RFQ Number	**NLM-QUO-24/057**
Request for Quotation Date	**26 September 2024**
RFQ Closing Date	**26 October 2024**
RFQ Closing Time	**17:00**
Compulsory Site Briefing	**Not compulsory but if more information required can be arranged**
Contact Person	**Catherine Matima**
Quotation Validity	**90 Days from the closing date**
Submission Details	**RFQ Response must be sent to:** **catherine.matima@necsa.co.za**
RFQ Description	To design and manufacture a scrubber system as per ENS-FDP-SPE-24008

Dear Service Provider

Kindly provide a quotation for goods and or services as outlined in section 2 of this document.

1. Introduction

The South African Nuclear Energy Corporation Limited (Necsa) is a state-owned public company (SOC), registered in terms of the Companies Act, (Act No. 61 of 1973), registration number 2000/003735/06.

The Necsa Group engages in commercial business mainly through its wholly-owned commercial subsidiaries: NTP Radioisotopes SOC Ltd (NTP), which is responsible for a range of radiation-based products and services for healthcare, life sciences and industry, and Pelchem SOC Ltd (Pelchem), which supplies fluorine and fluorine-based products. Both subsidiaries, together with their subsidiaries, supply local and global markets, earning valuable foreign exchange for South Africa and are among the best in their field in their respective world markets.

Necsa's safety, health, environment and quality policies provides for top management commitment to compliance with regulatory requirements of ISO 14001, OHSAS 18001 and RD 0034 (Quality and Safety Management Requirements for Nuclear Installations), ISO 9001 and ISO 17025.

Necsa promotes the science, technology and engineering expertise of South Africa and improves the public understanding of these through regular communications at various forums and outreach programmes to the community. We are a proudly South African company continuously striving, and succeeding in many respects, to be at the edge of science,

technology and engineering related to the safe use of nuclear knowledge to improve our world.

For more information on Necsa, please visit: www.necsa.co.za

2. Scope of Work

Item Description	Quantity
To design and manufacture a scrubber system as per ENS-FDP-SPE-24008	1

3. Attachments

Ref #	DOCUMENT NAME	DESCRIPTION
01	ENS-FDP-SPE-24008	Purchase Specification for the Scrubber S83123 in the PTFE Filter Destruction System
02	ENS-FDP-SPE-24009	Scrubber Specification Sheet

4. Pricing

- All price quoted to include all applicable taxes.
- Price must be fixed and firm
- Price should include additional cost elements such as freight, insurance until acceptance, duty where applicable, disbursements etc.
- Quotation must be completed in full, incomplete quote could result in a quote being disqualified.
- Payment will be according to Necsa's General Conditions of Purchase.

5. Evaluation

5.1. Phase 1- Functionality Evaluation / Technical Evaluation

Where functional or technical evaluation criterion is applicable, assessment will be performed in terms of the criterion listed below and the criterion may include Technical, Performance, Quality and Risk.
If the Bidder's response to the Technical templates does not indicate that the Bidder can support an acceptable technical solution, the Bidder's response will be rejected and not evaluated further.

Together the Technical, Performance & Quality and Risk criteria make up the functionality criterion and a Bidder's Proposal will be evaluated for functionality out of a possible 100 points. Only RFQ responses achieving an evaluation score of greater than the set threshold points

out of the possible 100 points and which score a number of points for functionality that is greater than or equal to the set threshold points of the number of points achieved by the highest scoring Bid for functionality will be selected to progress to the second stage.

The quotations will be evaluated according to the following selection criteria (based on information requested above):

Item	Requirement	Weight	Points	Criteria
1	**Company Experience** Relevant company (or JV/Sub-contractor) experience in design and manufacture of packed columns for the purpose of wet scrubbing. Completed projects – list of past projects (client details, project value, duration of the project, etc.) Traceable reference letter from clients that the supplier have completed the projects for 1. Company letter head 2. Contact details of the company 3. Purchase order amount Nature of the service rendered by the supplier.	70	70	More than 10 projects completed and reference letters from companies for which the supplier has designed and manufactured wet scrubber.
			60	Seven to Nine projects completed and reference letters from companies for which the supplier has designed and manufactured wet scrubber.
			50	Five to Six projects completed and reference letters from companies for which the supplier has designed and manufactured wet scrubber.
2	ISO 9001: 2015 (or latest) accredited (**30 points**). Must provide evidence (ISO 9001 certificate or approved Quality Management System)	30	30	ISO 9001 accreditation
			0	No ISO 9001 accreditation
Total		**100**		

5.2. **Phase 2 - Evaluation In Terms Of Preferential Procurement Policy Framework Act, 2022**

This bid will be evaluated and adjudicated according to the 80/20 point system, in terms of which a maximum of 80 points will be awarded for price and 20 points will be allocated based on the specific goals (B-BBE status level).

	POINTS
PRICE	**80**
SPECIFIC GOALS (B-BBEE status level)	**20**
Total points for Price and SPECIFIC GOALS	**100**

Preference goal
B-BBEE status level contributor

B-BBEE Status Level of Contributor	Number of points (80/20 system)
1	20
2	18
3	14
4	12
5	8
6	6
7	4
8	2
Non-compliant contributor	0

6. Required Documentation

- **CIDB (PE-ME 2) (Non-PE also eligible).**
- **Tax Clearance Certificate (Tax pin issued by SARS)**
- **Declaration of interest (SBD 4)**
- **BEE Certificate / Applicable Affidavit if classified as EME**
- **Letter of Good Standing (COID) only if Applicable due to the nature of work required**
- **Any other document or certification that might have been requested on this RFQ**

7. Important

7.1. **Quotation must be submitted on or before the RFQ closing date and time stated above.**

7.2. **Orders above R 30 000 will be evaluated according to the PPPFA 80/20-point system and a functionality scorecard where applicable and the ones above R 1 Million will be subjected to the tender process.**

7.3. **This RFQ is subjected to the Necsa's General Conditions of Purchase, Preferential Procurement Policy Framework Act 2000 and the Preferential Procurement Regulations, 2022, the General Conditions of Contract (GCC) and, if applicable, any other legislation or special conditions of contract**

7.4. **Failure on the part of a bidder to submit proof of B-BBEE Status level of contributor together with the bid, will be interpreted to mean that preference points for specific goals are not claimed.**

7.5. **The purchaser reserves the right to require of a bidder, either before a bid is adjudicated or at any time subsequently, to substantiate any claim in regard to specific goals, in any manner required by the purchaser.**

7.6. **For a Bidder to obtain clarity on any matter arising from or referred to in this document, please refer queries, in writing, to the contact details provided above. Under no circumstances may any other employee within Necsa be approached for any information. Any such action might result in a disqualification of a response submitted in competition to this RFQ.**

7.7. **No goods and/or services should be delivered to Necsa without an official Necsa Purchase order.**

7.8. **Necsa reserves the right to; cancel or reject any quote and not to award the RFQ to the lowest Bidder or award parts of the RFQ to different Bidders, or not to award the RFQ at all.**

7.9. **The supplier shall under no circumstances offer, promise or make any gift, payment, loan, reward, inducement, benefit or other advantage, which may be construed as being made to solicit any favour, to any Necsa employee or its representatives. Such an act shall constitute a material breach of the Agreement and the Necsa shall be entitled to terminate the Agreement forthwith, without prejudice to any of its rights**

7.10. **By responding to this request, it shall be construed that: the bidder, hereby acknowledge to be fully conversant with the details and conditions set out in the Necsa's General Conditions of Purchase, Preferential Procurement Policy Framework Act 2000 and the Preferential Procurement Regulations, 2022, the General Conditions of Contract (GCC), Technical Information and Specifications attached, and hereby agree to supply, render services or perform works in accordance therewith**

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South African Nuclear Energy Corporation SOC Limited

Title	**Purchase Specification for the Scrubber S83123 in the PTFE Filter Destruction System**
Doc. No.	ENS-FDP-SPE-24008
Revision	1

APPROVAL & DISTRIBUTION

	NAME	SIGNATURE & DATE
Prepared	M Correia Senior Process Engineer	
Checked	W Ludwick Senior Process Engineer	
Checked	B Khumalo Senior Process Engineer	
Checked	SM Mngoma Chief Mechanical Engineer	
Checked	G Manuel Chief C&I Engineer	
Checked	W van den Berg Chief Electrical Engineer	
Approved	K Moodley Chief Process Engineer	
Distribution	ES Records SM Mngoma K Moodley G Manuel	Docman W Ludwick N Mokoena

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1 INTRODUCTION

Wet scrubbing (otherwise referred to as gas absorption with chemical reaction) is required for the removal of entrained, toxic and acidic components from the process gas stream leaving the plasma reactor in Necsa's PTFE Filter Destruction Facility. The main component to be scrubbed from the gas is hydrogen fluoride (HF) and the scrubbing liquid of choice is potassium hydroxide (KOH) solution. Owing to the large amount of carbon dioxide (CO_2) also present in the gas, this component is also scrubbed in parallel to the HF. A packed bed scrubbing column is chosen for this purpose.

2 PURPOSE AND SCOPE

2.1 Purpose

The purpose of this document is to define the technical specifications for the KOH scrubber (S83123), so that a supplier may provide the process equipment required for use in the PTFE Filter Destruction Facility.

2.2 Scope

The scope of this document is to provide potential suppliers with the necessary information to design and manufacture the required KOH scrubber. The scrubber includes all of the following components:

- Scrubber sump tank
- Scrubber packed bed column (including packing, internal supports, liquid redistribution, etc.)
- Demister

3 REFERENCES, ABBREVIATIONS AND DEFINITIONS

3.1 References

This document refers to the following documents:	
[1]	ENS-FDP-CLC-24014: Mass Balance Calculation for the PTFE Destruction System
[2]	ENS-FDP-SPE-24009: Specification Sheet for Scrubber S83123 in the PTFE Filter Destruction System
[3]	ISO 9001:2015: Quality Management Systems - Requirements
[4]	ENS-FDP-PID-24003: P&ID Diagram – KOH Scrubber System 831

3.2 Abbreviations

Abbreviation	Description
CO_2	Carbon dioxide
F	Free Fluoride
HF	Hydrogen fluoride
H_2O	Water
K_2CO_3	Potassium carbonate
KF	Potassium fluoride
$KHCO_3$	Potassium bicarbonate
KOH	Potassium hydroxide
N_2	Nitrogen

Abbreviation	Description
O_2	Oxygen
P&ID	Piping and Instrumentation Diagram
PTFE	Polytetrafluoroethylene
QMS	Quality Management System
UF_6	Uranium hexafluoride
UO_3	Uranium trioxide
w/w	Weight per weight

3.3 Definitions

Phrase	Definition
Normal temperature and pressure	Taken as 20°C and 101.325 kPa

4 SYSTEM DESCRIPTION

4.1 Process Overview

The main purpose of the KOH scrubber (S83123) is to neutralise HF present in the gaseous stream coming from the plasma reactor in the PTFE Filter Destruction Facility, prior to releasing the gas into atmosphere via the building stack. Due to the nature of the reactions taking place, CO_2 will also be removed from the gas feed. The scrubbing liquid enters via spray nozzles near the top of the column and flows downward over the packing surface. The gas feed is introduced near the bottom of the column and rises upward, counter-current to the liquid. Mass transfer then takes place between the gas and liquid phases as they interact.

A scrubber sump is situated in a bunded area (B83169), with the packed bed column installed on top of the sump. The entire scrubber system is housed inside a secondary enclosure (Y82020) to prevent hazardous gases from reaching the wider operating area traversed by personnel, in the event of leakage from the scrubber system.

Figure 1 provides a schematic representation of the scrubber system to show its main dimensions and connection points. Note that this is not intended to be a mechanical or assembly drawing for the system. A description of lines entering and exiting the scrubber system is provided in Table 1.

All equipment numbers are as per the P&ID [4]. Only the scrubber and process connections (as per the scope in Section 2.2) are part of this specification. The P&ID is provided for context.

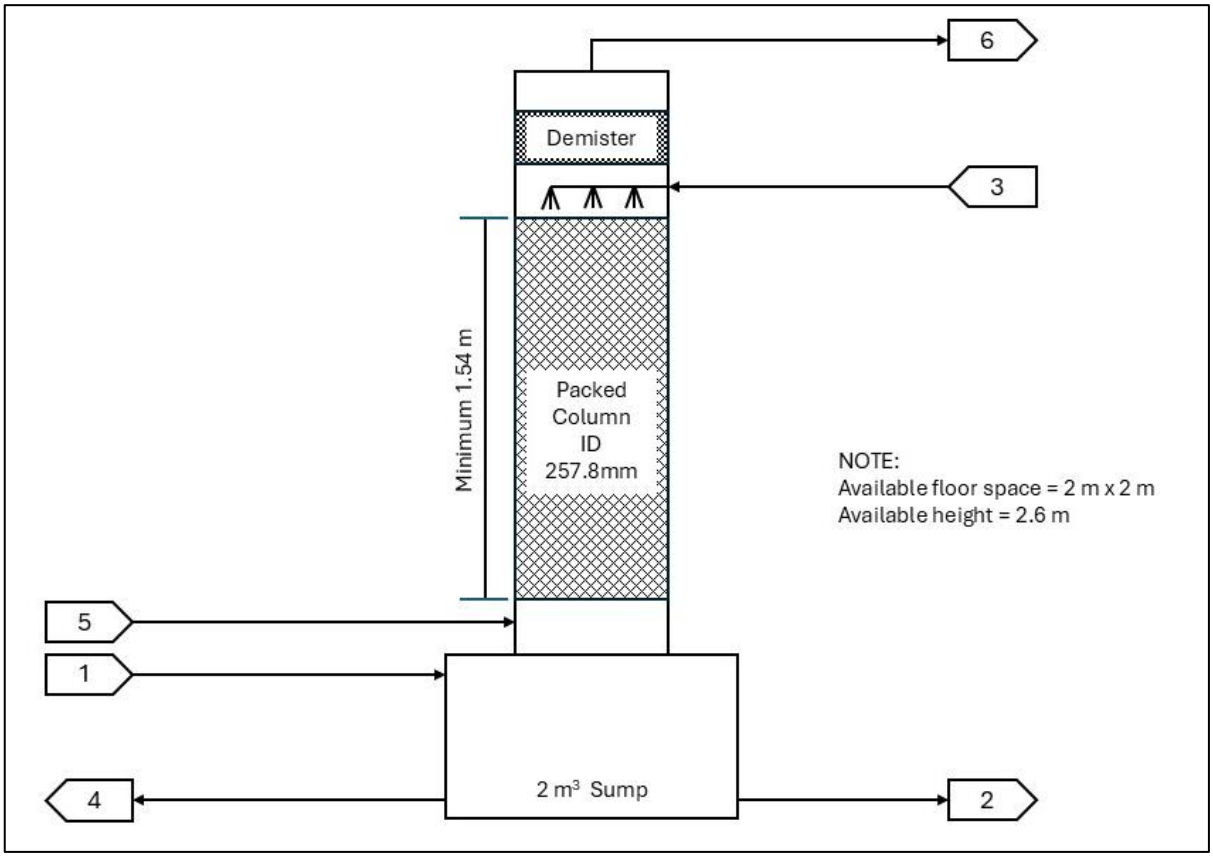


Figure 1: Schematic drawing of the packed scrubber column (S83123)

Table 1: Description of lines in Figure 1

Line number	Description
1	Fresh scrubbing solution from the KOH solution top up tank T853155 (batch process)
2	Scrubbing solution recycle stream, transfer to heat exchanger H83125
3	Scrubbing solution recycle stream, return from heat exchanger H83125
4	Scrubbing solution to liquid ring pump P83122
5	Two-phase mixture from liquid ring pump P83122. Mixture of scrubbing solution and gaseous feed stream from the plasma reactor, as well as products form from reaction that already may take place in the liquid ring pump.
6	Exhaust gas stream from scrubber to the process ventilation system

The composition of the gas feed stream to the scrubber (via the liquid ring pump) from the plasma reactor is shown in Table 2.

Table 2: Composition of the gas stream coming from the plasma reactor system

Chemical formula	Composition (% w/w)
CO_2	53.59
HF	28.74
H_2O	0.78
O_2	5.86
N_2	10.89
UF_6	0.14

The following reactions are expected to take place in the scrubber [1]:

$$KOH + HF \rightarrow KF + H_2O \quad (1)$$

$$CO_2 + 2KOH \rightarrow K_2CO_3 + H_2O \quad (2)$$

$$K_2CO_3 + HF \rightarrow KHCO_3 + KF \quad (3)$$

$$K_2CO_3 + CO_2 + H_2O \rightarrow 2KHCO_3 \quad (4)$$

$$KHCO_3 + HF \rightarrow KF + CO_2 + H_2O \quad (5)$$

Solids generated from these reactions (KF, K_2CO_3, and $KHCO_3$) become entrained in the scrubbing liquid. Based on solubility data, it is expected that KF and K_2CO_3 will remain in solution at all times. It is however possible for some of the $KHCO_3$ to precipitate. The scrubbing liquid collects at the bottom of the scrubber in the sump. From the sump, it is pumped through an in-line filter followed by plate heat exchanger (not shown in Figure 1), before being recycled backed to the top of the scrubber. The filter removes the solid material (precipitated $KHCO_3$) from the solution while the heat exchanger removes the heat generated by the exothermic reactions taking place in the scrubber.

A fresh batch of scrubbing liquid is an aqueous solution containing 30% (w/w) KOH. It is prepared externally and transferred into the scrubber sump at the start of the process. The batch is then re-used until it is considered spent. Due to the reactions taking place in the system, the composition of the scrubbing liquid changes over time. It is considered spent when the concentration of free fluorides in the scrubbing solution reaches 6% (w/w). At that point, the spent solution is pumped to a waste storage tank and a fresh batch of scrubbing solution is introduced. This is expected to be after 17 hours of operation.

The scrubbing process is divided into three phases, with the liquid effectively changing from an aqueous KOH solution to a K_2CO_3 solution to a $KHCO_3$ solution through the course of this process:

i. Phase 1: It is expected that Reaction (1) and Reaction (2) will dominate during the first 10.68 hours. During this time, the KOH concentration will decrease, until all is consumed. The KF and K_2CO_3 concentrations will increase.

ii. Phase 2: For the next 4.89 hours, Reaction (3) and Reaction (4) are expected to dominate. The K_2CO_3 concentration will decrease until all is consumed, while the KF and $KHCO_3$ concentrations will increase.

iii. Phase 3: During the last phase, until the scrubbing solution is considered spent, the $KHCO_3$ concentration will start to decrease and the KF concentration will continue to increase.

The change in concentration over time is shown in Figure 2, and the concentration at the end of each phase is shown in Table 3.

Table 3: Composition of the scrubbing liquid over time (% w/w)

Chemical formula	At the start	At end of phase 1	At end of phase 2	At end of phase 3
KOH	30	0	0	0
H_2O	70	66.81	68.04	68.95
UO_3	0	0.01	0.02	0.02
KF	0	11.01	16.62	18.30
K_2CO_3	0	22.16	0	0
$KHCO_3$	0	0	15.27	12.72
Free fluorides	0	3.6	5.45	5.99

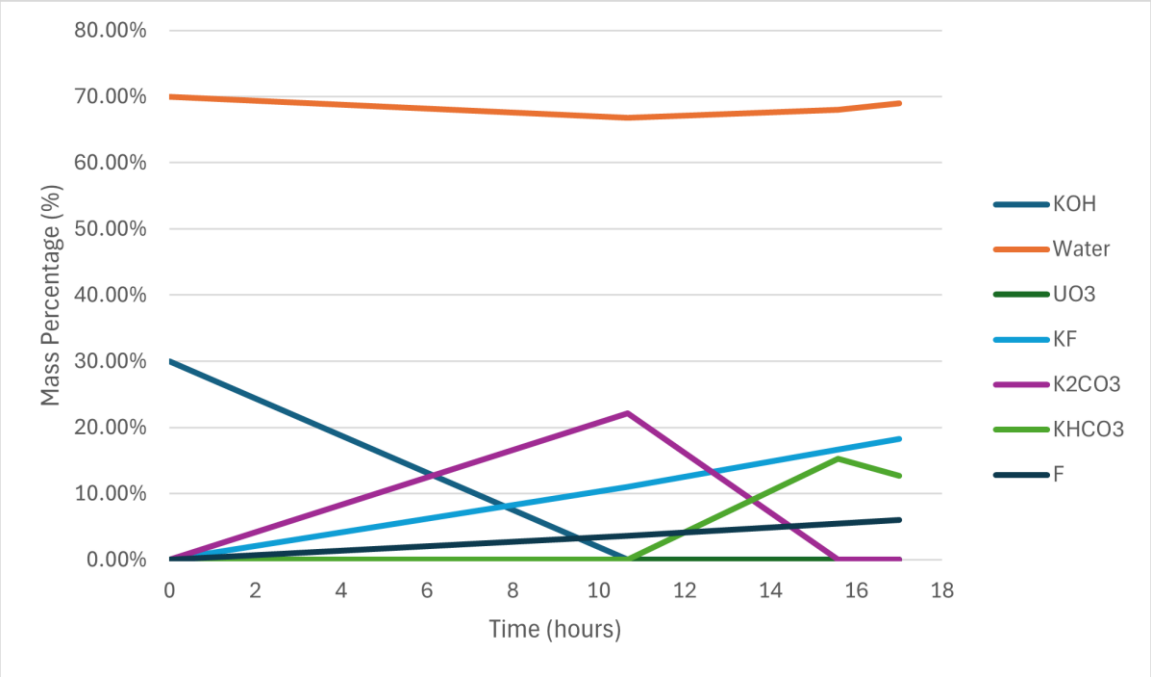


Figure 2: Composition of the scrubbing liquid over time

The gas stream exits the scrubber at the top after passing through a demister to capture any droplets that may be entrained in the gas. Due to the different reactions taking place through the various phases of scrubbing, the composition and flow rate of this off-gas stream will also vary during the different phases of scrubbing. These values are provided in Table 4.

Table 4: Composition and flow rate of off-gas during different phases of scrubbing

Chemical formula	Composition during phase 1 (% w/w)	Composition during phase 2 (% w/w)	Composition during phase 3 (% w/w)
CO_2	0.32	0.32	79.06
HF	0.17	0.17	0.04
O_2	34.83	34.83	7.32
N_2	64.68	64.68	13.59
Flow rate (kg/h)	4.7	4.7	22.1
Flow rate (Nm^3/h)	471	471	1650

4.2 System Location

The scrubber system is housed inside a Secondary Enclosure Y82020. In turn, the Enclosure is located inside Laboratory 131H in Building V-H2 on Necsa's Pelindaba-East site.

5 SYSTEM TECHNICAL DATA

5.1 Site Data

Site specific atmospheric data is provided in Table 5.

Table 5: Atmospheric data

Parameter	Minimum	Maximum
Mean summer temperature	18.9°C	26°C
Mean winter temperature	11.7°C	16.4°C
Design dry bulb temperature	2°C	32°C
Design wet bulb temperature	-1°C	21.6°C
Atmospheric pressure	87.4 kPa	88.3 kPa

5.2 Process Parameters

Process operating parameters and design conditions for the scrubber are defined in the specification sheet [2].

The scrubber must function at an efficiency of 99.9% with respect to HF, i.e. 99.9% of the mass of HF entering in the gas feed stream to the scrubber must be removed during operation.

The scrubber will not be operated continuously, it is expected to be operation for approximately 6 hours per day, 5 days per week.

5.3 Specific Requirements

Six connection points must be provided on the scrubber, as described in Table 6 (numbers correspond to Figure 1).

Table 6: Scrubber connections points

Number	Size	Connection type	Rating	Material	Location[Note]
1	50 NB	Raised Flange (RF)	150 lb	304L Stainless Steel	Side of the sump near the top
2	40 NB	Raised Flange (RF)	150 lb	304L Stainless Steel	Side of the sump near the bottom
3	40 NB	Raised Flange (RF)	150 lb	304L Stainless Steel	Side of the column, above the packed bed
4	40 NB	Raised Flange (RF)	150 lb	304L Stainless Steel	Side of the sump near the bottom
5	40 NB	Raised Flange (RF)	150 lb	304L Stainless Steel	Side of the column, above the sump, below the packed bed
6	100 NB	Raised Flange (RF)	150 lb	304L Stainless Steel	Top of the column

Note A schematic drawing is provided in Appendix A to show these positions relative to each other.

The scrubber sump shall be fitted with the following instrumentation:

- Ultra guided radar level indicator transmitter at the top of the scrubber sump

The specified sump volume is 2 m^3.

The total floor space available for installation of the complete scrubber system, including the sump, packed column, and all peripheral piping and components, inside the secondary enclosure is 2 m x 2 m. Similarly, the total height available for the installation is 2.6 m. The height of the packed bed inside the column shall be maximised within this space, subject to a minimum bed height of 1.54 m and internal diameter of 257.8 mm.

The design must make provision for the addition and removal of packing material, as well as accessing the scrubber internals for maintenance and/or other purposes.

Other design parameters for the scrubber are defined in the specification sheet [2].

Within the constraints of the above, the supplier shall advise on the following:

- Optimal shape and dimensions of the 2 m^3 sump tank.
- Alternative options to ensure sufficient packed bed height and enough space at the top to allow for construction and maintenance actions (e.g. splitting a single large sump tank into smaller interconnected vessels, etc.).
- Type, size and materials of construction for the demister, liquid spray nozzles and liquid redistribution.
- All mechanical supports required inside and/or outside the column and sump.

6 SCOPE OF SUPPLY

The following will be required from the supplier:

- To design and manufacture a scrubber system, including sump and column with demister and packing material, that conforms to all of the specifications given in this document. Note that all components identified in this document, which are located external to the scrubber (e.g. pump, filter, heat exchanger, KOH solution topup tank, waste storage tank, and piping) do not fall within the scope of this supply.
- The supplier shall provide Necsa with a preliminary design report and mechanical drawings of the designed scrubber for acceptance, prior to manufacturing thereof.
- Scrubber material will be purchased and supplied with material certificates. The hit-numbers shown on the material certificate will correspond with the hit-numbers punched or engraved on the purchased material.
- Non-destructive examination of the fabricated material will be done where practical. It should be noted that to be able to transfer the unit into the building and the laboratory, it will be necessary to supply the sump and column as separate units, only assembling it inside the laboratory. Supplier to confirm dimensions with Necsa after design before manufacturing to ensure that the separate units will fit through the laboratory doors. A leak test will be done after installation on site. The non-destructive examination results shall be supplied together with the scrubber on delivery.
- A pre-dispatch factory acceptance test will be carried out in presence of Necsa's engineers, as

follows:

- Verification of all quality control documents.
- Verification of traceability of materials and components used in the scrubber.

- The manufacturer shall first perform all the above checks/verification on their own, prior to calling Necsa's engineers for pre-dispatch factory acceptance test.
- In addition to the above, provide the following documentation:
  - General assembly drawings detailing major dimensions and connections
  - Scrubber design and manufacturing package, including non-destructive examination certificates
  - Installation manual
  - Operating manual (includes troubleshooting guides)
  - Maintenance manual
  - List of critical spares
  - Supply of critical spares

7 QUALIFICATION OF THE BIDDER

Based on the quality classification of the scrubber (as per [2]), the minimum qualification criteria for the supplier are as follows:

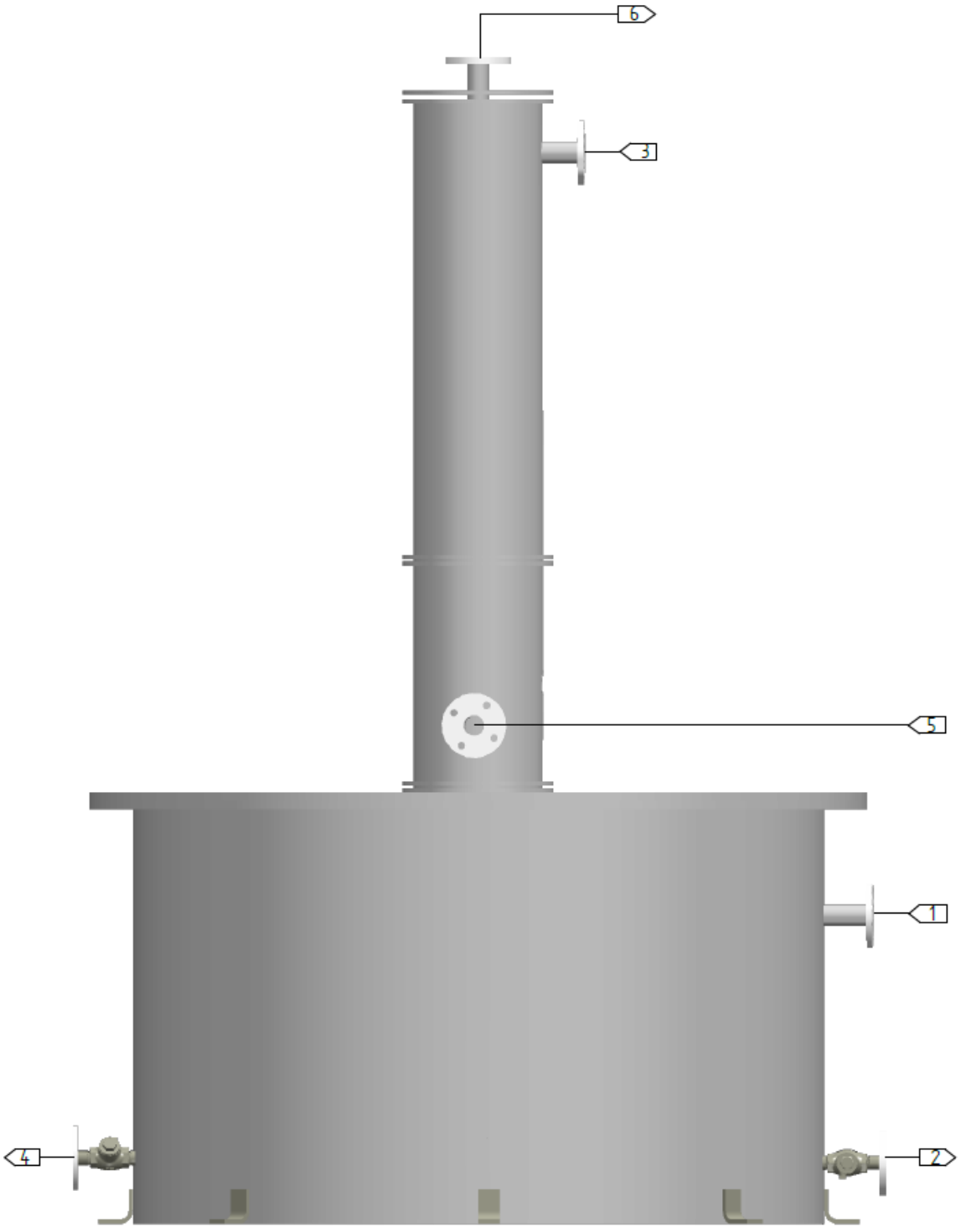
- The supplier shall be ISO 9001:2015 [3] accredited or be able to demonstrate that they have a QMS that complies with ISO 9001:2015 [3].

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	M Correia

APPENDIX A: SCHEMATIC TO SHOW LOCATION OF CONNECTION POINTS



ENGINEERING SERVICES DEPARTMENT

SCRUBBER SPECIFICATION SHEET

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Project	PTFE Filter Destruction	**Unit Tag Number**	S83123
Datasheet Document No.	ENS-FDP-SPE-24009	**Revision**	R1,0

Description	KOH Scrubber
Plant	PTFE Filter Destruction Demonstration Facility
Plant Location	Building V-H2, Laboratory 131H (housed inside a secondary enclosure Y82020)
Safety Classification	SC-2(C) and SC-3(N)
Quality Classification	QC-2(C) and QC-3(N)

FLUID PROPERTY DATA

		UNITS	GAS	LIQUID
Fluid Description			CO_2, HF, H_2O, O_2, N_2, UF_6 Note 1	H_2O, KOH, KF, K_2CO_3, $KHCO_3$, UO_3 Note 1, 2
Density (at average temperature)		**kg/m^3**	0.963	1274,8
Viscosity		**cP**	0.015	1.6
Operating Temperature	**Minimum**	**°C**	25	25
	Normal - in	**°C**	35	35
	Normal - out	**°C**	44.19	44.19
	Maximum	**°C**	80	60
Flow rate (feed to scrubber) Note 4		**kg/h**	28	5392
		m^3/h Note 3	22	4.3
Operating pressure	**Minimum**	**kPa(g)**	-10	190
	Normal	**kPa(g)**	-5	220
	Maximum	**kPa(g)**	0	250
Permissible pressure drop over packed bed		**kPa**	0.25	
Design pressure drop over packed bed		**kPa**	Supplier to advise	
Design temperature		**°C**	80	
Design pressure		**kPa**	2000	

CAPACITY DATA

Column diameter	Inner diameter 257.8 mm
Bed height	Minimum 1.54 m, to be increased to maximum feasible with available ceiling height
Type of packing	Pall rings
Packing material	Polypropylene
Packing size	16 mm
Sump volume	2 m^3
Sump dimensions	Supplier to advise
Instrumentation	Ultra guided radar level indicator transmitter on the scrubber sump
Accessories	Liquid redistribution every 1.29 m (maximum); supplier to advise optimal position
	Demister on gas outlet
	Spray nozzles for introduction of recycled scrubbing liquid
	Mechanism for gas injection
	Packing support
Operating hours	6 hours per day, 5 days per week

MECHANICAL SECTION

Process exposed meterial	Polypropylene (scrubber sump and column)
Code requirements	ASME B31.3; latest edition
Process connections	Flanged (150lb rated)

SITE CONDITIONS

Altitude	**m**	1300 m
Site Location		Pelindaba East, H-Building
Atmospheric Pressure	**kPa(a)**	Min: 87.4 kPa; Max: 88.3 kPa
Ambient Temperature (min./max.)	**°C**	Min: 2°C; Max: 32°C

ENGINEERING SERVICES DEPARTMENT

SCRUBBER SPECIFICATION SHEET

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Project	PTFE Filter Destruction	**Unit Tag Number**	S83123
Datasheet Document No.	ENS-FDP-SPE-24009	**Revision**	R1,0

REFERENCE DRAWINGS AND DOCUMENTS

[1] ENS-FDP-CLC-24016: Scrubber Design Calculation for the PTFE Filter Destruction System

[2] ENS-FDP-PID-24003: PTFE Filter Destruction System KOH Scrubber P&ID

NOTES

Note 1: The composition of the gas entering the scrubber is (w/w) : 53.59% CO_2, 28.74% HF, 7.80% H_2O, 5.86% O_2, 10.89% N_2, and 0.14% UF_6.

Note 2: The sump tank of scrubber S83123 will be charged with a batch of aqueous 30% KOH solution at the start and this solution will then recirculated through the heat exchanger H83125 during the scrubbing process. The scrubber solution composition will change over time due to the chemical reactions taking place in the scrubber. The scrubbing process is divided into three phases. During the first phase, KOH will start decreasing, while KF and K_2CO_3 start forming. At the end of this phase, the composition of the scrubbing solution will be 66.81% water, 11.01% KF, 22.16% K_2CO_3 and approximately 13 ppm UO_3. At the end of the next phase, the solution composition of the scrubbing solution will be 68.04% water, 16.62% KF, 15.27% $KHCO_3$ and approximately 19 ppm UO_3. At the end of the final phase, the solution composition will be 68.95% water, 18.30% KF, 12.72% $KHCO_3$ and approximately 21 ppm UO_3. At this point the solution will be replaced with a fresh batch of aqueous 30% KOH solution. All solids are dissolved in the solution, with the exception of some possible precipitation of $KHCO_3$. The precipitate will be captured by the filters in the recycle.

Note 3: Gas flow rate given at normal conditions: 20°C and 101,325 kPa

Note 4: Flow to scrubber may be two-phase flow, since reaction may already be taking place in the liquid ring pump

	Name	Signature	Date
Compiled by	M Correia (Senior Process Engineer)		
Checked by	SM Mngoma (Chief Mechanical Engineer)		
Checked by	B Khumalo (Senior Process Engineer)		
Checked by	W Ludwick (Senior Process Engineer)		
Checked by	G Manuel (Chief C&I Engineer)		
Checked by	W van den Berg (Chief Electrical Engineer)		
Approved by	K Moodley (Chief Process Engineer)		