>

Nitrogen ASU	
Capacity	- Nitrogen from 250 Nm <sup>3</sup> /h to 50 000 Nm <sup>3</sup> /h (8.5 - 1 500 TPD)
Purity	- Nitrogen < 1 ppm O <sub>2</sub>

OxySTEEL, OxyCEMENT, OxyPAPER	
Capacity	- Oxygen from 800 Nm <sup>3</sup> /h to 16 000 Nm <sup>3</sup> /h (27 - 540 TPD) - Nitrogen can be supplied on request
Purity	- 95% for gaseous O <sub>2</sub> - 99.5% for liquid O <sub>2</sub> - 99.9% for gaseous N <sub>2</sub>

Smart Liquid Plant	
Capacity	- Liquid Oxygen from 330 Nm <sup>3</sup> /h to 2 500 Nm <sup>3</sup> /h (12 - 90 TPD) - Liquid Nitrogen from 600 Nm <sup>3</sup> /h to 3 000 Nm <sup>3</sup> /h (19 - 98 TPD)
Purity	- Oxygen 99.6% - Nitrogen 99.999%



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## 1. **PROPOSAL OUTLINE**

The plant is based on the best available technology for the production of oxygen and nitrogen which reflects 50 years of successful experience in this specialized industrial sector, of SIAD MI of Italy.

Technical characteristics and general scope of works, are defined in detail in the following sections.

The here proposed cryogenic plant DRGAP type is designed and manufactured according to the most updated technologies and state of art within the field of Air Separation Plants which results in a high level of efficiency, safety and reliable operation. The long-lasting SIAD Macchine Impianti's experience acquired in the selection of main quality equipment and devices along with the proper design and technological applications allows to all the part of the plant to be easily and simply managed, operated and maintained.

The design of the plant will ensure proper and safe operation, ease of maintenance, proper monitoring of the status of the plant during normal and emergency conditions.

## 2. TECHNICAL DATA

### 2.1 DESIGN CONDITIONS

The Air Separation Unit (ASU) is foreseen for installation in a safe unclassified area and for outdoor installation, protecting the main machineries by a machinery building hall. Closed and conditioned rooms as control and electrical rooms are required to house the electrical and control panels.

#### 2.1.1 Ambient Conditions

##### 2.1.1.1 Design ambient conditions

- barometric pressure	988	bar a
(equivalent to 206 m a.s.l.)		
- temperature (dry bulb)	+35	°C
- relative humidity	70	%
- cooling water supply temperature	+20	°C

Feed ambient air shall have the characteristics as per attachment “**Air Quality Design Basis**”.

##### 2.1.1.2 Off design conditions

- min ambient temperature	- 20	°C
- max ambient temperature	+ 40	°C

#### 2.1.2 Cooling Water

- cooling water flow	4.000 m <sup>3</sup> /h
- cw temperature supply / return	+20 / +30 °C

The cooling water shall have the characteristics as per attachment.

#### 2.1.3 Power Supply

- Medium voltage (req. at B/L from Buyer)	6.30 kV - 50 Hz - 3 ph
- Low voltage (internal source of the plant)	400 V - 50 Hz - 3 ph



- control voltage (internal source of the plant) 24 Vdc
- field devices and DCS I/O voltage (int. source of plant) 24 Vdc
- electronic control equipment using 4 to 20 mA DC signals

#### 2.1.4 Instrument Air

Instrument Air during normal operation (ASU switched-on) is self-produced inside of the ASU as taken from the air compressor flow, downstream of dust filter as oil free and dry air. When the ASU is OFF and for first start up, temporary for ASU start-up it has to be supplied by Buyer to comply with following conditions:

- supply pressure 7,0 bar g
- flow rate 800 Nm<sup>3</sup>/h
- dew point -80 °C

In case this quality of IA is not available, LIN to be vaporised as IA shall be make available by Client.

The provision of vaporizers and trim heater to eventual warm up the vaporised LIN to be confirmed by Client.

#### 2.1.5 Steam consumption

##### For regeneration Heater

MP steam min 260°C and 14 barg 4 t/h in heating (2,5 hours)

MP steam min 260°C and 14 barg 0,4 in stand by (2,5 hours)  
(to keep the heater ready to re-start)

Condensed steam/water between 60-80°C at 5 barg can be straight returned to boiler or it can be sent to water bath vaporizers to keep warm the water of vaporizers in standstill in order to avoid to use the steam (when in standby)  
Energy saving for steam in regeneration heater is "700 kWh/h".

##### For vaporizers

MP GAN (17.000 Nm<sup>3</sup>/h at T<sub>out</sub> = +30°C) = 4.5 t/h steam min 260°C and 14 barg

LP GAN (30.000 Nm<sup>3</sup>/h at T<sub>out</sub> = +30°C) = 7 t/h steam min 260°C and 14 barg

MP GOX (20.000 Nm<sup>3</sup>/h at T<sub>out</sub> = +30°C) = 5.5 t/h steam min 260°C and 14 barg

Return water between 60-80°C at 5 barg to be degassed because in contact with atmosphere.

For drain vaporizer

Supply Steam = 0,5 t/h steam min 260°C and 14 barg

Return: steam lost (vented at atmosphere)

## 2.2 PERFORMANCES OF THE PLANT

At the design ambient conditions set forth under par. 2.1.1.1 above, the performances of the plant shall be:

### 2.2.1 Production capacity

	Purity	Flow rate Design/max LOX /max LIN Nm <sup>3</sup> /h	Pressure at Cold Box Bar abs
HP GOX	99,5% (10 ppm <sub>v</sub> N <sub>2</sub> )	21.000/18.600/21.000	27,99
MP GOX	99,5% (10 ppm <sub>v</sub> N <sub>2</sub> )	12.000/10.600/12.000	6,99
LOX	99,5% (10 ppm <sub>v</sub> N <sub>2</sub> )	0/3.700/0	to tank
MP GAN	3 ppm O <sub>2</sub>	18.800/18.800/17.700	20,99
LP GAN	3 ppm O <sub>2</sub>	50.000/50.000/47.250	6,99
LIN	3 ppm O <sub>2</sub>	0/0/3.700	to tank
LAR	2 ppm O <sub>2</sub> 5 ppm N <sub>2</sub>	1.300/1.300/1.220	to tank

Turn-down range: from 100 down to 80 % without venting any air or product; the electric energy consumption is not proportional to the electric energy consumption.

To reach higher turn down, without venting products, air, it is necessary to change technical solution (e.g. increasing the number of compressors)

#### Notes:

- (1) The Nm<sup>3</sup>/h are referred at 1,01325 bar abs and at 273 K.  
Design case is guaranteed, the max LOX, max LIN modes are expected.
- (2) In order to minimise the number of nitrogen compressors, necessary because of the high quantity of Argon recovery, the nitrogen will be produced by multistage compressor at different pressures.
- (3) The proposed plant includes 2 turbines: in DESIGN mode one is working and one is switched off; in liquid mode, both are working.  
This system allows the most efficient working to maximize the efficiency of the turbine optimizing the e.e.c. in design mode.



- (4) For a further optimization of the plant It is possible to consider an additional Liquid turbine in order to save about -150 kWh/h.

## 2.2.2 Absorbed electric power

At the ambient condition as stated at point 2.1.1.1 above, the estimated electric energy consumption is:

**27,5 MW/h**

The here above indicated absorbed electric power is based upon electrical consumption at terminals of the following units:

- No. 1 main air compressor motor
- air pre-cooling unit [ DCA Cooling Water + Chilled Water pump motors + chiller ]
- no. 1 booster air compressor motor
- no. 1 expansion turbine oil pump motor
- no. 1 Nitrogen Compressor
- process pumps motors (HP LOX, CRUDE Lox, Crude LAR)

### Notes:

1. Different ambient conditions will modify the estimated electric energy consumption and/or production capacity.
2. The total electric energy consumption is at motors terminal box (including motors efficiency).
3. If the reference ambient temperature will be +20°C (RH= 70%, cw = +20°C, P amb= 0,998), the electric energy saving will be -800 kWh/h
4. The spec. consumption divided for

## 2.2.3 Tolerances

- |   |                                |            |
|---|--------------------------------|------------|
| * | On production flow rate        | + 0 / - 2% |
| * | On electric energy consumption | - 0 / + 5% |

## 2.2.4 Utilities

### 2.2.4.1 Electric power installed

	<u><b>400 V</b></u>	<u><b>6 kV</b></u>	
- No. 1 Main Air Compressor motor		14.300	kW
- Air pre-cooling unit:			
• n° 2 (x 100%) DCA cooling water pumps	2 x 45		kW

• n° 2 (x 100%) chilled water pumps	2 x 37		kW
• Chiller unit	200		kW
- No. 1 Booster Air Compressor motor		6.300	kW
- No. 1 common turbine oil pump motor	12		kW
- No. 1 common turbine oil heater	8		kW
- No. 1 nitrogen compressor		7.600	kW
- n° 2 (x 100%) LOX process pumps	2 x 110		kW
- n° 2 (x 100%) crude LOX pumps	2 x 75		kW
- n° 2 (x 100%) crude LAR pumps	4 x 30		kW
- control and analyser panels	30		kW
- miscellaneous	25		kW

### 2.2.5 Noise Level

All the vents discharge to atmosphere and intakes in continuous operation are equipped with appropriate silencers suitable to reduce the noise level at 85 dBA at 1 mt.

The noise of each machine is between 115 and 130 dBA at 1 mt distance in free field.

Inside the building, because of different noise sources, the machinery noises interfere among themselves also in function of the building machine hall characteristics.

The above acoustic design criteria apply to continuous and normal operation.

Start-up, shut-down and other abnormal or transient operation conditions and emergency conditions are not treated as normal operation conditions and are not considered for noise design criteria.

## **2.3 ASU OPERATION AND DESCRIPTION**

### **2.3.1 Operating Periods**

When properly operated, the plant is capable of being operated continuously for three (3) years period before to be shut down for a planned defrosting (excluding maintenance for all the rotating machine which shall be performed according to the maintenance program indicated by the machine manufacturer).

### **2.3.2 Operating Personnel**

Because of the high degree of automation, operating staff attendance during normal working operation will be minimized, being limited to desultory control of the plant. However, plant's start up is manually done and must be executed by a skilled operator. Also few simple operations to be made in a discontinuous way, such as check of oil levels, etc. are manually executed.

### **2.3.3 Air Separation Unit: Process Description**

#### **2.3.3.1 Air compressor, precooling and prepurifier unit**

The feed air is filtered and then compressed in a main air compressor (MAC). The hot air coming from the compressor is cooled with Cooling Water approximately at same temperature of inlet CW temperature in the first stage of the direct contact aftercooler (DCA) and then chilled to approximately 10°C against chilled water in the second stage of the direct contact aftercooler. An evaporative tower provides the refrigeration for the chilled water. The evaporative tower uses dry, waste and pure nitrogen from the cold box to chill cooling water, which is further chilled by a mechanical chiller.

The chilled air stream is fed to a dual-bed prepurification system. After passing through a dust filter, a small amount of clean dry air from the prepurifier system is drawn off for plant instrument air.

#### **2.3.3.2 Cold box**

The air entering the cold box passes through the primary heat exchanger in which it is cooled by gas and liquid product coming from condenser. The exchanger is a finned plate type, in brazed aluminum.

The process air stream feeds the cold box by three different streams; the air coming from the dust filter is first split into two streams:

The LP air stream enters directly in the primary heat exchanger, cooled down almost at dew point, then it is joined with the air stream delivered by turbine and then sent to column.

The other ASU incoming air stream is first further compressed by the electric booster air compressor and then:

The HP air stream is further compressed by the booster compressor, that is driven by the work produced by the turbine. A shell and tube aftercooler removes the heat of compression downstream of the booster. This high pressure air stream is then cooled in the PHX against warming product streams and it exits the primary heat exchanger at a certain point. This cooled air stream is then sent to the turbine, providing the plant refrigeration duty, and finally it goes to the bottom of the high pressure column (lower column), joined with LP air.

The MP air stream is compressed in the last stage of the booster compressor and then is liquefied in the PHX, expanded by a first valve in a liquid air separator, further subcooled in the nitrogen superheater and then it enters the upper column after passing through a second expansion valve.

Before passing in the primary heat exchanger, waste and product nitrogen, coming from the upper column, cross the nitrogen superheater where they are warmed up by a liquid nitrogen stream (shelf), liquid oxygen, liquid kettle and a liquid air stream. Also the nitrogen superheater is made of aluminum. The high and low pressure gaseous oxygen, the low pressure gaseous nitrogen and the waste nitrogen are warmed up through the primary heat exchanger almost to the temperature of the inlet air.

The gaseous air entering the high-pressure column is separated into pure nitrogen at the top and oxygen enriched liquid air (kettle liquid) at the bottom. Most of the nitrogen gas at the top of the lower column is condensed against boiling liquid oxygen in the low-pressure distillation column main condenser. The uncondensed high-pressure nitrogen is used both for the reboiler (where it is cooled against boiling argon) and for the condenser (where it is boiled against condensing pure argon) of the high ratio column, before being mixed with waste nitrogen going to the superheater.

Part of the liquid nitrogen produced in the high-pressure column is used as reflux and part is subcooled in the nitrogen superheater. The subcooled nitrogen is divided into two streams: the first one is transferred to the low pressure column as reflux, the second one is sent to the liquid nitrogen storage tank.

Enriched liquid air is withdrawn from the bottom of the lower column and subcooled in the nitrogen superheater against returning low pressure nitrogen streams. The subcooled liquid kettle is divided into two streams. Some of the liquid is fed directly to the upper column. The other stream enters the crude argon condenser where a majority of the liquid kettle boils against condensing crude argon. The vapour kettle formed along with the remaining liquid kettle is returned to the upper column few stages below where the direct kettle feed is located.

The low pressure column produces high purity (99.5% O<sub>2</sub>) liquid oxygen at the bottom and pure gaseous nitrogen at the top. Gaseous nitrogen product from the top of the column is warmed first in the nitrogen superheater and then in the primary heat exchanger against incoming air, then is sent to a nitrogen compressor combo machine to deliver two pressure levels nitrogen.

Low purity waste nitrogen is withdrawn from the low pressure column and warmed in the same manner as the product nitrogen stream. At the warm end of the PHX, the waste nitrogen is fed to the prepurifier regeneration circuit and the remainder is fed to the evaporative tower.

Liquid oxygen is withdrawn from the bottom of the low pressure column, sent to a liquid oxygen pump, pumped to a pressure of approximately 30 bara and transferred to the PHX where, as above mentioned, its vaporization takes place.

The unbalanced liquid oxygen is withdrawn as liquid and sent to a storage tank as liquid product.

The low purity (crude) argon and superstaged columns separate oxygen from the argon feed stream. The crude column is fed by vapour from the upper column. Vapour at the top of the crude column is fed to the bottom of the superstaged column where further separation of argon and oxygen takes place. At the top of the superstaged column, low purity argon vapour is condensed against boiling kettle liquid in the crude argon condenser. Most of the condensed argon is used as reflux for the superstaged and crude column. The remainder of the condensed argon liquid is directed to the pure argon column where nitrogen is removed from the argon. The liquid from the bottom of the superstaged column is pumped back to the top of the crude argon column to serve as reflux for the crude column. The liquid from the bottom of the crude column is returned to the upper column.

As mentioned previously, the pure argon column separates nitrogen from the argon product. Oxygen free argon is fed to the refinery column. Liquid argon concentrates in the bottom of the column. Boil-up for the argon column is developed by condensing shelf nitrogen vapor in the high ratio argon reboiler located in the sump of the high ratio column. The liquid nitrogen condensed in the reboiler is then throttled and boiled in the argon condenser against condensing gaseous argon flow, completely used as reflux for the column. The vaporized nitrogen from the condenser is then fed to the cold end of the nitrogen superheater where it combines with the waste nitrogen stream from the upper column to provide refrigeration to the shelf, kettle and air streams. A small stream from the top of the high ratio column is vented to prevent the build-up of nitrogen in the argon product.



### **3. SCOPE OF SUPPLY**

#### **3.1 ENGINEERING AND DOCUMENTATION**

SIAD MI's scope is including the supply of all documentation mentioned here below and also the technical information to allow the good correct implementation of the project and the most suitable use of the units included in the scope of supply.

Such information will be transferred both in writing and orally by our technicians during the execution of the various phases of the project, including site erection, start up and first operation of the plant.

All technical information and documentation necessary to the Buyer for the best execution of his activity, after the plant start-up and operation will also be supplied by SIAD MI.

The documentation will include as minimum:

- foundation lay out showing equipment dimension, static and dynamic loads
- general plant lay-out
- assembly drawings for all the main equipment
- P&I diagram for all circuits
- painting specification
- plant assembly drawing with process piping lay-out
- field assembly drawing for air separation cold boxes
- plant assembly drawing with cooling water piping lay-out
- drawings and BOM relevant to pipes & supports erection on site
- electrical equipment list (load list, single line diagram)
- list of cylinders for analyser calibration
- electric power, control and analyzers panels schematic wiring diagrams
- power electrical connections with panel position layout
- instrument & pneumatic connections lay-out
- specifications for mechanical and electrical erection
- drawings and BOM relevant to instrument & control system erection on site
- drawings and BOM relevant to electric power systems erection on site
- lubricants list
- plant, machineries & Instruments maintenance and operating instruction manuals
- transportation documentation
- inspection book dossier and certificates

All the documentation will be provided in English language.

Delivery, copy and procedure of documentation issuing will be discussed and agreed in the Technical Clarification meeting.

The supply includes the following services/activities at care of SIAD MI's engineering and management team:

- Project management according to quality control system
- Purchasing activities
- Sub-Supplier's expediting activities

Site activities, as civil works and erection works including transportation, are subject to site survey and supporting documents. Therefore the indication below are to be considered as guideline.

### **3.2 CIVIL WORKS ( QUOTED IN ALTERNATIVE SCOPE – NOT IN BASE SCOPE )**

These activities will be carried out at care of Seller by proper workmanship following the valid technical local laws and the “best available technique”.

The activities for the civil works will include:

- Sizing and supply of foundation
- Design and supply of building (and relevant ancillaries as HVAC, firefighting, lightning)
- Calculation and supply of EOT crane
- lighting and socket systems indoor and outdoor
- design and supply of primary grounding system
- fire-fighting system
- No. 1 Underground Plastic Condensed Steam Drum, total max capacity about 10 m<sup>3</sup>, atmospheric pressure.
- The steam condensate from vaporizers. Downstream are foreseen water pumps to return the condensate to be degassed (degasification excluded from scope) up to battery limits.

The following works / services must be performed / make available by Buyer:

- Geological analysis
- General service as office, warehouse, cantine, changing room, construction site sanitary facilities, first-aid station and so on.

The present proposal is based on the assumption that the area is normally accessible by trucks and free of hidden dangers.

It shall be available free area for the temporary storage of bulk and semifinished materials.

### 3.3 INSTALLATION (QUOTED IN ALTERNATIVE SCOPE – NOT IN BASE SCOPE)

These activities will be carried out at care of Seller by proper workmanship according to the different disciplines, following the valid technical rules and regulation, and the “best available technique”, and in accordance to the Seller’s erection drawings and documentation.

The erection on site will include the necessary erection, control and check-up tools (N.D. test devices), and lifting equipment for daily use.

Rental of special cranes for heaviest and largest equipment are included in Seller's scope.

The activities for the erection of equipment and materials supplied shall be considered the following works :

- unloading and un-packing of equipment upon arrival at site
- positioning and assembly on the foundation of all the supplier equipment
- installation and alignment of machineries and motors
- installation and alignment of cold box equipment
- construction and installation of cold boxes metallic closure plates (cold boxes casings)
- construction and installation of ladders and platforms on cold box outer casings
- construction and installation of all the interconnection piping between the equipment, and relevant supports, for all circuits (process, cooling water, instrument Air etc.)
- field pneumatic test after mechanical completion
- final equipment and piping insulation and painting
- electrical and control panels installation in the relevant electrical and control rooms
- power cables lay down inside BL
- control cables lay down between field instruments to field JB and from field and skid mounted JB to control panel in control room.
- power and control cables check out
- first filling of raw materials such as molecular sieve, oil, greases, etc.

Installation activity at care of Seller is including also the Sub-Suppliers’ service for construction supervision to be executed over the 6 months period (field construction activity period).

Before arrival of Seller’s personnel on site, the following works must be completed by Civil Contractor and/or by Buyer:

- permitting
- utilities

### 3.4 COMMISSIONING ACTIVITIES AT SITE ( QUOTED IN ALTERNATIVE SCOPE – NOT IN BASE SCOPE )

These operations will be carried out at care of Seller's technicians and by Buyer's staff assigned to the operation of the Plant.

During the above operation, Seller's technicians will perform the training of Buyer's staff, transferring all the information required to operate the plant which are normally integrated into the operating manual.

Commissioning activity by Seller is including also the same supervision service by Sub-Suppliers' technicians for the commissioning of main machineries.

The start-up, operation, and correct working of storage and vaporization system not included in this supply (quoted as option) are in the responsibility of the Client; therefore, they are completely excluded from the Supplier's activities and responsibility.

#### 3.4.1 SUPERVISION TO SITE ACTIVITIES

These activities will be carried out at care of Seller by proper workmanship according to the different disciplines, following the valid technical rules and regulation, and the "best available technique", and in accordance to the Seller's erection drawings and documentation.

The erection, commissioning and start up on site will be performed by Other under SIAD supervision.

The erection, pre-commissioning, commissioning proposal includes indicatively the below supervision:

no. 1	mechanical supervisor (including tanks)	7	man / months
no. 1	quality control supervisor	2	man / months
no. 1	electrical supervisor	2	man / months
no. 1	MAC/BAC/NIC supervisor	1	man / months
no. 1	expansion turbines supervisor	10	man / days

The start up proposal includes indicatively the below supervision:

n. 1	skilled technician	for plant start up	60	man/days
n. 1	skilled technician	for software tuning	40	man/days
n. 1	skilled technician	for electrical check out	30	man/days
n. 1	skilled technician	for MAC/BAC/NIC	40	man/days
n. 1	skilled technician	for cryogenic pumps	20	man/days
n. 1	skilled technician	for expansion turbines	10	man/days

### **3.5 TRAINING IN ITALY (EXCLUDED FROM SIAD'S SCOPE)**

As option per diem rate, it will concern basic engineering operation and maintenance of the Air Separation Plant and relevant equipment, and it will involve no more than 4 people among the operating and maintenance Client's personnel.

The basic training program (1 week lasting) will take part in Italy, by SIAD Macchine Impianti's offices.

#### **4. EQUIPMENT AND MATERIALS**

The scope of supply of Siad MI is including what following:

##### **4.1 No. 1 MAIN AIR COMPRESSOR**

Oil free centrifugal compressor water cooled, is equipped with the following main items and systems:

- No.1 air filter suitable for the environmental conditions
- No.1 blow-off discharge silencer
- water inter-coolers and after-cooler
- condensate separators with automatic drainage
- adjusting inlet valve
- synchronous electric motor IP 54 - softstarted
- lubricating system
- I/O cards for control and regulation
- base-plate
- piping

##### **4.2 AIR PRE-COOLING UNIT**

Equipped with:

- No. 1 Direct Contact After-cooler Tower (air/chilled water direct contact Tower: 1 Tower only by 2 separated stages) with annexed at top a demister
- No. 1 Evaporative tower to cool down by Waste Nitrogen the cooling water
- NO. 1 CHILLER unit
- No. 2 DCA cooling water pumps (1 + 1 in stand-by)
- No. 2 chilled water pumps (1 + 1 in stand-by)
- Instrumentation
- Junction boxes
- Piping and Valves

##### **4.3 AIR PREPURIFIER UNIT**

Including:

- No. 2 air prepurifier Vessels (one is in operation while the other one is in regeneration) filled with suitable absorbing materials such as the molecular sieve and activated alumina
- No.1 Steam Heater for regeneration



- No.1 Dust filter
- No.1 Regeneration gas discharge silencer
- On/off automatic valve for air prepurifier unit automatic operation;
- Check valves;
- Instrumentation;
- Junction boxes;
- Piping

#### **4.4 No. 1 BOOSTER AIR COMPRESSOR**

Oil free centrifugal compressor, water cooled, is equipped with the following main items and systems:

- water inter-cooler and after-cooler
- adjusting inlet valve
- electric motor IP 54
- lubricating system
- I/O cards for control and regulation
- base-plate
- piping

#### **4.5 COLD BOX PACKAGE**

The main components of the whole Cold Box package are:

- Lower (high pressure) column in stainless steel with structured packing internals
- Upper (low pressure) column in stainless steel with structured packing internals
- main condenser exchanger: brazed aluminium plate finned type
- primary heat exchanger: brazed aluminium plate finned type
- nitrogen super heater: brazed aluminium plate finned type
- crude argon and super-stage columns in stainless steel with structured packing internals
- crude argon condenser exchanger: brazed aluminium plate finned type
- pure argon column in stainless steel with structured packing internals
- pure argon condenser and re-boiler exchangers: brazed aluminium plate finned type
- interconnecting piping: stainless steel and aluminium
- outer casing box: carbon steel
- on-off and control valves
- analysis and exhaust points
- safety and manual valves

Interconnected at the bottom sections of Cold box package will be the following equipment:

- HP LOX process pumps installed at ground and to be interconnected to Cold box by insulated pipes
- Crude LOX process pumps installed at ground and to be interconnected to Cold box by insulated pipes
- Crude LAR reflux pumps installed at ground and to be interconnected to Cold box by insulated pipes
- Turbine Expander cold end installed in a duct together with the interconnection piping

To respect the limit of transportation of 5m height from ground, **4 m width** and 36 m length, the possible configuration of the cold box package is considered:

No. 1 cold box PHX will be constructed at site.

No. 1 Nitrogen cold box will be constructed at site.

No. 1 Oxygen cold box will be constructed at site

No. 1 Argon cold box **will be constructed at site**

Actually the maximum height is 35 m.

The configuration will be fine tuned during detail engineering.

#### 4.6 NO. 2 EXPANSION TURBINE COUPLED WITH BOOSTER COMPRESSOR

Each Turbine expander is directly coupled with a booster compressor; the common lube oil system is supplied skid mounted, while the expansion/compression unit are stand alone to be annexed to the cold box by a cold plate. The expander/compressor casing and the lube oil system are interconnected by flexible hoses.

The supply is composed by :

- lube oil system including a lube oil reservoir, oil lubricating pump with filter, control and safety instrumentation, oil cooler, oil heater and demister.
- adjustable nozzle ring for the flow control on expander inlet
- quick acting shut-off valve on expander inlet
- surging control valves on booster by-pass
- local instrument panel with instruments and safety interlocks system
- seal gas system

#### 4.7 NO. 2 BOOSTER AFTER COOLER

Located downstream of booster stage coupled at the expansion turbine, this after-cooler (shell & tube type with water in the tube side) is cooling down by cooling water the high pressure gas air; this after-cooler is assembled as a skid unit.

## **4.8 PROCESS PUMPS SYSTEM**

### **4.8.1 NO. 2 X 100% HP LOX PUMPS (1 + 1 IN STAND-BY)**

Centrifugal type pumps, each one suitable to pump liquid Oxygen up to indicative 30 bar(a) and equipped with:

- main centrifugal type process pump suitable for continuous operation
- electric motor IP 54 – 400 V - 50 Hz -3ph
- inlet and outlet manual valves, flexible and instrumentation
- sealing gas system
- frequency converter for flow rate regulation

### **4.8.2 NO. 2 X 100% CRUDE LOX PUMPS (1 + 1 IN STAND-BY)**

Centrifugal type pumps, each one suitable to pump liquid Oxygen up to indicative 7 bar(a) and equipped with:

- main centrifugal type process pump suitable for continuous operation
- electric motor IP 54 – 400 V - 50 Hz -3ph
- inlet and outlet manual valves, flexible and instrumentation
- sealing gas system
- frequency converter for flow rate regulation

### **4.8.3 NO. 2 X 100% CRUDE LAR PUMPS (1 + 1 IN STAND-BY)**

Centrifugal type pumps, each one suitable to pump liquid Argon up to indicative 8 bar(a) and equipped with:

- main centrifugal type process pump suitable for continuous operation
- electric motor IP 54 - 400 V - 50 Hz -3ph
- inlet and outlet manual valves, flexible and instrumentation
- sealing gas system
- frequency converter for flow rate regulation

4.9 void

## **4.10 NO. 1 NITROGEN PRODUCT COMPRESSOR**

Oil free centrifugal compressor, water cooled, is equipped with the following main items and systems:

- water inter-cooler and after-cooler

- adjusting inlet valve
- electric motor IP 54
- lubricating system
- I/O cards for control and regulation
- base-plate
- piping

The compressor is 5 stages and allows to withdraw two streams:

First stream: 68.800 Nm<sup>3</sup>/h at delivery pressure of 7 bar abs

Second stream: 18.800 Nm<sup>3</sup>/h at delivery pressure of 21 bar abs

#### **4.11 BACK UP AND VAPORIZATION SYSTEM (QUOTED SEPARATELY)**

##### **4.11.1 LOX Back up part**

###### **4.11.1.1 No.1 LOX Storage tank**

Double vessel type vacuum insulated with perlite having the following characteristics:

- |                       |      |                |
|-----------------------|------|----------------|
| - Operating pressure: | 0,05 | bar g          |
| - Tank Capacity :     | 500  | m <sup>3</sup> |

The vertical tank is double shell type (stainless steel inner shell - carbon steel outer shell), perlite filled in the vacuum gap and is equipped with level and pressure indicators, level transmitter and safety valves.

The oxygen tank is complete with boil off (in order to avoid over pressure due to the heat losses) and build up standard circuit.

The tank is supplied as loose material to be constructed at site (erection, welding, purging, perliting).

The tank is equipped with the connection for truck loading / unloading.

The tank is suitable for slightly less than 24 hours of back up at 33.000 Nm<sup>3</sup>/h of withdraw; The tank will be filled in about 10 days with LOX production of 3.700 Nm<sup>3</sup>/h.

Considering that the limit of transportation, FBT (supplied loose to be erected at site) is the most convenient choice.

###### **4.11.1.2 No. 1x100% back up HP LOX pump**

Centrifugal type, sized for 21.000 Nm<sup>3</sup>/h at 27 barg. LV motor equipped.

#### 4.11.1.3 No. 1 Steam LOX vaporizer

The vaporizer will include the HP liquids coils to vaporize:

- max HP oxygen vaporized flow: 20.000 Nm<sup>3</sup>/h
- indicative oxygen working pressure: approx. 20 barg

The system is complete with condensate water pumps.

#### 4.11.2 LIN BACK UP

##### 4.11.2.1 No.1 LIN Storage tank

Double vessel type vacuum insulated with perlite having the following characteristics:

- Operating pressure: 0,05 bar g
- Tank Capacity : 1.000 m<sup>3</sup>

The vertical tank is double shell type (stainless steel inner shell - carbon steel outer shell), perlite filled in the vacuum gap and is equipped with level and pressure indicators, level transmitter and safety valves.

The nitrogen tank is complete with boil off (in order to avoid over pressure due to the heat losses) and build up standard circuit.

The tank is supplied as loose material to be constructed at site (erection, welding, purging, perliting).

The tank is equipped with the connection for truck loading / unloading.

The tank is suitable for about 1 day of back up at 17.000 Nm<sup>3</sup>/h of withdraw; The tank will be filled in about 8 days with LIN production of 3.700 Nm<sup>3</sup>/h.

##### 4.11.2.2 No. 2 x100% LIN HP pump

One Centrifugal type, sized for 17.000 Nm<sup>3</sup>/h at 20 barg. LV motor equipped

One Centrifugal type, sized for 30.000 Nm<sup>3</sup>/h at 6 barg. LV motor equipped

##### 4.11.2.3 No.1 Steam vaporizer

The vaporizer will include the HP liquids coils to vaporize:

- max HP nitrogen vaporized flow: 17.000 Nm<sup>3</sup>/h
- indicative nitrogen working pressure: approx. 20 barg

and will include the MP liquids coils to vaporize:

- max MP nitrogen vaporized flow: 30.000 Nm<sup>3</sup>/h
- indicative nitrogen working pressure: approx. 6 barg

The system is complete with condensate water pumps

### 4.11.3 LAR back up

#### 4.11.3.1 No. 1 LAR tank

Double vessel type vacuum insulated with perlite having the following characteristics:

- |                        |     |                |
|------------------------|-----|----------------|
| - Operating pressure   | 1,5 | bar g          |
| - Tank Capacity (each) | 150 | m <sup>3</sup> |

The horizontal tank is double shell type (stainless steel inner shell - carbon steel outer shell), perlite filled in the vacuum gap and is equipped with level and pressure indicators, level transmitter and safety valves.

The argon tank is complete with boil off (in order to avoid over pressure due to the heat losses) and build up standard circuit.

The tank is equipped with the connection for truck loading / unloading.

The tanks will be filled in about 4days with a production of 1.300 Nm<sup>3</sup>/h capable to supply 1.300 Nm<sup>3</sup>/h for about 4 days.

#### 4.11.3.2 No. 1 x100% LAR HP pump

Centrifugal type, sized for 1.300 Nm<sup>3</sup>/h at 20 barg. LV motor equipped.

#### 4.11.3.3 No. 2 Atmospheric type vaporizers

It is included 2 set of vaporizers each suitable for 1.300 Nm<sup>3</sup>/h, one in operation + one in defrosting for continuous working.

The temperature will be 10°C lower than ambient temperature.

If temperature goes below 0°C, manual defrosting shall be provided by Client.

### 4.12 Electrical Part

#### 4.12.1 No.1 Medium Voltage (6,3 kV) Switchboard MV

Metal enclosed type, for indoor installation in the Buyer's local Electrical Room – inside of the ASU Area - including:

- n° 1 incoming line cubicle
- n° 1 measurement cubicle
- n° 1 feeder cubicle for Main Air compressor motor
- n° 1 feeder cubicle for Booster Air compressor motor
- n° 1 feeder cubicle for Nitrogen compressor motor
- n° 1 feeder cubicle for MV / LV transformer



#### 4.12.2 No. 1 Distribution Transformer MV / LV

With standard protection and measuring system, resin type, suitable for indoor installation in the Buyer's local Electrical Room – inside of the ASU Area - and with the following main characteristics:

- input / output voltage: 6,3 / 0,4 kV

#### 4.12.3 No.1 Low Voltage (400V) Switchboard LV

Metal enclosed type, for indoor installation in the Buyer's local Electrical Room - inside of the ASU Area - equipped with feeders for L.V. utilities, including the incoming line equipped with automatic circuit breaker feeding and outgoing direct motor/heater units for:

- Main Air Compressor auxiliary
- Booster Air Compressor auxiliary
- Nitrogen Compressor auxiliary
- Chiller unit
- air pre-cooling unit: 1<sup>st</sup> and 2<sup>nd</sup> stage DCA water pump motors
- turbine/booster unit: oil pump motors, oil heaters and demister fan motors
- control / analysers panels
- LOX process pump motors
- Crude Lox pump motors
- Crude Lar pump motors

#### 4.12.4 Electrical Power Cables

- medium voltage (6,3 kV) electrical cables inside the battery limits: from field motors to MV switchboard and from MV switchboard to 6,3 / 0,4 kV transformer
- low voltage (400 V) electrical cables inside the battery limits.

### 4.13 CONTROL SYSTEM

#### 4.13.1 General

Plant operations are managed by a PLC which performs machinery and process control collecting all I/O's (motors, sensors, solenoid valves, ...) installed on the plant; operators monitor and operate the plant using a supervision system (HMI) installed on a personal computer (PC).

Control equipment installed on the plant are shared and connected themselves through industrial networks; industrial communication means more efficiency based on international standards.

Remote I/O cards, main PLC and other field equipment, directly engaged for the machinery and process control, are connected on system bus while PC, printers and other equipment used for the HMI are connected on terminal bus.

The data acquired from the field equipment are managed by the PLC to perform the basic process control, then read and arranged in the process database (PDB) by the HMI system which handles all the data and makes them available for operation and monitoring by operators or stored to be used for on/offline reporting or graphic functions provided by preconfigured tools.

The HMI application allows the operator to monitor plant status, display alarms and carry out commands and settings necessary for running the plant, by means of a graphic interface that uses different symbols and colours in order to identify the status of all the devices connected to the basic process control.

The PLC and HMI applications are designed and developed according to proven SIAD MI standards; language used for control system interface devices (HMI views, software programs, reports, etc.) is English.

#### **4.13.2 Architecture**

Basic process control system is managed by a PLC Siemens PCS7, which is connected on the system bus using Profinet the Ethernet standard for automation which offers secure and fast data exchange at all levels; the open standard guarantee more flexibility, efficiency and performance.

On the system bus following devices are connected:

- field remote I/O to collect instruments, controls and panel signals
- VFD for motors if any,
- Measuring devices
- Packages local control system, if any, for monitoring purposes only.

The PLC is also connected with the HMI system, using TCP/IP Ethernet standard.

On the terminal bus following devices are connected:

- Operator stations and other devices like printers and network components

#### **4.13.3 Configuration**

Mainly, following components are foreseen:

Located in the control room are:

- No. 1 off Operator Station with single LCD monitor, keyboard and mouse.

The operator station is equipped with WINcc for PCS7, HMI run-time software and MS Office components used to develop the HMI system according to SIAD MI standards.

- No. 1 B/W printer
- No. 1 color printer
- terminal bus network components like switch and fast connect RJ45 cables
- No. 1 main control panel equipped with Siemens PCS7 type and including:
  - No. 1 off Process controller equipped with Profinet interface
  - No. 1 off Industrial Ethernet TCP/IP communication card
  - No. 1 off single power supply
  - No. 1 off cards rack
  - I/O cards for area signals collection

Located in the field are:

- remote I/O peripherals for the following machinery and process areas:
  - No. 1 Main air compressor
  - No. 1 Prepurifier and precooling area
  - No. 1 Cold box (PHX, O2 and Ar) area
  - No. 1 Product nitrogen compressor
  - No. 1 Booster Air Compressor
  - No. 1 Storage and back-up area
- MV & LV distribution switchboards and other electric panels are interfaced with remote I/O cards
- following equipment are connected with the basic process control system:
  - No. 1 Chiller local control panel hardwired connected to the remote I/O of the prepurifier and precooling area (only for on/off status, cumulative alarm and shutdown)
  - Plant analyzers, installed inside the related panel, connected on the system bus

#### **4.13.4 Application software**

The PLC manage the Plant control and is connected with the operator station to exchange data as follows:

- process parameters
- alarms and interlocks
- measures and controller loops.

Basically, the application software performs control, interlock and protection of machinery and process equipment, alarm management, loops control and communications of the networks.

The PLC software is developed using the Siemens STEP7 tools; all the programming languages comply to IEC 61131-3.

Digital and analogical inputs from the process (control valves – various instrumentation to detect or measure flows, pressures, analysis, temperatures etc.) and from the machineries, are controlled by the PLC located in the main control panel, which sends back to the plant all the processed outputs.

At the same time signals are monitored on the display of the operator station for the management of the plant.

The start up of the single unit is done manually by the operators from the control room using the HMI system excluding the cryogenic pumps which shall be locally started-up; few field manual operations are required during this stage.

Process control loops of the plant are manually operated by operators up to the plant reaches steady conditions; once such conditions are settled, operators can turn the control loops to the automatic operation.

#### **4.13.5 Instrument & Control Cables, Tubing**

Instrument & Control cables supply:

- cables between field instrumentation to field junction boxes
- cables from field junction boxes to control panel in local Control Room - inside of the ASU Area
- tubing from field sampling points to Analyzers Panel in local Control Room - inside of the ASU Area

#### 4.13.6 Analyzers Panel

##### 4.13.6.1 Process analyzer panel

On this panel, field installed closest as much as possible to sampling points, will be assembled the automatic process analysers which provide information about the quality of the following gases:

TAG	Measure	Example	DRGAP	Standard Measuring Principle
AT1	%O2	Gas or Liquid O2	X	Paramagnetic
AT2A	ppm O2 in N2	Liquid N2	X	Zirconium oxide
AT2B	ppm O2 in N2	Gas N2	X	ppm O2 in N2
AT2C	ppm O2 in N2	Nitrogen @ MID Lower Column	X	ppm O2 in N2
AT3	% O2 in N2	Waste Nitrogen	X	Zirconium oxide
AT4	%O2	Crude Argon Feed	X	Paramagnetic
AT5	%O2+N2	Top of Crude Ar Column	X	Thermal Conductivity
AT7	ppm O2 in Ar	Top of Crude Ar / Pure Ar Column	X	Zirconium Oxide
AT11	ppm THC	Total Hydrocarbons in MC	X	Flame Ionization Detector
AT11-1	ppm THC	Feed air to PPU	(1)	Flame Ionization Detector
AT12	ppm CO2	CO2 @PPU outlet	X	Infrared
AT14	Ambient sensor	Low / High O2 in atm.	X	Electrochemical
AT23	ppm N2O in O2	Nitrous Oxide in Main Condenser	(2)	Infrared

It is assumed Ambient Air quality is in accordance with “Air Quality Design Basis”. Therefore the AT11-1 and AT23 are not foreseen.

Note (1) Client shall advise if any of the Hydrocarbons in ambient air exceeds the upper limits indicated in document GUI-4 “AIR QUALITY DESIGN BASIS”; in case the analyser shall be added.

Note (2) Client shall advise if any of the Hydrocarbons in ambient air exceeds the upper limits indicated in document GUI-4 “AIR QUALITY DESIGN BASIS” ; in case the analyser shall be added.

All the analysers are designed to meet the process control and product qualification needs of air separation plants.

Analysers have following main characteristics:

- easy to set up and operate
- low maintenance
- extremely stable and reliable sensors
- can measure up to four gases simultaneously
- network communications capability

Based on the reliability required by the continuous operation of the plant more than one sensor can be managed by the same control unit.

The analyser panel will be supplied complete with manual sampling systems and discharge manifold for sample gases.

#### 4.13.6.2 Storage Area Analyzer System (quoted together with Storage system – point 4.11)

The system will be installed in a dedicated brick broom close to the storage area.

The analytic system SCADA PENTATEC provide an automatic method to analyse the production and the storage tanks.

The software is in accordance with 11-CFR21.

The system is complete also with the remote panels to manage the mobile truck loading analysis.

The system could dialog by network with ASU plant PLC, Client's weight bridges for filling (by network), customer's management software (by interface database).

The supply includes the safety certification for the installation room thanks to sensors to monitor O<sub>2</sub>, H<sub>2</sub> and ventilation system in the room with relevant signals status.

#### **The analysers for Oxygen are:**

- Oxygen purity (paramagnetic type)
- CO and CO<sub>2</sub> (Infrared type) Siemens Ultramat 6
- Total Hydrocarbons content (FID type) Servo Pro
- Humidity (Electrochemical type) MEECO MEDOX



**The analysers for Nitrogen are:**

- CO and CO<sub>2</sub> (Infrared type) Siemens Ultramat 6
- Total Hydrocarbons content (FID type) Servo Pro
- Humidity (Electrochemical type) MEECO MEDOX
- NOX (chemiluminescenza) Ecotec Serious 40
- Oxygen traces (Electrochemical) SERVOMEX MOMO EXACT DF 310
- Gas chromatograph AGC NOVACHROM 4000 complete with trend vision card

**The analysers for Argon are :**

- Total Hydrocarbons content (FID type) Servo Pro
- Humidity (Electrochemical type) MEECO MEDOX
- Gas chromatograph AGC NOVACHROM 4000 complete with trend vision card
- Helium purifier for Argon carrier purification NOVAPUR GETTERX

The analysers will be installed in dedicate panels complete of pressure reducers

**4.13.7 FIELD INSTRUMENTATION & VALVES**

- electronic pressure transmitters of level, pressure and output
- gaseous flow (GOX and GAN) made by orifice plates and pressure transmitters
- temperature sensors
- pressure indicators
- adjustment valve with remote control
- safety and manual valves

**4.14 void****4.15 INTERCONNECTING PIPE MATERIALS****4.15.1 Piping & Fittings**

CS, SS Interconnecting piping, for process, utility and gaseous products, inside the battery limits, supplied in commercial length and / or size.

**4.15.2 CS Piping Supports**

To support the interconnecting pipelines, supplied in commercial length and / or size.

#### **4.16 INSULATION MATERIALS**

The supply includes materials in commercial length and / or size for external insulation on site of equipment and interconnecting pipelines according to Siad's standard Insulation Specification TS 1.030 rev. 8.

#### **4.17 MISCELLANEOUS**

The supply includes also:

- No. 1 Steam type Drain Vaporizer for cold liquids Cold Box drainage;
- No. 1 set of vent silencers for the air prepurifier unit and for the product gaseous discharge;
- defrosting & thawing circuit for cold box package complete with piping and valves;
- first charge of alumina and molecular sieve for air prepurifier vessels;
- foundation & anchor bolts;
- external ladders and platforms for cold box package;
- UPS 10 minutes back-up of control system only;
- soft-starter for start-up of Main Air Compressor MV synchronous motor
- perlite powder for cold box package insulation (to be charged on site)
- set of lubrication oils and greases for the first filling
- set of sample gas cylinders for analysers calibration

#### **4.18 SPARE PARTS FOR COMMISSIONING AND START UP**

## 5. **PROCESS BATTERY LIMITS**

Air feed	:	at the inlet filter of air compressor
Gaseous oxygen	:	at the outlet flange of Cold box
Liquid oxygen	:	at the outlet flange of Cold box
Gaseous nitrogen	:	at the outlet flange of Cold box
Liquid nitrogen	:	at the outlet flange of Cold box
Liquid Argon	:	at the outlet flange of Cold box
Cooling Water	:	at the flanges plant battery limit
Electrical MV power supply	:	at the inlet terminals of 6,3 kV switchboard
Equipment	:	at top edge of foundation blocks
Water draining	:	at the outlet flanges of the drainage points
Instrument Air	:	at the inlet flange at plant battery limit

## 6. **CODES AND STANDARDS**

The plant is designed and manufactured according to SIAD M.I. standard including the latest technology applied in this sector by the leading manufacturers in the world.

The main components of the plant such as machineries, instrumentation and electrical equipment are supplied by primary manufacturers in accordance with the long experience of SIAD M.I. in this field.

Pressure vessels, exchangers, columns and safety valves are calculated according to recognized international codes as suitable to be CE stamped according to 97/23/EC directive.

Piping material according to SIAD MI standard.

Piping construction according to SIAD M.I. standard.

Electrical equipment will be in accordance with IEC rules.

Cryogenic equipment and oxygen use items are according to MFR STD.

The following packaged equipment/items:

- Main Air Compressor, air booster and nitrogen compressor package
- Expansion turbine and booster compressor, oil pump motor, instrumentation and lube oil system

are designed, manufactured and tested according to Manufacturers' standards, which is suitable for the scope, and according to the application and the environmental conditions.

The plant will be suitable to be installed in Slovakia.

## 7. **PAINTING**

Cold box, Vessels and all largest pieces shop assembled, are supplied finished/painted according to Siad's Painting Specification TS 1.005 rev. 3 suitable for the scope and environmental.

Piping, supports and in general all the structures and parts to be field erected and welded, are supplied in commercial length and / or size, prime painted only; they will be finished/painted at site after complete erection and testing, according to Siad's painting specification TS 1.005 rev.3 suitable for the scope, application and environmental.

Instrumentation, electric motors, machines, junction boxes, electric panels and in general all the pre-assembled units, sub-suppliers' equipment or materials will be supplied painted according to Manufacturers' standards painting.

## 8. **SUPPLY LIMITS**

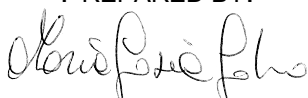
The basic supply limits are those clearly stated in this Proposal, but not limited to.

**In particular, from SIAD's Supply are excluded:**

- Demolition of installation area
- supply and erection of offices, warehouse, etc
- process and utilities connections outside the plant battery limits
- MV incoming electric power to MV switchboard terminals
- MV, LV trenches
- Piling
- Utilities
- emergency power generating systems
- sewers availability
- first aid service at site
- site fence and night watchman
- All taxes, fees, customs duties and clearance outside of exporting countries

Any other equipment and materials not expressly listed in the present specification.

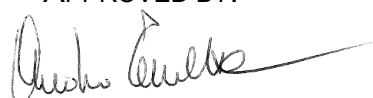
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