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Title	**Purchase Specification for Compressed Air Purification System for the Plasma Gasification Demonstrations Facilities**
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1 INTRODUCTION

Instrument air will be utilised in the plasma gasification demonstration facilities in Building V-H2 at Necsa. The crude compressed air that is available on-site from Necsa Utility Services is not of suitable quality for direct use as instrument air in the plasma facilities. Therefore, an air purification system must be sourced and incorporated into the facilities, as an intermediate step, to convert the crude compressed air into instrument air of the required quality.

2 PURPOSE AND SCOPE

2.1 Purpose

The purpose of this document is to define the technical requirements so that a Supplier may provide the required air purification system for the plasma gasification demonstration facilities.

2.2 Scope

The scope of this document is limited to the technical specifications and the scope of work for the supply of the air purification system.

3 REFERENCES AND ABBREVIATIONS

3.1 References

This document refers to the following documents:	
[1]	LSA-GEN2021-REP-0001: Site Description: Pelindaba Site
[2]	ISO 8573-1:2021(E): Compressed Air Part 1 – Contaminants and Purity Classes
[3]	ISO 9001:2015: Quality Management Systems - Requirements

3.2 Abbreviations

Abbreviation	Description
^{o}C	Degrees Celsius
% RH	Percentage Relative Humidity
(C)	(Chemical)
(g)	Gauge (Pressure)
(N)	(Nuclear)
FAT	Factory Acceptance Test
H	Height
HMI	Human Machine interface
Hz	Hertz
IP	Ingress Protection
IQ	Installation Qualification
K	Kelvin
kg	Kilogram
kPa	Kilopascal
kW	Kilowatts
L	Length
mm	Millimetre
Nm^3/min	Normal Cubic Meter per Minute
mg/m^3	Milligram per cubic meter
P&ID	Piping and Instrumentation Diagram
QC	Quality class
SAT	Site Acceptance Test
SC	Safety class
W	Width
V	Volts

3.3 Definitions

Term	Definition
Pressure dew point	Temperature to which air must be cooled, at a given pressure and water-vapour content, for it to reach saturation; the temperature at which dew begins to form.
Reference conditions	The ambient pressure and temperature conditions at which dryer performance is specified.

4 SPECIFICATION SHEET FOR AIR PURIFICATION SYSTEM

Table 1: Technical Specification Sheet for Air Purification System

AIR PURIFICATION SYSTEM Y1702 SPECIFICATION SHEET					
Design description	Air purification system Y1702 is used to condition crude compressed air into instrument grade air. The crude compressed air is sourced from an existing supply from Necsa Utility Services in the V-A12 compressor plant. Moisture separator Y1701 is installed upstream of the air purification system. The instrument air will be used as a utility for the plasma gasification demonstration facilities in Laboratory 150 and 131 in Building V-H2 on Necsa's Pelindaba East site. The air purification system shall consist of the following, as a minimum: o single pre-filter o Twin desiccant vessels o Single after-filter o Interconnecting piping and valves o Necessary control and instrumentation o First fill of desiccant o Noise attenuation equipment o Baseplate or support structure				
Plant Location	NECSA, Pelindaba, North-West Province.				
Equipment Location	NW PlasGas Demonstration facility – Outside Laboratory 150.				
Safety Classification	Non-classified(N) & SC-3(C)				
Quality Classification	Non-classified(N) & QC-3(C)				
OPERATING PROPERTIES					
PARAMETER	**UNITS**	**MINIMUM**	**NORMAL**	**MAXIMUM**	
Inlet temperature [Note 1]	^{o}C	-3	19	40	
Inlet pressure	kPa (g)	100	500	750	

AIR PURIFICATION SYSTEM Y1702 SPECIFICATION SHEET				
Normal flow rate [Note 2]	Nm^3/min	0	8	12
Relative humidity (annual average) [1]	% RH	50	56	62
Maximum moisture content (gram of water per cubic meter of dry air)	g/m^3	-	-	67

AIR PURIFICATION SYSTEM REQUIREMENTS	
PARAMETER	**SPECIFICATION**
Required minimum purity class for particles	Class 3, as per ISO 8573-1:2010(E) [2]
Required minimum purity class for humidity and liquid water	Class 4, as per ISO 8573-1:2010(E) [2]
Required minimum purity class for total oil	Class 1, as per ISO 8573-1:2010(E) [2]
Maximum pressure dew point for dyer	- 40 °C
Type of pre-filter	Supplier to advise. Pre-filter shall be equipped with an automatic condensate drain.
Size of pre-filter	Supplier to advise.
Type of dryer	Heatless regenerative desiccant dryer, twin vessels configuration.
Dryer control system	Local controller and HMI system to monitor the operation of the dryer.
IP rating for housing of dryer control system	Minimum rating: IP 65
Dryer blow-off/exhaust ports	Fitted with pneumatic silencers/mufflers for noise reduction and safe venting of pressurised air.
Type of after-filter	Supplier to advise.

AIR PURIFICATION SYSTEM Y1702 SPECIFICATION SHEET	
Size of after-filter	Supplier to advise.
Allowable maximum pressure drop across entire system (pre-filter, dryer and after-filter)	30 kPa
Fail position of dryer inlet switching sequence valves in case of power failure	Fail closed (Uninterrupted air flow is **NOT** required in case of power failure.)
Packaging and handling requirement	The air purification system (package) shall be self-contained, with all components on a common structural steel skid or baseplate.
Operational and maintenance requirement	The arrangement of equipment, piping and valves shall provide adequate operation clearance and maintenance access, including safe manual handling.
Installation location and method-	Outdoor under a canopy – Northern side of Building V-H2. Anchor bolt installation (preferable).
NOTES FOR SUPPLIER	
Note 1: Minimum temperature is based on the lowest ambient night temperature, the normal temperature is an annual average temperature and the maximum temperature is based on the highest ambient temperature on the Necsa site [1]. The atmospheric pressure on the Necsa site is 88 kPa.	
Note 2: The flow rate value in Nm^3/min are given at the reference conditions of 101.325 kPa(a) and 273.15 K. The actual normal flow rate is 1.33 m^3/min at 19 ^oC and 500 kPa(g). The actual maximum flow rate is 1.60 m^3/min at 40 ^oC and 750 kPa(g).	
Note 3: Maximum allowable installation space: Length = 3000 mm, Width = 1000 mm and Height = 2500 mm	

5 SCOPE OF WORK FOR THE SUPPLY OF THE AIR PURIFICATION SYSTEM

The sections below detail the work that the Supplier shall perform for Necsa with respect to the supply and delivery of the required air purification system. The Supplier shall not deviate from this scope of work without prior approval from Necsa. The Supplier is advised to take note of all the requirements provided here when developing their project plan.

5.1 Scope of Supply

Figure 1 below depicts the scope of supply for the Supplier, which is indicated within the red-marked boundaries.

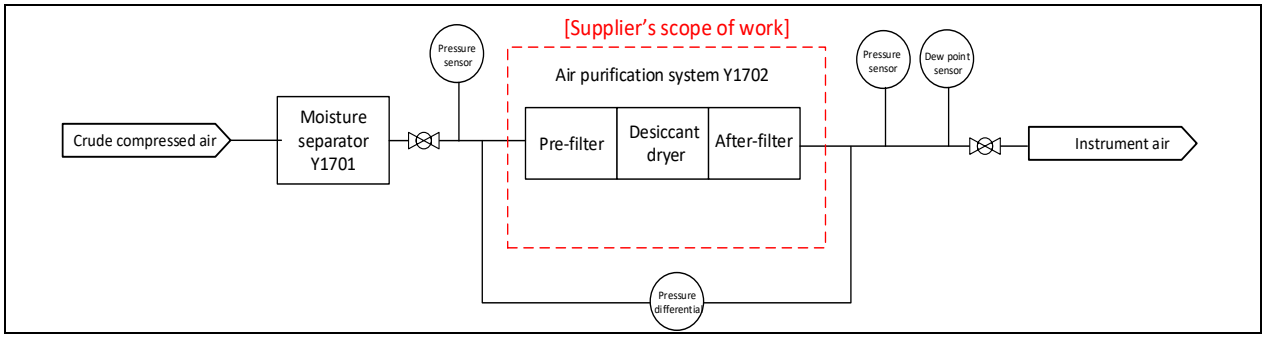

Figure 1: Scope of Supply for Supplier

5.2 General requirements

5.2.1 Documents generated by the Supplier

All the documents provided by the Supplier as part of this scope of work shall clearly indicate the status of the document, e.g. for information, approved, specification, datasheet, calibration certificate etc.

5.2.2 Witness and hold points

As part of this scope of work, Necsa has identified deliverables that are considered as witness points and hold points. Those deliverables are clearly indicated in the list of deliverables in Table 2 below. The Supplier must note the following:

- The deliverables identified as witness points shall be witnessed by Necsa either physically or virtually (physical witness is preferred).
- The deliverables identified as hold points shall be submitted by the Supplier to Necsa for acceptance.

5.3 Engineering design requirements

The supplier shall perform all the engineering and design work, based on the Supplier's engineering design control plan to deliver an air purification system based on the technical requirements specified in Table 1 above. The supplier's engineering and design work shall include the following:

5.3.1 Desiccant vessels requirements

- The supplier shall be responsible for the correct sizing of vessels based on the maximum inlet air volume flow rate at operating pressure and maximum moisture content as stated in Table 1 above.
- The desiccant vessels shall be fabricated pressure equipment, designed, constructed, inspected, tested and certified as per ASME Section VIII Div. 1 or EN 13445. The vessels shall be ASME code stamped.
- The supplier shall provide evidence that the vessels can withstand the cyclic fluctuation of pressure and temperature as specified in Table 1 above.
- The vessels shall have dedicated fill and drain ports for filling and emptying of desiccant medium.
- The Supplier shall be responsible for the first fill of the desiccant medium.
- The supplier shall provide the expected life of the supplied desiccant medium and the cycling frequency, based on maximum moisture loading for the inlet conditions specified in Table 1 above.
- The supplier shall provide the total time for one complete drying and regeneration cycle.
- The supplier shall provide the duration of each individual stage, as applicable.
- The supplier shall provide the duration for pressurization and de-pressurization prior to cycle changeover.
- The supplier shall provide the interval for valve cycle switching for main switching valves and purge-flow valve.

5.3.2 Pre-filter requirements

- A single pre-filter shall be provided and sized for 100% of the dryer inlet capacity.
- The provided pre-filter shall be capable of removing water droplets of oil aerosol, water, dust and other foreign matter.
- The pre-filter shall be equipped with automatic drain trap with manual bypass
- The pre-filter particle removal rating shall be 1.0 micron absolute or less.

5.3.3 After-filter requirements

- A single after-filter shall be provided and sized for 100% of the dryer inlet capacity.
- The provided after-filter shall be capable of removing suspended particles and desiccant dust that may be carried over from dryer.

- The after-filter particle removal rating shall be 1.0 micron absolute or less.

5.3.4 Control system requirements

- A programmable logic (PLC) type of controller shall be provided,
- The local control panel shall provide display, status and alarm indication as a minimum for:
  - Which desiccant vessel is in drying mode
  - Which desiccant vessel is in regenerative mode
  - Switching valve operational and failure status
- Dryer inlet switch sequence valves shall be fail close type to ensure that supply of air is terminated in case of a power failure.

5.3.5 Drawing and data requirements

The supplier shall provide the following documentation as a minimum:

- Detailed operating, installation and maintenance procedures for all applicable components of the system
- Electrical drawings
- Piping and instrumentation diagram
- Datasheets for all components of the air purification system
- The supplier shall provide a spares list for capital, operating and maintenance and commissioning spares indicating the following:
  - Supplier part number and/or original equipment manufacturer (OEM) part number
  - Manufacturer and model number
  - Recommended stocking quantity
  - Unit price
  - Delivery time
- Calibration certificates for instrumentation used during FAT and SAT.
- Provide information indicated as “Supplier to advise” on Table 1 above.
- Certification for pressure vessels for desiccant vessels.

5.3.6 Baseplate and support structure requirements

- A baseplate or structural steel skid shall be a single-fabricated structural steel unit
- If applicable, the structure shall provide with lifting lugs at least four-point.

5.3.7 Piping requirements

- Air distribution systems should be designed in accordance with local, national and international codes and standards.

5.4 Testing requirements

5.4.1 Factory Acceptance Test (FAT)

Prior to having the air purification system delivered to Necsa, Necsa shall participate in a FAT, which shall be conducted at the Suppliers testing facility. The Supplier shall provide Necsa with the relevant approved FAT protocol(s) in advance. The FAT outcomes/results are considered as a witness and hold point.

5.4.2 Site Acceptance Test (SAT)

A SAT shall be conducted by the Supplier at Necsa. The Supplier shall provide Necsa with the relevant approved SAT protocol(s) in advance. The SAT outcomes/results are considered as a witness and hold point.

6 QUALIFICATION OF THE SUPPLIER

Based on the quality classification of the scrubber (as per [3]), the minimum qualification criteria for the supplier are as follows:

- The supplier shall be ISO 9001:2015 [3] accredited or be able to demonstrate that they have a QMS that complies with ISO 9001:2015 [3].

7 SUMMARY OF DELIVERABLES

Table 2: Summary of deliverables that form part of the scope of work

Deliverables	Status of deliverable
Engineering documentation: a) Detailed operating, installation and maintenance manuals/procedures b) Flow diagrams, P&ID's, electrical drawing c) Datasheets of components d) Spares list e) Calibration certificates for instrumentation f) Pressure vessel certificates for desiccant vessels	Witness point
FAT protocol(s)	Witness point
FAT outcomes/results report	Hold point
SAT protocol(s)	Witness point
SAT outcomes/results report	Hold point

8 REVISION HISTORY

This document has been revised in accordance with the following schedule:

Rev. No.	Date approved	Nature of Revision	Prepared
1	See title page	First issue.	L Dlamini