RFQ Number	**PTFE-2023-001**
Request for Quotation Date	**2023/11/14**
RFQ Closing Date	**2023/12-05**
RFQ Closing Time	**10.00am**
Compulsory Site Briefing	**2023/11/21 at 10:00 in H-Building**
Contact Person	kasuren.moodley@necsa.co.za
Quotation Validity	**90 Days from the closing date**
Submission Details	**RFQ Response must be sent to: Catherine.Matima@necsa.co.za**
RFQ Description	**D&D Process Engineering – PTFE Basic Design**

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
Professional Engineering Services from an Engineering Consultant to perform specific process engineering activities in the Basic Design of the PTFE Demonstration Plant. The SOW is limited to the *process engineering* deliverables listed below, with the work largely divided into five phases: · Phase 1: Mass, Energy and Pressure Balances · Phase 2: Piping, Pumps and Blower Sizing · Phase 3: Process Equipment Sizing · Phase 4: Technical Specifications · Phase 5: Pressure Protection Calculations The work shall be based on an existing engineering design of the PTFE Demonstration Plant to be provided by Necsa ecsa. Engineering design work not directly related to the above deliverables, as well as work for all other disciplines of engineering, are currently excluded from this SOW. See attached Document ENS-FPD-SOW-23001 Rev. 1.0.	1

3. 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.

4. Evaluation

4.1. 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.

4.2. 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

5. Required Documentation
   - 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

6. Important

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

6.2. 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.

6.3. 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

6.4. 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.

6.5. 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.

6.6. 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.

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

6.8. 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.

6.9. 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

6.10. 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

Document Title	SCOPE OF WORK: PROCESS ENGINEERING BASIC DESIGN FOR THE PTFE DEMONSTRATION PLANT
Number	ENS-FDP-SOW-23001 Rev. 1.0
Date	2023-11-07

APPROVAL & DISTRIBUTION

	NAME	SIGNED	DATE
Prepared	K MOODLEY Chief Process Engineer Engineering Services	07/11/2023 11:51:21(UTC+02:00) Signed by Kasuren Moodley, kasuren.moodley@necsa.co.za	
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Accepted	L MOGOTLHONG Project Manager		09/11/2023 12:32:03(UTC+02:00) Signed by Leonard Mogotlhong, leonard.mogotlhong@necsa.co.za
Approved	YA MANDRI GE: Technical Services	10/11/2023 12:10:41(UTC+02:00) Signed by Yolan Mandri, yolan@ntp.co.za	
Distribution	Engineering Services CMS (DG Ngwenya); All persons listed above		

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REVISION HISTORY

REV. NO.	DATE APPROVED	NATURE OF REVISION	PREPARED BY
1.0	See cover page	First Issue	K Moodley

1 INTRODUCTION

Polytetrafluoroethylene (PTFE) candle filters were previously utilized in Necsa's pilot and semi-commercial uranium enrichment plants. The spent filters emanating from these plants are thus contaminated with uranium and are currently classified as radioactive waste. There is a need to safely dispose of this waste to reduce Necsa's nuclear liability and to recover the uranium values locked into the matrix of these filters.

It has been determined that depolymerization of the filters inside an inductively heated reactor will allow the uranium to be recovered in the form of a uranium-containing residue. However, a key safety hazard associated with this process relates to the possible formation of perfluoroisobutylene (PFIB) gas, which is highly toxic, along with other fluorocarbon gases. To manage the risk of PFIB formation in a safe and controlled manner, a modified depolymerization-plasma gasification process is therefore considered here. To date, this technology has been investigated by Necsa only in experimental work undertaken on a relatively small laboratory-scale. The technology needs to be verified in a larger pilot plant, before a full-scale operational plant can be established to dispose of the radioactive waste.

Necsa therefore plans to design and construct a pilot facility, hereafter referred to as the "PTFE Demonstration Plant", not only to test the depolymerization-plasma gasification technology, but also to optimize the process parameters.

2 PURPOSE

The purpose of this document is to give high level Scope of Work (SOW) for the sourcing of Professional Engineering Services from an Engineering Consultant to perform specific process engineering activities in the Basic Design of the PTFE Demonstration Plant.

3 SCOPE

The SOW is limited to the *process engineering* deliverables listed below, with the work largely divided into five phases:

- Phase 1: Mass, Energy and Pressure Balances
- Phase 2: Piping, Pumps and Blower Sizing
- Phase 3: Process Equipment Sizing
- Phase 4: Technical Specifications
- Phase 5: Pressure Protection Calculations

All of this work shall be based on an existing engineering design of the PTFE Demonstration Plant to be provided by Necsa (see Section 7.1). Design changes are not permitted unless endorsed and authorized by Necsa.

Engineering design work not directly related to the above deliverables, as well as work for all other disciplines of engineering, are currently excluded from this SOW.

4 OWNERSHIP

This SOW document belongs to Necsa's Engineering Services Department. The General Manager or as delegated is responsible for updating of the document and to ensure implementation thereof.

5 ABBREVIATIONS

CMS	- Configuration Management System
CO_2	- Carbon Dioxide
e.g.	- For Example

etc. - And So Forth
H_2O - Water
HAZOP - Hazard and Operability (Safety Study)
HF - Hydrofluoric Acid
HSE - Health, Safety and Environment
HVAC - Heating, Ventilation and Air Conditioning (System)
KOH - Potassium Hydroxide
LPG - Liquefied Petroleum Gas
Necsa - The South African Nuclear Energy Corporation SOC Ltd
NQF - National Qualification Framework
P&ID - Piping and Instrumentation Diagram
PFD - Process Flow Diagram
PFIB - Perfluoroisobutylene
PTFE - Polytetrafluoroethylene
QMS - Quality Management System
Ref. - Reference
SOW - Scope of Work
SQEP - Suitably Qualified and Experienced Person
SSC - Structures, Systems and Components
viz. - Namely

6 DEFINITIONS

Term	Definition
Concept Design	All the design and testing activities and supporting documents necessary to confirm the feasibility of the elected waste disposal process. It provides inputs to the HSE Design Basis for the Basic Design and typically includes HAZOP 1 and 2 Reports, as well as a Design Base Accident Analysis.
Basic Design	All the design and testing activities and supporting documents necessary to confirm that the facility specification can be met. It typically includes the HAZOP 3 safety study, an SSC Safety Classification Report and Equipment Technical Specifications as inputs to the Detail Design of the equipment.
Detail Design	All the design documentation necessary to manufacture individual items of equipment, to construct the plant, and to meet all design and regulatory requirements. The documentation also describes all the necessary functional and physical characteristics of each item; the characteristics selected for product acceptance testing; and the tests necessary for installation, operation, support, training, and disposal of each item.
Consultant	A consultant specializing in process engineering design and providing technical solutions to the sizing and specification of process equipment in the PTFE demonstration plant.
Professional Engineering Services	A service that requires or is based on the application of process engineering principles and data to a design relating to engineering.

Term	Definition
Professionally Registered Chemical Engineer	A chemical engineer who is registered professionally as a Professional Engineer (Pr Eng) with the Engineering Council of South Africa.
PTFE Demonstration Plant	A new pilot-scale facility which Necsa plans to establish in a laboratory on-site to investigate the destruction of radiologically contaminated PTFE candle filters via a depolymerization-plasma gasification process.
Review	A detailed check of an engineering design deliverable to determine if the information presented is correct.
Suitably Qualified and Experienced Person (SQEP)	An individual holding a chemical engineering degree equivalent to NQF Level 8 or higher.

7 REFERENCES

The list of references given below is divided into two sections, viz. Basic Design Package (Section 7.1) and Supporting Information (Section 7.2). The former indicates specifically which engineering documents and drawings have already been prepared as part of the Basic Design Package for the PTFE Demonstration Plant and are considered relevant as input to the SOW defined here. All other documents listed under Supporting Information (Section 7.2) are referenced in this SOW but do not form part of the Basic Design Package.

Unless otherwise indicated, parties using this document shall apply the most recent edition of the documents listed in Sections 7.1 and 7.2.

7.1 BASIC DESIGN PACKAGE

[1] AC-FDP-DES-22002 Rev. 4, PTFE Filter Destruction Plant System Design Description
[2] AC-FDP-DES-22003 Rev. 4, PTFE Filter Destruction Plant Process Description
[3] AC-FDP-PFD-22001 Rev. 2, Filter Destruction Project – Process Flow Diagram
[4] AC-FDP-LST-22004 Rev. 1, Filter Destruction Project – Piping and Instrumentation Diagrams Lead Sheet
[5] AC-FDP-PID-22001 Rev. 2, Filter Destruction Project – P&ID Diagram
[6] AC-FDP-PID-22002 Rev. 2, Filter Destruction Project Reactor System 820 – P&ID Diagram
[7] AC-FDP-PID-22003 Rev. 2, Filter Destruction Project KOH Scrubber System 831 – P&ID Diagram
[8] AC-FDP-PID-22004 Rev. 2, Filter Destruction Project Cooling Water System 832 – P&ID Diagram
[9] AC-FDP-PID-22005 Rev. 2, Filter Destruction Project Gas Supply System 833 – P&ID Diagram
[10] AC-FDP-LST-21001 Rev. 2, PTFE Filter Destruction Plant System Line List
[11] AC-FDP-LST-21002 Rev. 3, PTFE Filter Destruction Plant System Valve List
[12] AC-FDP-LST-21004 Rev. 3, PTFE Filter Destruction Plant Process Equipment List
[13] AC-FDP-REP-22008 Rev. 2, Mass Balance Calculation for PTFE System
[14] AC-FDP-REP-23002 Rev. 1, Energy Balance Calculation
[15] AC-FDP-REP-23001 Rev. 2, Pressure Balance across the PTFE Filter Destruction System (Requirement B-303)
[16] AC-FDP-CLC-23001 Rev. 1, PTFE Filter Destruction project – Pressure Protection Calculations: Pressure Relive Valve Sizing
[17] AC-FDP-RQM-23001 Rev. 1, HVAC Design Information for the PTFE Filter Destruction System (Requirement B-674).

7.2 SUPPORTING INFORMATION

[18] SHEQ-INS-0189, Overview of Necsa's Security Processes
[19] SHEQ-INS-8920, Access Control to Necsa Sites and its Facilities
[20] SHEQ-INS-8921, Necsa's Requirements for the Security Clearance of Items (Deliverables and Removals)
[21] SHEQ-INS-8923, Requirements for the Searching of Persons, Vehicles and Items Accessing and Egressing Necsa's Sites
[22] SHEQ-INS-0113, Overview of Necsa's Information Security Processes
[23] SHEQ-INS-0310, Information Security: Acceptable Use Procedure
[24] SHEQ-INS-0320, Information Security: Requirements for Third Party Access
[25] SHEQ-INS-8930, Security Requirements for the Control of Classified Information
[26] SHEQ-INS-0234, Necsa QMS Requirements for External Design Organisations
[27] EIGA IGC Doc 13/02/E, Oxygen Pipeline Systems

8 ROLES AND RESPONSIBILITIES

8.1 NECSA

Necsa is required to:

1) Provide access to the Necsa site for physical meetings.
2) Provide the relevant information to the Consultant for completion of the engineering work.
3) Timeously respond to queries from the Consultant to avoid project delays.
4) Organize and participate in meetings on a regular basis to ensure that all Necsa requirements are fulfilled.
5) Review and/or comment on the work provided by the Consultant, and eventually accept the work once all issues have been satisfactorily resolved.

8.2 CONSULTANT

The Appointed Consultant is required to:

1) Adhere to Necsa's security requirements in terms of access to the Necsa site and the handling of Necsa's information, as defined in Refs. [18] to [25].
2) Ensure that its quality management system complies with the requirements of Necsa, as defined in Ref. [26].
3) Perform a comprehensive review of all existing documents and drawings provided by Necsa for the PTFE Demonstration Plant.
4) Ensure that all engineering design work is undertaken by a Suitably Qualified and Experienced Person (SQEP).
5) Provide adequate resources (including SQEPs, computer hardware and software, etc.) for the required SOW.
6) Ensure that the scope of each task is carried out in full.
7) Provide regular feedback on the status of the work, no less than once per week.
8) Comply with all Necsa specific policies, procedures and guidelines.
9) Ensure compliance with the relevant design codes and standards.
10) Produce all deliverables for the SOW, with complete traceability through all design work presented.
11) Ensure that each deliverable is reviewed internally by a Professionally Registered Chemical Engineer and approved, thereafter, before submission to Necsa for consideration.
12) Take accountability and provide assurance for the quality of the work.

9 DESCRIPTION OF THE PLANT

The PTFE Demonstration Plant is schematically illustrated in the block flow diagram in Figure 1. The Plant will consist of five subsystems:

1. PTFE feed receival and preparation system
2. Reactor system, which includes a depolymerization reactor and a plasma gasification reactor
3. Process gas clean-up system, which includes KOH scrubber and ion exchange columns
4. Cooling water system, which includes primary and secondary systems (not shown in Figure 1)
5. Gas supply system, which provides nitrogen, oxygen, argon, methane and LPG to the process (not shown in Figure 1)

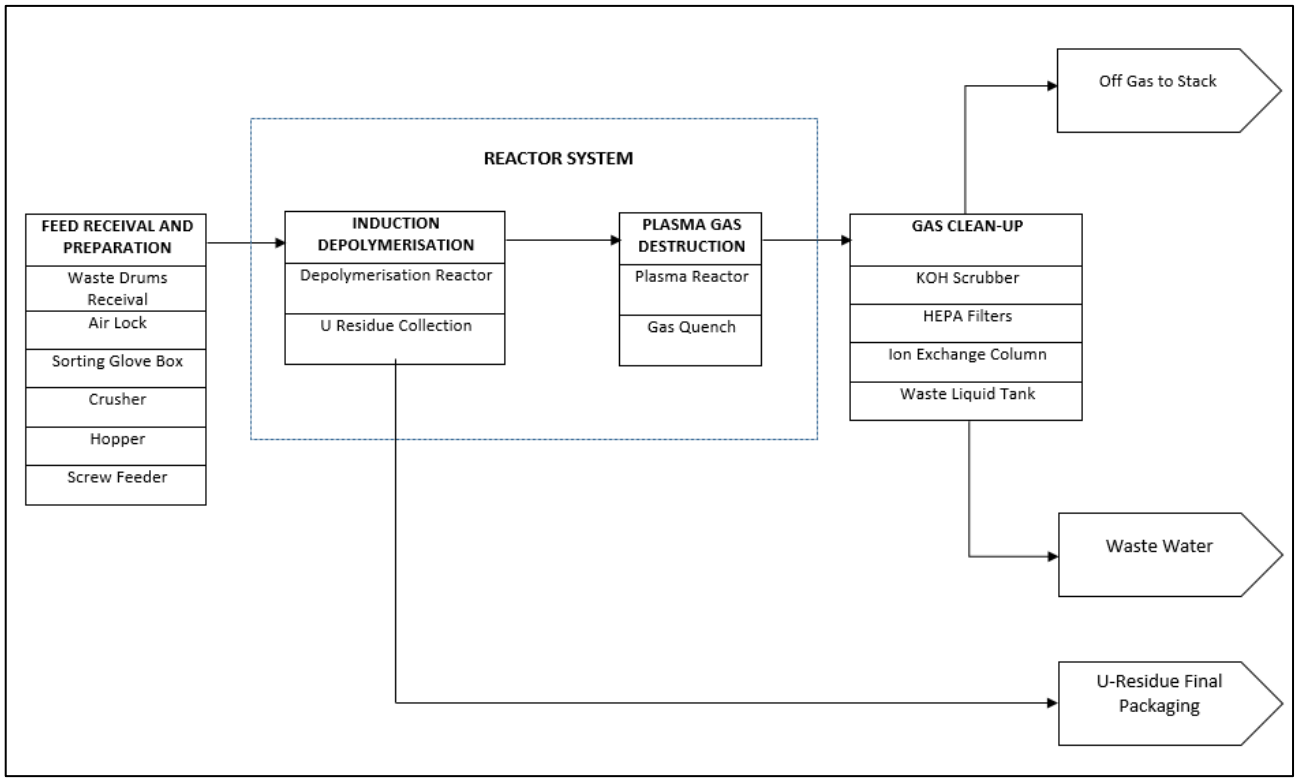

Figure 1: PTFE Demonstration Plant Block Flow Diagram.

Drums containing the contaminated filters will be received from storage and their contents will be emptied onto a sorting table inside a glove-box to remove any foreign matter. The filters will then be crushed to a pre-determined particle size in the contained environment, before being conveyed to a feed hopper. From there, the crushed material will be fed to the reactor system using a screw feeder. The section between the screw feeder and reactor will be cooled using a double-pipe heat exchanger to ensure that the heat from the reactor does not propagate upstream and to prevent the feed material from melting before entering the reactor.

In the two-stage reaction process, the PTFE filters will first be depolymerized inside a reactor at a temperature of around 800 °C. Thereafter, the gaseous products from this reactor will be destroyed inside a plasma reactor which will be positioned very close to the depolymerization reactor to prevent the gas from cooling down. The proposed reactor setup is supposed to prevent PFIB from forming, since the fluorocarbon intermediates will be converted into HF, CO_2 and H_2O before stable fluorocarbons can form. During this process, the uranium-containing residue will be collected from the depolymerization reactor before it is sent for uranium recovery in a separate facility (which is not within the scope of this project).

The off-gas exiting the plasma reactor will be cooled in a quench, before the gas is treated using a KOH scrubber to remove HF from the gas stream. After cleaning, the gas from the scrubber will be released to atmosphere via the off-gas stack. When the KOH scrubbing solution becomes spent, it will be pumped through

an ion exchange column to remove any radioactive components that may have dissolved in the solution and disposed of, thereafter.

A detailed description of the structures, systems and components in the PTFE Demonstration Plant is given in Ref. [1] and the operational process is described in Ref. [2]. For a complete understanding of the facility, these documents should be viewed in conjunction with the process flow diagram (PFD) presented in Ref. [3] and piping & instrumentation diagrams (P&IDs) in Refs. [4] to [9]. Line, valve, and equipment lists are also available in Refs. [10] to [12]. The HVAC system (which is not part of this SOW) is being designed according to the requirements defined in Ref. [17]. All of these references will be made available to the Engineering Consultant assigned to this project. This will also include plant and piping layout drawings, but these are not listed in Section 7 as these are still preliminary and subject to change, most likely after sizing of the process equipment is completed.

10 SCOPE OF WORK

10.1 SCOPE OF WORK STATEMENT

The engineering design of the PTFE Demonstration Plant was initiated by Necsa. The Concept Design has already been completed. The Basic Design commenced thereafter, and this progressed to the point of the HAZOP 3 safety study being undertaken. At this time, the findings and recommendations from the HAZOP 3 are in the process of being implemented and closed out by Necsa.

To complete the process engineering component of the Basic Design, various engineering calculations and technical specifications are required. In some cases, this will involve checking (verifying) calculations which are available in the current design package and, if necessary, updating the calculations, thereafter. In other cases, the required calculations were not performed previously, and therefore, entirely new calculations must be undertaken at this time. Once the relevant information is available from the calculations, various equipment technical specifications must then be compiled. The services of an Engineering Consultant are therefore sought for completion of the outstanding work described here.

The SOW for the Consultant largely entails the following:

1) Comprehensive review of the existing Mass, Energy and Pressure Balances, pipe sizes and pressure relief valve sizes in the PTFE Demonstration Plant.
2) Updating the calculations and/or reports associated with (1) above, if necessary.
3) Designing and sizing selected pumps, blowers and other process equipment in the PTFE Demonstration Plant.
4) Generating technical specifications for the sized equipment.
5) Ensuring that all equipment designed in this SOW meets the requirements of interfacing systems, e.g. HVAC (see Ref. [17]), etc.
6) Taking full accountability and liability for any changes to the existing design which result from the work undertaken here.
7) Preparing and issuing of handover documentation.
8) Attending to technical queries from Necsa.

The SOW will be conducted within the five phases and deliverables summarized in Table 1. The output from Phase 1 will effectively provide the input to other Phases.

10.2 SPECIFICATION AND DESCRIPTION OF THE SERVICES AND DELIVERABLES

10.2.1 PHASE 1: BALANCES

Reports for the Mass Balance, Energy Balance and Pressure Balance in the PTFE Demonstration Plant are currently available in Refs. [13], [14] and [15], respectively. The Consultant is required to review each of these Reports and verify if the results presented are correct. A document describing this exercise and the outcome thereof must be provided. If any errors, inconsistencies, gaps, etc. are identified during this process, then new calculations must be undertaken for the affected Balance(s) and an update (new revision) provided in place of Refs. [13], [14] and/or [15].

The above Balances are supplemented by the stream table that is attached to the PFD in Ref. [3]. The stream table summarizes the results of the Balances and provides the temperature, pressure, phase, mass flow rate and composition of each stream identified in the PFD. Therefore, if the values of any of the operating parameters are revised during this exercise, then the stream table must be updated accordingly.

Note: The FactSage software package was utilized when the Energy Balance was performed previously, as presented in Ref. [14]. It will be the responsibility of the Consultant to obtain access to FactSage in order to verify the existing calculations. In the event that these calculations are found to be incorrect, then an entirely new Energy Balance must be provided, however, the new calculations must be performed using Microsoft Excel and not FactSage.

Table 1: Scope of Work Statement.
All equipment and valves are identified using the tag numbers assigned in the P&IDs presented in Refs. [5] to [9].

Phase 1: Balances	• Verification of Mass, Energy and Pressure Balances
Phase 2: Piping, Pumps & Blowers	• Piping System Design: – Pipe Size Verification and Optimization • Pump and Blower Sizing: – Liquid Ring Pump P83122 – KOH Pump P83126 – KOH Solution Top-up Pump P83156 – Primary Cooling Water Pumps P83239A & B – Secondary Cooling Water Pump P83235 – Blower P83130
Phase 3: Process Equipment	• Process Equipment Sizing: – Double-pipe Heat Exchanger H81006 – Electrical Heater H83127 – Plate Heat Exchanger H83125 – Plate Heat Exchanger H83236 – KOH Scrubber S83123 (includes packed section and sump tank) – Ion Exchange Columns V83131A & B – Waste KOH Tank T83132 – KOH Solution Top-up Tank T83155 (includes heat transfer coil and agitator inside tank) – Primary Cooling Water Tank T83237 – Cooling Tower T83234 and Fan P83259
Phase 4: Specification	• Technical Specification of all equipment in Phases 2 and 3 above.
Phase 5: Pressure Protection	• Verification of Pressure Relief Valve Sizing Calculations: – Valves NH833-87, GA833-91, GM833-95, GS833-99 and LG833-105

Note: The sizing and specification of all plant SSCs not listed in Table 1 is excluded from this SOW.

10.2.2 PHASE 2: PIPING, PUMPS AND BLOWER

Part 1:

Refer to the P&IDs [5] to [9] and the Line List [10].

The sizes for the pipelines in the PTFE Demonstration Plant are captured in the line numbers shown in the P&IDs and Line List. However, there is currently no documented technical basis (e.g. engineering calculations) available to support the indicated sizes. Hence, there is a risk that these sizes may lead to fluid velocities which fall outside the acceptable (optimal) ranges recommended in literature for the fluids considered here, possibly lead to excessive pressure drops in the system or even erosion in the lines. Of a greater safety concern is the possibility that the velocities attained for hazardous fluids in the system (e.g. oxygen, methane, etc.) might exceed the safe limits prescribed in the relevant codes and standards (e.g. Ref. [27] for oxygen). For these reasons, all pipeline sizes currently specified for the PTFE Demonstration Plant must be verified. A document

describing this exercise and the outcome thereof must be provided. If the existing size of any pipeline is found to be incorrect and therefore revised, then this must be clearly indicated, with justification provided.

Part 2:

Refer to the P&IDs [5] to [9] and the Equipment List [12].

The blower P83130, together with the pumps P83122, P83126, P83156, P83239A & B and P83235, are used for fluid transfer in the PTFE Demonstration Plant and need to be sized in accordance with the applicable engineering practices and procedures. Design Reports must be provided and these must be accompanied by the supporting calculations. Separate Reports must be provided for the different equipment. However, where the same principles and methods are applied to sizing of the centrifugal pumps in the Plant, then the discussion of all of these pumps can be combined into one Report.

Notes:

1) In the case of fluids which are pumped through the system, the capital cost of the pipe run increases with increasing diameter, whereas the pumping cost decreases with pipeline diameter,. Therefore, the line sizing in Part 1 above must be performed in cognisance of the pump sizing in Part 2 to ensure that the most economic line and pump sizes are specified for the Plant.
2) The blower P81011 will be procured from the manufacturer of the glove box system Y81008 (shown in the P&ID [5]) as one complete package. Therefore, the blower is not sized here.
3) Through the process design work conducted in this SOW, it might become evident that the positioning of certain items as per Necsa's preliminary plant layout is not optimal, for e.g. the location of the equipment may not facilitate the smooth flow of material through the process or there may not be enough room in the laboratory to accommodate the sized equipment or to facilitate maintenance, etc. If such cases do arise, then the Consultant is requested to bring this to the attention of Necsa and recommend a more suitable layout for the PTFE Demonstration Plant.

10.2.3 PHASE 3: PROCESS EQUIPMENT

Refer to the P&IDs [5] to [9] and the Equipment List [12].

The following process equipment, which are utilized in the PTFE Demonstration Plant, need to be designed and sized in accordance with the applicable engineering practices and procedures:

- Scrubber S83123 (includes packed section and scrubber sump tank)
- Ion exchange columns V83131A & B
- Cooling tower T83234 (includes its fan P83259)
- Heat transfer equipment H81006, H83125, H83236 and H83127
- Tanks T83237, T83132 and T83155 (includes the heat transfer coil and agitator in tank).

Design Reports must be provided and these must be accompanied by the supporting calculations. In general, separate Reports must be provided for the different equipment. However, where similar principles and methods are applied to the sizing of multiple equipment of the same type (e.g. the plate heat exchangers in the Plant) or where design work is performed for the different sections/components of a single unit (e.g. the packed section and sump tank in the scrubber), then the discussion of the different items can be combined into one Report.

10.2.4 PHASE 4: SPECIFICATION

Following the design and sizing of the various equipment in Phases 2 and 3, a Technical Specification must be generated for each item. The Specifications must be of sufficient detail to allow the documents to be used as input to the equipment selection and procurement processes which will follow in this project. Wherever the Consultant is able to recommend potential suppliers, makes and models of equipment for use in the PTFE Demonstration Plant, such recommendations would be welcome and should be included in the Technical Specifications.

The output from Phases 2, 3 and 5 should eventually provide a large part of the information that is currently missing from the Equipment List [12].

10.2.5 PHASE 5: PRESSURE PROTECTION

There are five pressure relief valves in the PTFE Demonstration Plant, viz. NH833-87, GA833-91, GM833-95, GS833-99 and LG833-105. A Report describing the method used to size these valves and the results of the calculations are presented in Ref. [16]. The Consultant is required to review this Report and verify if the specified valve sizes are correct. A document describing this exercise and the outcome thereof must be provided. If any errors, inconsistencies, gaps, etc. are identified during this process, then new calculations must be undertaken and an update (new revision) provided in place of Ref. [16].

Note: Each pressure relief valve will vent to a safe location through a discharge pipe as shown in the P&ID [9]. However, the details (diameter, length and material of construction) of the discharge pipe are currently not known. It is therefore understood that Ref. [16] is only a preliminary sizing of the relief valves and will need to be updated once the required information becomes available. The Consultant is therefore encouraged to make recommendations with respect to the discharge pipes for the respective relief valves.

10.3 DOCUMENTATION

The project documentation to be provided by the Consultant must, at a minimum, include the following:

1) Report for verification of the Mass, Energy and Pressure Balances. Additional documents and/or calculations may be required if any of the existing Balances are found to be incorrect.
2) Report for verification of the pipeline sizes. Additional documents and/or calculations may be required if any of the existing line sizes are found to be incorrect.
3) Report, together with supporting calculations, for the design and sizing of each of the blower, pumps and other specified process equipment in the Plant.
4) Technical Specification for each of the blower, pumps and other process equipment in the Plant.
5) Report for verification of the pressure protection calculations. Additional documents and/or calculations may be required if any of the existing relief valve sizes are found to be incorrect.

In fulfilling the requirements of this SOW, the Consultant shall also comply with the following:

1) All engineering design calculations shall be undertaken in Microsoft Excel, with electronic copies of the live working files provided to Necsa.
2) A report shall always supplement an Excel calculation, with the report covering the following topics at a minimum:
    a. Background to the calculation.
    b. Assumptions on which the calculation is based.
    c. Inputs to the calculation. Where these include the physical properties of chemical species, the values used shall be provided and the sources thereof specified. In the event that the physical properties are estimated, the methods used shall be explained.
    d. Description of the methodology applied in the engineering calculation.
    e. Sample calculation to demonstrate implementation of the methodology, e.g. if two plate heat exchangers are sized in the Plant, provide a sample calculation for one of them, etc.
    f. Results of the calculation and interpretation thereof.
    g. Conclusions and recommendations drawn from the calculation.
3) There shall be clear and complete traceability between the report and Excel calculation, wherever applicable.