PetroSA

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ANNEXURE "A1"

ENQUIRY NO: CTT26808
DESCRIPTION: FEEDSTOCK SELECTION STUDY - SCOPE OF SERVICES

1. SCOPE OF WORK

1.1 Introduction

The feedstock selection study is to be conducted by a specialist consultant with substantial oil refining industry insight and knowledge to support medium- and long-term production and pricing forecasts (for current and new field developments), and to advise on potential volumes that may be available to PetroSA. The specialist must be able to technically screen potential feedstocks from assay databases and supplier assays against the Mossel Bay Refinery specific technical criteria. In addition to production market intelligence, credible and independent medium- and long-term pricing forecasts are required to support the commercial evaluation. The specialist is required to calculate the feedstock price landed in Mossel Bay, which requires determining the freight logistics and in line with the parcel size enabled by the project. Project partners / funders will rely on this independent and expert information (i.e. feedstock availability, quality and pricing) to assess the credibility of the commercial case for the project.

The Bidder must have access to the Chevron Assay Library and / or similarly comprehensive Crude assay databases, and HCAMS or equal, and knowledge of heavy condensates or ultra-light / light crudes that have recently started production or will become available by 2032, that may not yet be available in assay databases. This is required since the pool of heavy condensates and light crudes available that comply with qualities and yields will be highly constrained for this refinery, and identification of all the most viable crudes is required.

1.2 Background

The Petroleum Oil and Gas Corporation of South Africa (PetroSA) is a wholly state-owned company of the Government of South Africa and registered as a commercial entity under the South African law. PetroSA is a subsidiary of CEF SOC Limited (CEF) which is wholly owned by the State through the Department of Mineral Resources and Energy.

Key PetroSA assets include the following:

- An offshore production platform (approximately 90 km offshore of Mossel Bay) for production of indigenous natural gas and condensate for conversion to synthetic liquid fuels via an onshore Gas-to-liquids (GTL) processing plant. The offshore platform is currently not in operation (due to insufficient gas production to sustain commercial GTL operation) and is currently under care and maintenance.

- An onshore GTL plant broadly comprising of [1] a High Temperature Fischer Tropsch (HTFT) gas-to-liquid process and [2] a liquids refinery that upgrades both imported condensates (light and heavy) and indigenous produced condensates as well as synthetic oils produced in the HTFT process to liquid fuels such as LPG, petrol, kerosene, diesel and fuel oil. The GTL plant has not been in operation since December 2020.

- An onshore terminal (based at Voorbaai, Mossel Bay) initially designed for export of produced fuels and speciality products via SPM and CBM moorings respectively (located approximately 3km offshore in 20 meters of water depth). The terminal operations have adapted to the requirement for importation of supplementary condensates (as indigenous condensate production declined over time), and more recently for the bulk importation of finished products.

PetroSA wishes to recommission the liquids refinery, without operation of the offshore platform and HTFT gas to liquid sections. At present, two liquids operation options are being considered in parallel:

- A short-term option to mechanically reinstate and recertify the existing refinery, processing imported light and heavy condensate similar to those previously processed.

- A longer-term project to extensively debottleneck and modify the refinery for improved economics as well as producing petrol and diesel meeting South African Clean Fuels 2 (CF2) specification (broadly in line with Euro V standards). This refinery will process a heavy condensate or light / ultra-light crude feedstock with characteristics / criteria provided in attachment A.

Note that the optimal feedstocks, cargo sizes and import logistics are different in each case below, requiring a separate assessment.

a) Mechanical re-instatement & re-certification of the existing refinery

In this case, the refinery is limited by the design of existing assets, and the maximum throughput will be determined by the availability of imported feedstocks for dual processing (i.e. both a light and a heavy condensate must be available to process at the same time).

Prior to the GTL site shutdown in December 2020, the liquids refinery demonstrated capability to co-process a variety of imported condensates (along with indigenous condensate) that were then included in the 'condensate basket'.

Depending on the available feedstocks, the estimated maximum throughput (total of light and heavy feed) is approximately 18 000 bpd. The heavy condensate feed would be expected to be 10 000 to 14 000 bpd heavy condensate and 8 000 to 4000 bpd light condensate.

Shipping parcel sizes for this case are limited to 325 000 bbl vessels by current marine infrastructure and tankage at Voorbaai terminal.

Both a light and heavy condensate must be processed at the same time. Since they follow different fractionation paths, they must be supplied separately i.e. cannot be pre-mixed. In the flow path for the light condensate, the kerosene and heavier fraction is routed to diesel via the distillate hydrotreater. This dictates that the colour and heavy end distillation of the light condensate must be suitable. Since the main capacity bottleneck is the Catalytic Reformer unit, it is important that the heavy naphtha fraction contained in the heavy condensate is limited. Additionally, since fuel oil consumption and sales capacity are limited, the fuel oil portion of the heavy condensate must be limited.

It is necessary to confirm sufficient availability (post recommissioning) of these feedstocks, and other similar grades from other / new field developments. Up to date assay information is required for suitable light and heavy condensates in order to verify product yields and fuel self-sufficiency requirement for this re-instatement option.

Screening and selection of feedstocks will be based on criteria provided in Attachment B.

b) Refinery expansion project

This option is aimed at improving project economics by maximising refinery throughput by extensive debottlenecking and revamping of the existing plant and by adding limited VGO hydrocracking conversion capacity. The project would also produce products meeting clean fuels 2 specifications (expected to be in force 1st July 2027). Based on previous project work (named ECP, or Enhanced Condensate Processing project), and depending on the condensate processed, the estimated maximum throughput is around 46 000 bpd.

Finding an optimal design feedstock that is available for an acceptable period post commissioning of the project is critical to demonstrating technical and economic feasibility the design feedstock, Agbami, for the previous ECP condensate processing project may no longer be sufficiently available).

The refinery, and import logistics, will be revamped to process between 40,000 bpd and 50,000 bpd of imported heavy condensate (light / ultra-light) crude, via LR2 oil tankers. The ECP project (Feasibility phase concluded in 2017) identified processing of Agbami at 46,000 BPSD as the design case. A feedstock selection study was completed for the Feasibility Phase in 2016. A new feedstock selection study is required. Certain feedstocks (including the project design Agbami) may no longer be sufficiently available, and acceptable properties were previously based on meeting the current Clean Fuels 1 (CF1) specifications for petrol and diesel.

Note that the marine / terminal solution developed for this project and feed storage availability does not allow for blending of feedstocks on site, or processing more than one condensate/crude at a time.

Note that the project is based on revamping existing refinery units to maximum capacity rather than building new units. This means that certain feedstock cut yields are constrained in order to achieve acceptable throughput and cut properties are constrained by the capability of the existing units. Capacity for hydrocracking conversion of the heavier than diesel cut is constrained due to revamping of hydrotreater units to hydrocracking service, and sales volume of fuel oil is constrained. Producing CF2 compliant petrol from only two major components introduces further constraints to the naphtha cuts. Not having a fuel gas sulphur recovery unit constrains the feedstock sulphur level.

Screening and selection of feedstocks will be based on criteria in Attachment A.

1.3 Deliverables

The following are key deliverables of this study:

a) <u>Mechanical re-instatement & re-certification of the existing refinery</u>

(i) PetroSA will identify a basket of six condensates (including both light and heavy), for which the bidder is required to provide:

- Current production rates and forecast (until 2040) the reserves, production profiles, life of field, and quantities available to the open market. The operator, historical production, equity holders, terms of trade, current and potential future off-takers, loading types, locations, load frequencies and typical shipping sizes must also be provided. Shipping parcel sizes are limited to 325 000 bbl vessels by current marine infrastructure and tankage at Voorbaai terminal.

- Forecast pricing (until 2040) of Mossel Bay delivered condensate prices showing a full breakdown of pricing components and assumptions (e.g. marker crude, premium to marker, FOB, freight, insurance, taxes, duties etc).

(ii) It is necessary to identify an additional two light and two heavy condensates (in addition to those identified in (i) by PetroSA), that comply with the technical criteria provided in Attachment B, would be expected to be in production until at least 2033, are available in 325 000 bl parcels and are expected to be relatively commercially attractive (based on shipping distances, FOB price and parcel size etc.). For these it is required to provide:

a. Current production rates and forecast (until 2040) the reserves, production profiles, life of field, and quantities available to the open market. The operator, historical production, equity holders, terms of trade, current and potential future off-takers, loading types, locations, load frequencies and typical shipping sizes must also be provided. Shipping parcel sizes are limited to 325 000 bbl vessels by current marine infrastructure and tankage at Voorbaai terminal.

b. Forecast pricing (until 2040) Mossel Bay delivered condensate prices showing full breakdown of pricing components and assumptions (e.g. marker crude, premium to marker, FOB, freight, insurance, taxes, duties etc).

(iii) Product price forecasts (until 2040 and consistent with the above provided condensate pricing) on a RSA BFP basis are required for LPG, ULP-95, diesel, kerosene, JET A1 and fuel oil.

b) <u>Refinery expansion project</u>

(iv) It is required to identify a minimum of 12 heavy condensates or ultralight / light crudes which can be processed as alternatives to Agbami, that comply completely or with agreed exceptions to the Feasible technical criteria provided in Attachment A. Note that all the technical parameters in Appendix A (overall properties, cut yields, cut properties, compositions) will have to be determined and reported for each feed for this evaluation and screening.

- To achieve this, it is required that the consultant has access to the latest Chevron Assay Library and / or other similarly comprehensive crude assay databases to be able to perform the study.
- Additionally, the assays need to be cut according to specified cut points for both the yields and property / composition within the cut point ranges required in Appendix A, as well as for the PIMS LP model input template. Therefore, the consultant is required to have access to and use tools such as HCAMS or equivalent to perform this analysis. This compliance to the feasible and preferred range needs to be shown graphically in the report.
- In addition, it is required to identify and obtain assays for feedstocks that are not in these databases but are either currently in production or expected to be in production by startup of this project (from ~2032). These may not yet be in available assay libraries, but the contractor is to request / source assay information from suppliers.

- The technical suitability is to be ranked according to the compliance with the feasible and preferred yield and quality parameters as provided in Attachment A.
- For these 12+ identified feeds it is required to provide assays to PetroSA from the supplier and/or database (including values for the parameters in Appendix A). Assays are to be as recent as possible.
- For these 12+ identified feeds it is required to fill in the “LP model” input template that will be supplied by PetroSA at kick-off (MS Excel format). Data input to be as recent as possible. This requires generating and completing the cut yields, cut properties and component data in line with the LP input template.

(v) For each of the 12+ compliant heavy condensate or ultralight / light crude, it is required to forecast (until 2055) the reserves, production profiles, life of field, and quantities available to the open market. The operator, historical production, current production, equity holders, terms of trade, current and potential future off-takers, loading types, loading locations, load frequencies and typical shipping sizes must also be provided. Confirm the shipping from loading point in LR2 tankers is feasible, and identify where this is not the typical parcel size for that condensate / crude. Smaller cargo sizes could be considered depending on the overall economics.

(vi) The identified heavy condensate or ultralight / light crude is to then be ranked according to compliance with the feasible and preferred yield and quality parameters as provided in Attachment A, as well as availability and logistics / freight considerations, using weighting as agreed with PetroSA. A meeting will be held to agree ranking criteria, and a subsequent meeting to discuss and agree the resultant feed ranking, prior to the confirmation of the top six ranked feedstocks to carry into the next part of the study.

(vii) For the top six (6) ranked heavy condensate or ultralight / light crudes, it is required to forecast (until 2055) Mossel Bay delivered prices showing full breakdown of pricing components and assumptions (e.g. marker crude, premium to marker, FOB, freight, insurance, taxes, duties etc).

(viii) Product price forecasts consistent with the above provided feedstock pricing, until 2055 are required. These are to be on a RSA BFP basis. Required for LPG, ULP-95, diesel, kerosene, Jet A1 and fuel oil (MS Excel format).

(ix) In addition to the assay information and information in the file formats given above, the consultant is required to deliver a final report within 9 weeks after contract award. A draft report for comment (word format) will be required 8 weeks after contract award. The report must document the approach to work, methodology and all assumptions. A closeout presentation is to be provided in PowerPoint format.

(x) The following meetings are required (all TEAMS online):
- A project Kick Off meeting with PetroSA to meet and introduce the respective teams and align on the scope of work to be performed

- Weekly progress and alignment meetings.
- Meeting to agree on Feedstock ranking criteria.
- Meeting to discuss and agree the resultant feed ranking, prior to the confirmation of the top six ranked feedstocks to carry into the next part of the study
- Final close-out presentation.

The Consultant is expected to work closely with the PetroSA technical team to ensure an aligned and iterative process, with regular progress meetings.

ATTACHMENT A

HEAVY CONDENSATE / CRUDE SCREENING FOR REFINERY EXPANSION PROJECT

The tables in Attachment A provide provisional technical feedstock screening criteria for the screening study (updated criteria will be provided to the contractor at the kick-off meeting).

The explanation of the different criteria ranges in Attachment A for identifying potential acceptable condensates is as follows:

Preferred Range

- More constrained property / contaminant / yield range that is expected to allow throughput within 10% of the design feedstock throughput without changes to the current revamp configuration and unit capacities.
- This will facilitate ranking feedstocks to indicate those that are both in alignment with the current project technical design basis, and likely to allow a commercially attractive throughput.

Feasible Range

- Less constrained property / contaminant / yield range that may be technically viable without significant additional capital investment, but may be restricted to a significantly lower throughput or product yield.
- This will provide the long list of potential feedstocks for further commercial / availability analysis.

Additional Investment Cases

- To allow identification of the additional basket of feedstocks that will be technically feasible if significant further significant capital investment is made to overcome the identified property / contaminant limit.
- Please note that where an Additional investment case is shown against a particular constraint in the table, the requirement is to identify the additional feedstocks that would be allowed by relaxing that constraint alone.

ATTACHMENT A

CONDENSATE / LIGHT CRUDE FOR THE REFINERY EXPANSION PROJECT (46000BPD)

The following criteria are provisional; they will be updated following the kick-off meeting

Property and Contaminant Criteria:

Property	Units	Feasible Range		Preferred Range		Additional Investment Case
		Min	Max	Min	Max	
°API Target		37	56	40	53	-
Total Sulphur	ppm mass	-	TBC	-	TBC	TBC Max
Sulphur in 150- 240ºC	ppm mass	-	TBC	-	TBC	TBC Max
Sulphur in 530ºC+	Mass %	-	TBC	-	TBC	TBC Max
Mercaptan Sulphur	ppm mass	-	TBC	-	TBC	-
H2S	ppm mass	-	TBC	-	TBC	-
Nitrogen in 380 - 530ºC	ppm mass	-	TBC	-	TBC	TBC Max
Arsenic, Lead	ppb mass	-	TBC	-	TBC	-
Mercury	ppb mass	-	-	-	TBC	-
Pour Point	°C	-	TBC	-	TBC	-
Cloud Point of 150-380ºC	°C	-	TBC	-	TBC	-
N+2A of 85º-150ºC	%v/v	TBC	-	TBC	-	-
Cetane Number of 150-380ºC	-	TBC	-	TBC	-	-
Total Acid Number	mg KOH/g	-	TBC	-	TBC	TBC
Salt (as Chloride)	ppm mass	-	TBC	-	TBC	TBC

Yield Criteria:

Cut	Units	Feasible Range		Preferred Range		Additional Investment Case
		Min	Max	Min	Max	
C4 minus	Vol %	TBC	TBC	TBC	TBC	-
C5-150ºC	Vol %	-	TBC	-	TBC	-
85-150ºC	Vol %	-	TBC	-	TBC	-
380ºC +	Vol %	TBC	TBC	TBC	TBC	-
530ºC +	Vol %	TBC	TBC	TBC	TBC	-
Heavy Naphtha to Light Naphtha Ratio (85-150ºC : C5-85ºC)	Vol ratio	TBC	TBC	TBC	TBC	< TBC

*All distillations cut points refer to TBP

ATTACHMENT B

LIGHT CONDENSATE AND HEAVY CONDENSATE FOR MECHANICAL RE-INSTATEMENT & RE-CERTIFICATION OF THE EXISTING REFINERY (18 000 BPD)

The tables in Attachment B provide provisional technical feedstock screening criteria for the screening study (updated criteria will be discussed with the contractor at the kick-off meeting).

Heavy Condensate

The following criteria are provisional, they will be updated following the kick-off meeting

Property and Contaminant Criteria:

Property	Units	Feasible Range		Preferred Range	
		Min	Max	Min	Max
ºAPI Target		35	55	40	53
Total Sulphur	ppm mass	-	TBC	-	TBC
Sulphur in 530ºC+	Mass %	-	TBC	-	TBC
Mercaptan Sulphur	ppm mass	-	TBC	-	TBC
H2S	ppm mass	-	TBC	-	TBC
Nitrogen of 160- 415ºC	ppm mass	-	TBC	-	TBC
Arsenic, Lead	ppb mass	-	TBC	-	TBC
Mercury	ppb mass	-	-	-	TBC
Pour Point	ºC	-	TBC	-	TBC
Cloud Point of 160-415ºC	ºC	-	TBC	-	TBC
N+2A of 70º-150ºC	%v/v	TBC	-	TBC	-
Cetane Number of 160- 415ºC	-	TBC	-	TBC	-
Total Acid Number	mg KOH/g	-	TBC	-	TBC
Salt (as Chloride)	ppm mass	-	TBC	-	TBC

Yield Criteria:

Cut	Units	Feasible Range		Preferred Range	
		Min	Max	Min	Max
C4 minus	Vol %	TBC	TBC	TBC	TBC
C5-150ºC	Vol %	-	-	-	TBC
70-150ºC	Vol %	-	-	-	TBC
415ºC +	Vol %	TBC	TBC	TBC	TBC

*All distillations cut points refer to TBP

Light Condensate

The following criteria are provisional, they will be updated following the kick-off meeting

Property and Contaminant Criteria:

Property	Units	Feasible Range		Preferred Range	
		Min	Max	Min	Max
ºAPI Target		52	65	54	60
Total Sulphur	ppm mass	-	TBC	-	TBC
Salt (as Chloride)	ppm mass	-	TBC	-	TBC
Colour		-	TBC	-	TBC
Mercaptan Sulphur	ppm mass	-	TBC	-	TBC
H2S	ppm mass	-	TBC	-	TBC
N+2A of 70º-160ºC	%v/v	TBC	-	TBC	-
Cetane Number of 160- 415ºC	-	TBC	-	TBC	-
Total Acid Number	mg KOH/g	-	TBC	-	TBC
Arsenic, Lead	ppb mass	-	TBC	-	TBC
Mercury	ppb mass	-	-	-	TBC

Yield Criteria:

Cut	Units	Feasible Range		Preferred Range	
		Min	Max	Min	Max
C4 minus	Vol %	TBC	TBC	TBC	TBC
C5 to 70ºC	Vol%	TBC	-	TBC	-
70-160ºC	Vol %	TBC	-	TBC	-
375ºC+	Vol %	-	TBC	-	TBC
400ºC +	Vol%	-	TBC	-	TBC

*All distillations cut points refer to TBP