Well Reservoir & Facility Management
(Process Optimization)

OPPORTUNITY REALIZATION NOTE:
TUNU HP GAS REROUTING

Adomokhai Segun
Process Optimization Engineer

April 2021

Security Classification: Restricted

Document Number: SPDC-2021-04-00000065

Document Revision: A01

Document number:	SPDC-2021-04-00000065	**Originator**	Segun Adomokhai	Adomokhai Segun Digitally signed by Adomokhai Segun Date: 2021.04.19 14:10:26 +01'00'
		Approver	Barka Chiroma	Barka Chiroma Digitally signed by Barka Chiroma Date: 2021.04.19 14:38:38 +01'00'
		Version:	Final	
Document Owner:	UPC/G/UR	**Review Date:**	April 2021	
Issue Date:	April 2021	**Record Series Code:**		
Record Type Name:	Proposal	**ECCN classification:**	Not Subject to EAR - No US Content	
Security Classification:	Restricted			

Table of Contents

1. INTRODUCTION

1.1Background

The SSAGS project in the Tunu Node is a significant part of SPDC's domestic gas supply plan which was commissioned to eliminate gas flaring and gather AG from all the four flowstations (Tunu, Opukushi, Ogbotobo and Benisede flowstation) to supply the gathered AG and NAG gas from the Node primarily to the Domgas market via the East-Lagos Pipeline System (ELPS). The gas is routed through the EA riser platform A (RPA) to the Forcados Yokri Integrated Platform (FYIP) CPF with flexibility to supply to NLNG via the offshore gas gathering system (OGGS) pipeline network.

The recent increase in oil and gas production from New SSAGS wells and STOG wells caused an increase in flare volume in Tunu flowstation due to the booster compressor capacity constraint. The design capacity of the booster compressors (3x5MMscfd) is 15MMscfd with current available capacity of 10MMscfd as compared to the current produced gas of 14MMscfd. There are also ongoing project execution works to bring in additional new well and five more STOG wells that will generate about 4MMscfd additional produced gas.

It is therefore important to resolve the current capacity constraints issues of the Tunu AG booster compressor to ensure Non-flaring policy of the Federal Government of Nigeria, increase in oil production, increase in gas sales.

1.2 Opportunity

This opportunity is aimed at debottlenecking the Tunu AG booster compressor capacity by rerouting the HP gas from the booster compressor inlet (bypassing the compressor) to the discharge of the booster compressor, reducing flare volume and optimizing oil and gas production in the Tunu flowstation.

1.3 A case for Change

The recent increase in oil and gas volume in the Tunu flowstation from new SSAGS wells and STOG wells caused the increase in flare volume in Tunu flowstation as a result of the AG booster compressor capacity constraint. The current design of the facility routes the HP gas from the Tunu flowstation at 10barg through a pressure control valve that let down the pressure to 3.5barg to commingle with the LP gas into the LP gas inlet knockout vessel. The current commingling of the LP gas and HP gas with total produced gas of 14MMscfd into the booster compressors of current available capacity of 10MMscfd is causing additional flare volume of about 4MMscfd. This flare volume will increase over the remaining months of the year due to new wells and STOG wells planned to come in to the Tunu flowstation.

In the case of do-nothing scenario, we will be carrying the following risk;

- Increase in flare rate in the facility of about 9MMscfd by the end of the year.

- Production deferment of about 7000bopd from well creaming to control high flare rates.
- Energy inefficiency of dropping the HP gas pressure to commingle it with the LP gas.

1.4 Optimal Concept Selection

The integrated team considered few options to debottleneck the AG booster compressor capacity constraints, the option of rerouting the HP gas from the inlet of the AG booster compressor to the discharge of the booster compressor was selected for further detailed engineering design.

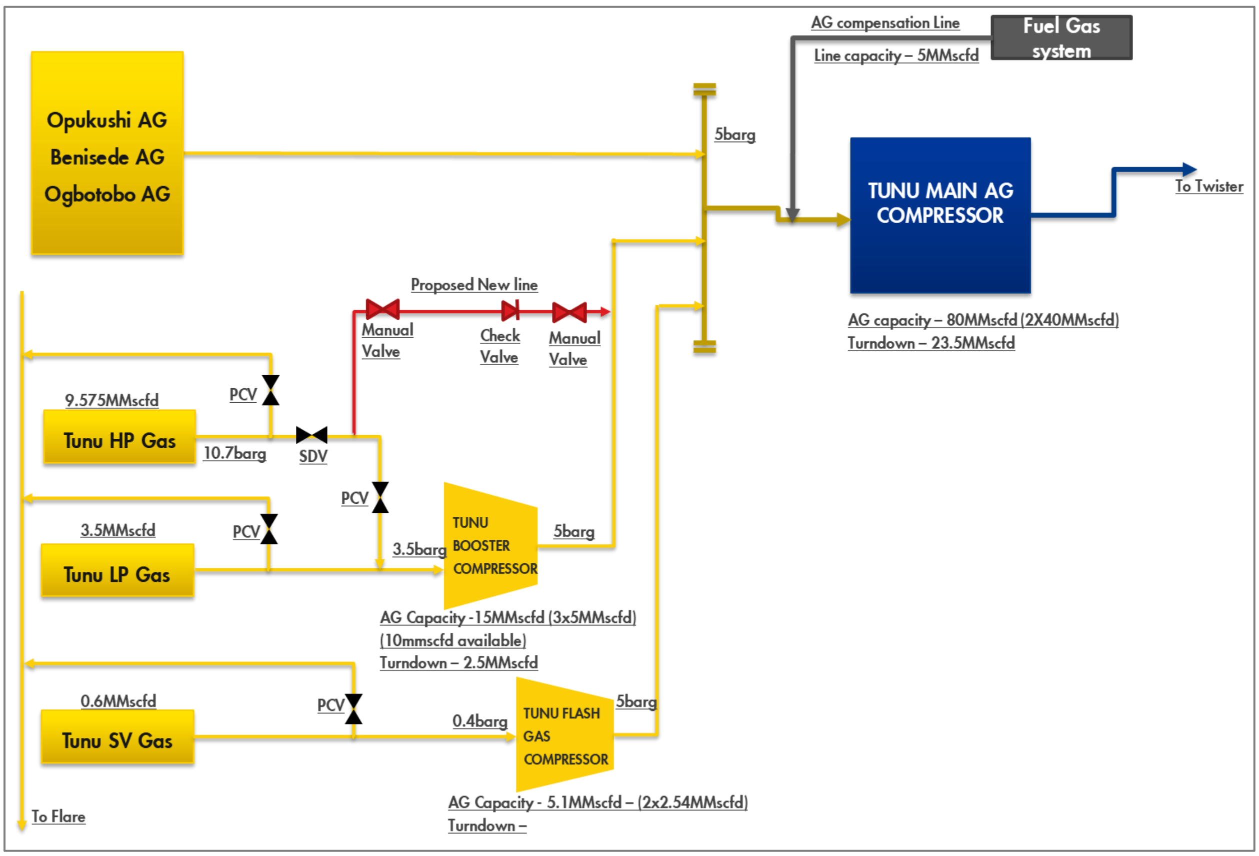

Fig 1.1: Schematic showing the Tunu HP gas header rerouting

The business case and potential benefits of implementing this option include

- Safeguarding 7000bopd of production deferment from possible creaming of the wells to control high flare rates.
- Achieve additional production of 1000bopd from HP static pressure reduction from 10.7barg to 6barg.
- Eliminate the flare rate of about 9MMscfd of gas by year end
- Additional gas sale of about 9MMscfd.

- Eliminate the energy utilized in compressing the HP gas that translates to an annual CO2 reduction of about1280tonnes of GHG and annual fuel gas value savings of about $54,000.

1.4 Project value drivers

The main drivers of this project are:

- Reduced cost of implementation and early delivery of the opportunity.
- Production optimization.
- Minimize environmental impact of operations.
- Reduce business risk.

1.5 Tunu Flowstation description

The primary function of the Tunu flow station is to stabilize crude oil from all the wells producing into Tunu for onward delivery to export. The Tunu flow station is a standard SPDC swamp sand filled/piled flow station. It is a three-bank flow station, with two Test, three HP, three LP separators and three surge vessels. The produced fluid from the wells flows to the flowstation through the inlet manifold. At the inlet manifold, the flow is directed to one of three headers: HP, LP or Test header. The XHP separators are not in use. All high-pressure wells are directed to the HP header. The HP header feeds the HP separator, which has an operating pressure of 105 psig. Oil from the HP separator is then fed into the LP separator together with the flow from the LP header. The low-pressure wells are directed to the LP header, together with the oil from the HP separator outlet, feed the LP separator operating at 45 psig. The oil outlet from the LP separator goes to the surge vessel, where the oil is stabilized at atmospheric pressure. The oil pressure is then boosted by the export pumps and sent to the export header for onward delivery to Forcados terminal.

AG gas from the LP and HP headers are routed to the AG booster station and then commingles with AG gas from other facilities (Benisede, Opukushi and Ogbotobo) to the Tunu CPF for processing and export.

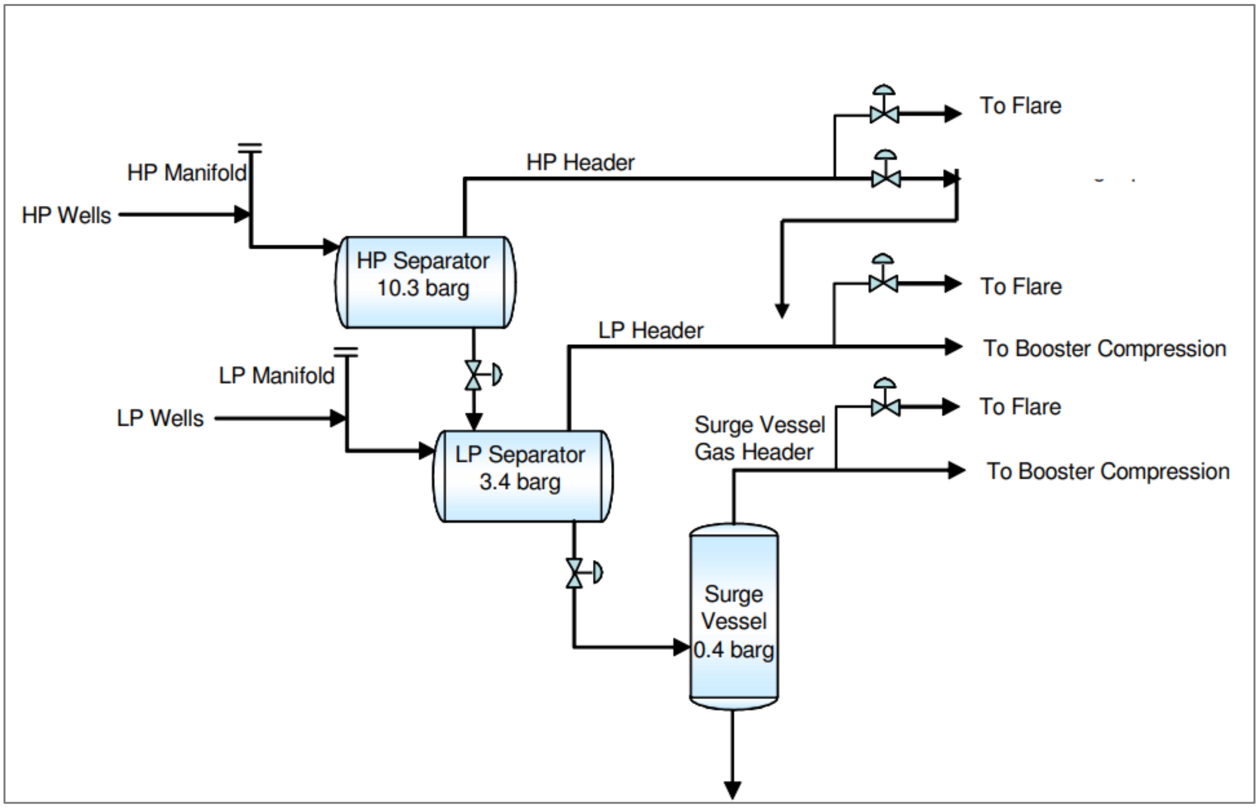

Fig 1.2: Overview of Tunu Flowstation

1.6 Tunu AG Booster station description

The booster station is in close proximity with the flow station. It receives produced gas from the Tunu flow station separators and surge vessels; boost it to high pressure and export to Tunu CPF for further treatment. The booster stations are made up of compressors, suction and discharge scrubbers and air coolers. The booster station is composed of three compressor trains designed to send the gas from the HP and LP vessels to the booster compressor trains (3x33%) that are designed to boost the gas from HP and LP separators and send it to the CPF.

The gas from the booster compressor trains are comingled, before metering and sent to CPF.

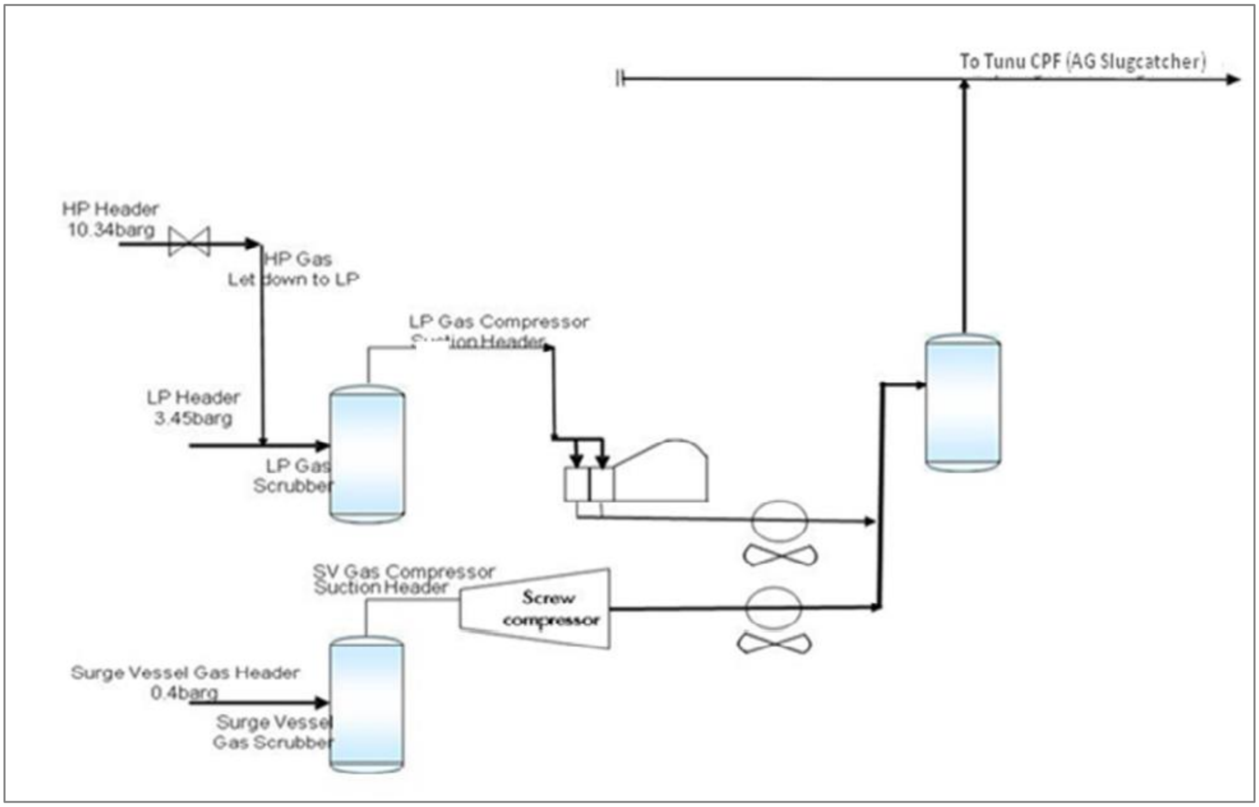

Fig 1.3: Overview of Tunu Booster Station

2 PROPOSED MODIFICATION

2.1 Concept selected

The selected concept includes in the installation of a new line to reroute the HP gas produced from the Tunu flowstation to the inlet of the Main AG slug catcher bypassing the AG booster compressor. The tie in of the new line will be downstream the shutdown valve 11-UZV-009 to the downstream of the Tunu AG gas metering section after the AG booster compressor.

The option of rerouting the HP gas from going through the AG booster compressor will allow adequate compressor capacity for the expected LP gas, thereby eliminating the high flare rate due to compressor capacity constraints.

The preliminary check for the material of construction of the proposed new line from the HP gas header to the inlet of the main AG slug catcher is a carbon steel material, which as been identified to be available in the warehouse. This material will be confirmed to be fit for purpose during the detailed engineering design of this project, ensuring it meets the basic functional requirement based on the expected fluid composition of the gas to be routed through the line.

2.2 Compositional Basis

The Table 2.1 Shows the compositional basis for the update Unisim model for the Tunu flowstation. This compositional basis will be used for the detailed design of this project.

Table 2.1: Compositional Basis

Component	Mole Fraction
nitrogen	0.00043
CO2	0.01739
Methane	0.86215
ethane	0.04283
propane	0.00626
i-butane	0.00126
n-butane	0.00198
i-pentane	0.00070

n-pentane	0.00043
n-hexane	0.00044
H2O	0.05794
C7+*A	0.00396
C7+*B	0.00128
C7+*C	0.00061
C7+*D	0.00051
C7+*E	0.00048
C7+*F	0.00043
C7+*G	0.00035
C7+*H	0.00025
C7+*I	0.00016
C7+*J	0.00015

2.3 Process /Facility Conditions

The expected process conditions of the HP gas header, inlet to the AG booster compressor and the inlet to the Main AG compressor are summarised in Table 2.1 below

Table 2.2: Process conditions

	Temperature (^oC)	Current Operating Pressure (barg)	Proposed Operating pressure (barg)	Relief valve set Pressure (barg)
HP gas header	37	10.7	6	17
inlet to the AG booster compressor	32	3.5	-	10
Booster compressor discharge	25	5	-	16.5

2.4 Design Flowrate of Proposed Flowline

Based on the current HP gas production rate of 9.6MMscfd and with the consideration for future requirements, the maximum produce HP gas from the Tunu flowstation is not expected to exceed 15MMscfd. A design flowrate of 15 MMscfd has therefore been selected for the proposed new gas flowline from the HP gas header to the downstream of the AG gas metering after the AG booster compressor, with sensitivities checked at flowrates up to 30 MMscfd.

2.6 Recommended Line Size for Proposed line

The DEP 31.38.01.11-Gen specify that the gas outlet lines from the HP and LP separators as well as the HP and LP gas headers up to the PCVs are rated based on a maximum allowable velocity of 10 m/s as soft limit (noise) and 20m/s as hard limit (erosion).

The existing HP gas header is an 8-inch line, which has a maximum capacity of 17MMscfd based on the DEP specification and a 6-inch has a maximum capacity of 10MMscfd. The recommended line size for the new line will be an 8-inch, to allow for future increase in HP gas in the flowstation.

2.7 Flowline Tie-Ins

The tie-in of the new line will be downstream the shutdown valve 11-UZV-009 on the HP gas header and a point downstream of the Tunu AG gas metering section after the AG booster compressor as indicated in the PEFS below.

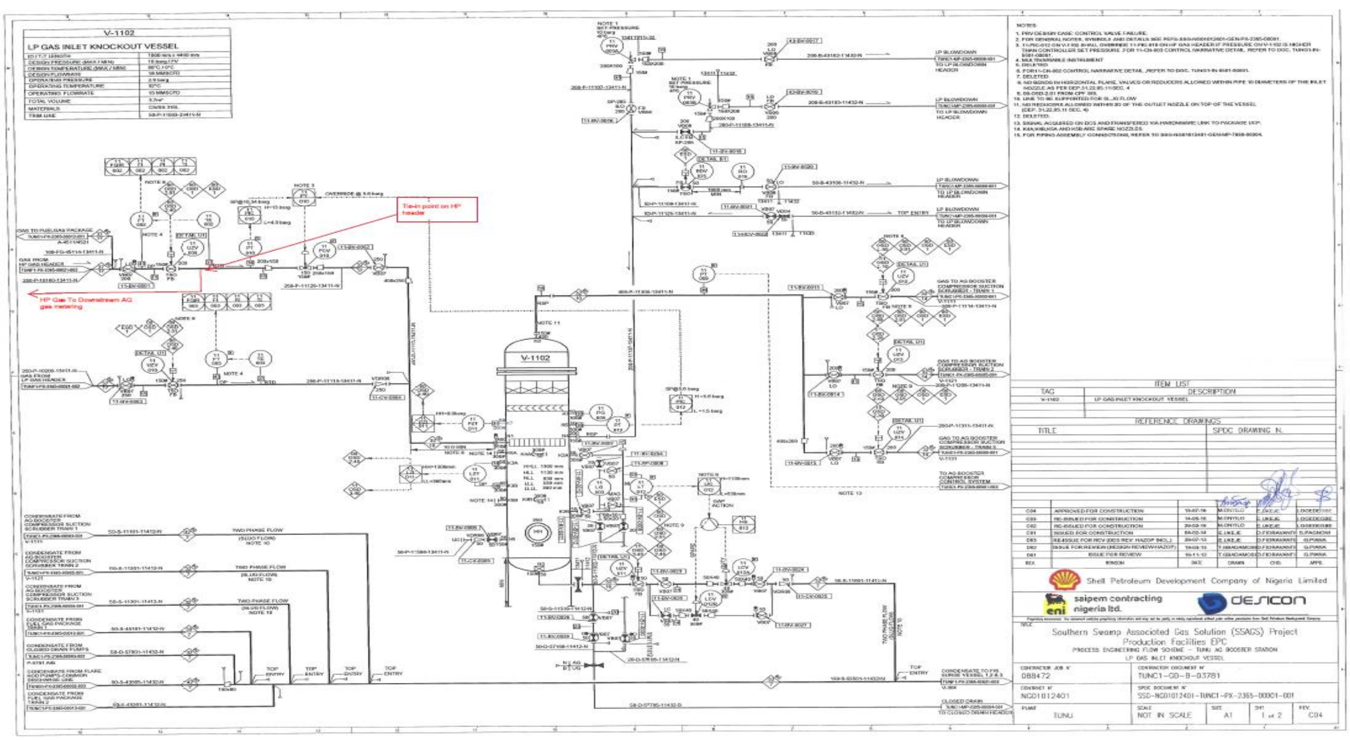

Fig 2.1: PEFS showing the tie-in point downstream the Shutdown valve

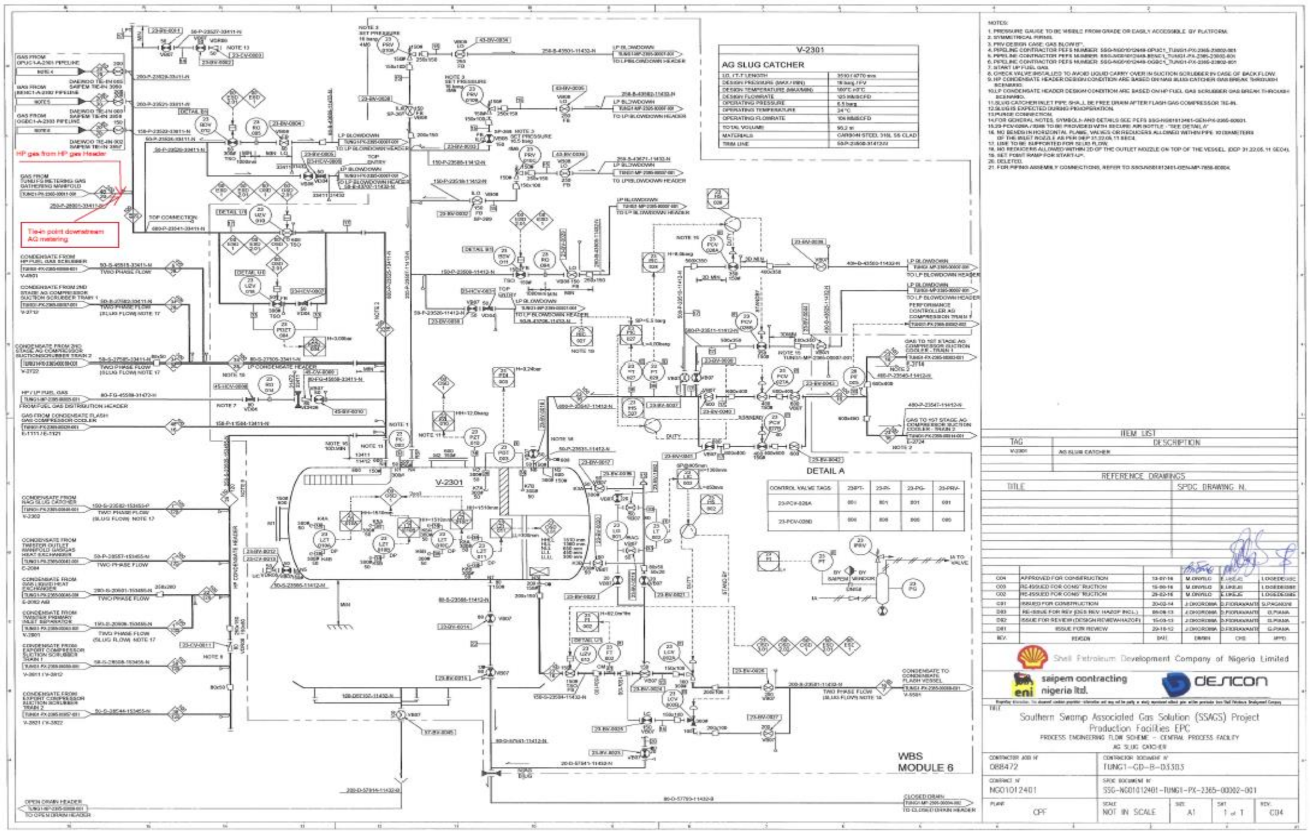

Fig 2.2: PEFS showing the tie-in point downstream the Shutdown valve

3 Scope of Design Work & Deliverables

3.1 Scope of Design

The Detailed Engineering Design Scope of work also includes the following;

- Confirmation of the Line Size and material of construction
- Process Design Report
- Piping Stress Analysis
- Piping Isometrics
- Piping Base Foundation Design
- Materials Take-off and Construction Scope/Package
- Process Safety reviews (HAZOP & SIL)
- Update of all affected drawings and documentation

3.2 Deliverables/Activities

Process Engineering

- Preparation/Update of PFS/PEFS/PSFS.
- Preparation/Update of Heat and Mass balance.
- Update of Northbank and FOT Safeguarding Memorandum.
- Preparation of Process Design Report.
- Update of Facility Operating and process control Philosophy.
- Design and Specification of new equipment's (Shutdown Valves & Relief Valve).

PACO

- Update process control and safeguarding narrative.
- Instrument datasheets
- Instrument hook-up and loop drawings
- Instrument tagging (Instrument index) and MTO
- Update of affected drawings and documents

Mechanical (Piping)

- Constructability Study Report
- Updated Plot plan drawings and Overall plant layout.
- Demolition drawings.
- Isometric drawings.
- Pipe support drawing and schedule.
- Tie-in points and schedule.
- MTO.
- Stress analysis.
- Functional specification.
- PDMS model (new, update existing).

- Pipe stress analysis report.

Civil

- Civil Design report.
- Layout, elevations drawings.
- Updated plot plan.
- Design of pipe supports and new support foundation layout.
- Bulk MTO

MCI

- Material selection Study

4.0 REFERENCES

1. Tunu Flowstation and Booster station Process Engineering Flow Scheme (PEFS)
2. Tunu Booster station Process Engineering Flow Scheme (PEFS)