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Process Simulation and Equipment Sizing of a Modular Skid-Mounted CNG Compression Plant for Stranded Gas Utilization

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Abstract: This study presents the process simulation and equipment sizing of a modular skid-mounted compressed natural gas (CNG) compression plant designed for stranded gas utilization in the Western Niger Delta. Using Aspen HYSYS V14 with the Peng-Robinson equation of state, a steady-state model was developed to process flare gas from seven flow stations within OML 30 and OML 34, with a combined average flaring rate of 22.98 MMscfd. The simulation achieved full convergence with near-perfect mass and energy balance closure (relative error < $1x10^{-10}$). The three-stage main compression train, complemented by an inlet compressor and gas purification unit, delivers 18.08 MMscfd of vehicular-grade CNG meeting ISO 15403 specifications (99.9 mol% methane, 205 barg, -40°C). The compression train, comprising K-101, K-102, K-103, achieves an overall pressure ratio of 20.8 with a total shaft power requirement of 3,002 kW. Equipment sizing was performed using standard engineering equations and industry criteria, yielding specifications for separators (DN600x2.0 m), heat exchangers (thermal duties ranging from 869 kW to 1,702kW), and compressors (driver ratings from 350kW to 1,600kW). The results demonstrate that modular skid-mounted CNG compression offers a technicaly feasible solution for monetizing stranded gas, with potential for NGL recovery to enhance project economies.

Keywords: *Process Simulation; Modular Compression Plant; Stranded Gas; Gas Flare;Compressed Natural Gas.*

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I. INTRODUCTION

Natural gas has emerged as a pivotal transitional fuel in the global shift towards sustainable energy systems. Compared to coal and oil, it produces significantly lower emissions of carbon dioxide (CO2), nitrogen oxides (Nox), sulphur dioxide (SO2), and particulate matter during combustion [1]. In the context of sustainable energy transitions, compressed natural gas (CNG) plays a particularly important role as a cost-effective and environmentally sound transportation fuel [1].

Despite the recognized potential of natural gas, the widespread practice of gas flaring remains a critical environmental and economic challenge. Approximately 140 billion cubic metres (bcm) of gas are flared annually, releasing over 300 million tonnes of CO2 and enervating economic losses valued at USD 30 billion, while posing direct health risks to affected communities [2]. The absence of robust gas processing and transportation infrastructure in remote or distributed fields remains a primary driver of continued flaring. Traditional, sick-built CNG processing plants suffer from high capital expenditure, lengthy construction timelines, and limited operational flexibility, rendering them unsuitable for small-volume or variable-production sites where gas flowrates typically range between 1 and 15 MMscfd [3].

Modular skid-mounted systems offer a transformative approach to CNG compression plant design, providing flexibility, reduced construction time, and lower capital cost for deployment in remote or distributed gas fields [4]. Prefabricated modules assembled in controlled factory environments allow for rapid transportation and on-site commissioning, substantially minimising on-site construction work [4, 5].

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The scope of this study encompasses: (i) the development of a steady-state process simulation model for a modular CNG compression plant processing gas from seven flow stations within OML 30 and OML 34 in the Western Niger Delta;(ii) the sizing of all major equipment including headers, separators, compressors, heat exchangers, and control valves based on simulation outputs and standard engineering equation; (iii) the specification of instrumentation and an automated control and safety system in accordance with ISA S88 and IEC 61511 standards

II. MATERIALS AND METHODS

A. *Feed Gas Characterisation*

Flare gas compositions from seven selected flow stations (Field A through G) were obtained from Ebrunu and Akpoturi [6]. Component mole fractions of methane (CH4), ethane (C2H6), propane (C3H8), butanes, pentanes, heavier hydrocarbons (C6 – C9), carbon dioxide (CO2), nitrogen (N2), hydrogen sulphide (H2S), and water H2O) were determined. Daily and weekly flare gas volumes, expressed in MMscfd, were sourced from secondary data published by the Nigerian Upstream Petroleum Regulatory Commission (NUPRC). Table 1 presents the flare gas mole compositions.

The combined average daily flaring rate across all seven stations is approximately 22.98 MMSCFD, with individual station rates ranging from 0.17 to 7.22 MMSCFD. The mole fraction and molecular weight of each feed stream were computed as follows:

➢ *Component Mole Percentage:*

The mole percentage of individual component A in a gas mixture is calculated from Gas Chromatography (GC) peak areas as:

Component % of A = (Vol. of Component A/Total Vol. of Sample) × 100 (1)

➢ *Gas Relative Density (Specific Gravity):*

The gas relative density (γ^g) is computed from the mixture molecular weight using:

Gas gravity (γ_g) was computed for mixture properties using:

$$\gamma_g = \text{Molecular Weight of Gas} / 28.97 \quad (2)$$

where the molecular weight was derived from the weighted average of component mole fractions.

M^g is the mixture molecular weight (kg/kmol) derived from the weighted average of component mole fractions and their respective molecular weights, and $M_a{}^I{}_r$ = 28.97 kg/kmol is the molecular weight of dry air at standard conditions.

B. *Process Simulation Using Aspen HYSYS V14*

The Peng-Robinson (PR) equation of state was selected as the thermodynamic fluid package. The PR equation of state is widely recognized as the industry-standard model for hydrocarbon gas and CNG systems, providing accurate predictions of vapour-liquid equilibrium, density, enthalpy, entropy, and compressibility factor for natural gas mixtures under high-pressure conditions [7, 8]. The simulation model encompasses the complete integrated process from feed gas inlet to final CNG product storage, including:

- Inlet feed collection headers (HD-100 and HD-101);
- Inlet compression of low-pressure feeds (K-100);
- Inlet cooling and liquid knock-out separation (E-100, V-100);
- Gas purification and heavy-ends separation (X-100);
- Methyl mercaptan odorant injection (V-101, K-102)
- Three stage main compression train with inter-stage cooling (K-101, K-102, K-103, E-101, E-102);
- Final CNG cooling and pressure let-down to storage conditions (E-103)

All unit operations were modelled using built-in Aspen HYSYS unit operation modules. The component splitter (X-100) was specified using fixed component split fractions to represent the target performance of a gas purification system, consistent with standard industry practice for preliminary simulation studies.

C. *Equipment Sizing Methodology*

Equipment was sized using simulation outputs from Aspen HYSYS as primary design inputs, supplemented by standard engineering equations and recognized industry sizing criteria.

➢ *Compressor Sizing*

Compressor shaft power was estimated using the theoretical power equation for polytropic compression:

$$P_{theoretical} = (Q \times \Delta P) / \eta \quad (3)$$

where $P_{theo}{}^R$ is the theoretical shaft power (kW), Q is the actual volumetric flow rate at suction conditions (m³/s), ΔP is the differential pressure across the compressor stage (Pa), and η_p is the polytropic efficiency (dimensionless). Driver sizing incorporated a 15% service margin over the calculated absorbed power. Compressor types were selected based on pressure ratio, gas composition, and flowrate considerations consistent with industry practice for each service.

Table 1. Gas Data

Component	Field A (OML 30)	Field B (OML 30)	Field C (OML 30)	Field D (OML 34)	Field E (OML 34)	Field F (OML 30)	Field G (OML 30)
N_2	0.13	0.05	0.69	42.74	0.04	0.29	10.23
CO_2	2.58	0.64	4.62	6.35	8.81	0.71	0.65
H_2S	—	~0.00	—	—	—	—	—
CH_4	91.20	94.93	84.68	34.96	84.03	77.60	86.99
C_2H_6	5.63	4.13	5.83	8.41	4.14	10.73	1.87

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C_3H_8	0.18	0.09	2.72	4.49	1.49	5.56	0.15
i-C_4	0.14	0.01	0.50	1.39	0.46	1.89	0.04
n-C_4	0.05	0.01	0.61	1.09	0.37	1.57	0.01
C_5+	0.08	0.05	0.34	0.56	0.61	1.62	0.05
H_2O	0.01	0.03	0.01	0.01	0.00	0.01	0.01
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

➢ *Separator Sizing*

Vertical and horizontal gas-liquid separators were sized in accordance with ASME Section VIII Division 1 requirements, applying the Souders-Brown equation to determine the maximum allowable vapor velocity (V_{max}) for prevention of liquid carryover:

$$V_{max} = K \sqrt{[(\rho_l - \rho_v) / \rho_v]} \quad (4)$$

where K is the Souders-Brown coefficient (m/s), taken as K = 0.04–0.06 m/s for two-phase vertical separators, ρ_l is the liquid phase density (kg/m³), and ρ_v is the vapour phase density (kg/m³) at separator operating conditions. The required cross-sectional area was derived from the actual vapour volumetric flowrate and V_{max}, with vessel length-to-diameter (L/D) ratios of 3–5 applied to determine overall vessel dimensions. Minimum residence times of 2–3 minutes were confirmed for the liquid phase.

➢ *Heat Exchanger Sizing*

Heat exchangers were sized using the Log Mean Temperature Difference (LMTD) method and assumed overall heat transfer coefficients (U) based on process fluid service conditions:

$$Q = U \times A \times \Delta T_{lm} \quad (5)$$

where Q is the thermal duty (W), U is the overall heat transfer coefficient (W/m²·°C), A is the effective heat transfer area (m²), and ΔT_{lm} is the log mean temperature difference (°C). Values of U were selected within the ranges 500–600 W/m²·°C for gas-to-cooling water service and 300-500 W/m²·°C for high-pressure gas services, consistent with published shell-and-tube heat exchanger performance data

III. RESULTS

A. *Overall Mass and Energy Balance*

The Aspen HYSYS simulation achieved full steady-state convergence with near-perfect mass and energy balance closure (Table 2). The three-stage compression and purification process design was confirmed to be technically feasible when the Aspen HYSYS simulation reached complete steady-state convergence. The thermodynamic consistency of the simulation and the applicability of the Peng-Robinson equation of state for this high-pressure, multi-component natural gas application are validated by the near-zero mass and energy balance imbalances ($< 1 \times 10^{-10}$ relative error).

B. *Key Process Stream Conditions*

Table 3 presents the conditions of major intermediate and product streams.

Table 2: Overall Mass and energy Balance Summary

Balance Parameter	Total Inlet	Total Outlet	Absolute Imbalance	Relative Imbalance (%)
Mass Flow Rate (kg/h)	2.201×10^4	2.201×10^4	-6.40×10^{-12}	0.00
Energy Flow Rate (kJ/h)	-8.385×10^7	-8.385×10^7	3.93×10^{-8}	0.00

The final specifications for compressed natural gas (CNG) meet all the standards set forth by ISO 15403-0, which are as follows: 99.9 moles per million of CH_4, 205 barg, -40°C, zero water content, and zero inert gas content. The X-100 purification unit's performance is mainly responsible for the high level of methane purity since it rejects over 99% of all non-methane components into the sludge stream.

Recovering C_2-C_5 hydrocarbons from the Sludge stream as NGL by-products might enhance project economics, especially for Feed F, which has a high concentration of these components, and reduce the 4.4% methane loss to the Sludge stream, which is a small economic penalty and a waste management problem.

C. *Compression Train Performance*

The three-stage main compression train (K-101, K-102, K-103) together with the inlet compressor (K-100) achieves the performance summarised in Table 4.

The three-stage compression train produces a pressure ratio of 20.8 (10 bar suction to 218 bar discharge) in the major compression stages. Choosing three stages with ideal interstage pressures of 65 barg and 150 barg yields balanced stage pressure ratios of 6.5, 2.4, and 1.47, following known design practices for high-pressure gas compression. Stage-by-stage intercooling lowers input temperature to 45 °C, significantly lowering compression effort compared to single-stage adiabatic compression. Matovu et al. [9] showed a shaft work savings of 1.23% for four-stage compression compared to two-stage compression, confirming the thermodynamic benefit of multi-stage intercooled compression for high-pressure CNG operation. The Stage-1 compressor (K-101) accounts for 46.6% of the total installed compressor power, using 1,398 kW (46.6%) due to its high-pressure ratio (6.5) and substantial gas mass flow (14,470 kg/h filtered gas).

D. *Final CNG Product Specification*

The final CNG product meets ISO 15403 vehicular-grade specifications, as detailed in Table 5.

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Table 3: Key Intermediate and Product Stream Conditions

Stream ID	Description	Temp. (°C)	Pressure (barg)	Mass Flow (kg/h)	Molar Flow (MMscfd)
Process gas	Combined feed to E-100	76.6	6.0	22,010	22.98
Gas to Compression Train	X-100 overhead purified CH4	-36.1	10.0	14,470	18.08
Sludge	X-100 bottoms (impurities)	141.0	11.0	7,404	4.74
Stage 1 HP Gas	K-101 discharge	125.7	65.0	14,470	18.08
Stage 2 HP Gas	K-102 discharge	133.0	150.0	14,470	18.08
Stage 3 HP Gas	K-103 discharge	79.7	218.0	14,470	18.08
CNG to Storage	**Final product**	**-40.0**	**205.0**	**14,470**	**18.08**

Table 4: Summary of Compression Train performance

Tag	Unit Name	Feed Stream	Suction Press. (barg)	Discharge Press. (barg)	Pressure Ratio	Temp. Rise (°C)	Shaft Power (kW)	Energy Duty (kJ/h)
K-100	Inlet Compressor	Throttled LP Gas	1.05	6.08	~5.8	106	517	1.860×10^6
K-101	Stage 1 Compressor	Gas to Compression Train	10.0	65.0	6.5	162	1,398	5.033×10^6
K-102	Stage 2 Compressor	Throttled Stage 1 Gas	62.5	150.0	2.4	89	779	2.804×10^6
K-103	Stage 3 Compressor	Throttled Stage 2 Gas	148.1	218.0	1.47	36	308	1.109×10^6
TOTAL	—	—	—	—	—	—	**3,002**	$\mathbf{1.081 \times 10^7}$

Table 5: Final CNG Product Specification (Stream: CNG to Storage)

Property / Component	Simulated Value	Unit / Remarks
Temperature	−40.0	°C
Storage Pressure	205	Barg, meets ISO 15403
Mass Flow Rate	14,470	kg/h
Methane (CH_4)	99.90	mol%
Ethane (C_2H_6)	0.07	mol%
Propane (C_3H_8)	0.02	mol%
i-Butane / n-Butane (C_4)	< 0.01	mol%
i-Pentane / n-Pentane (C_5+)	< 0.01	mol%
Heavier Hydrocarbons (C_6+)	Trace	mol%
Water (H_2O)	0.00	mol% — below hydrate formation threshold
Nitrogen (N_2) / CO_2 / H_2S	0.00	mol% — fully removed by X-100
Mercaptan Odorant	Present	Injected upstream; concentration controlled by AT-101

The final CNG product specification (99.9mol% CH_4, 205barg, −40°C, no water, no inert gas) meets ISO15403 criteria for vehicular-grade CNG. Methane purity is high due to the X-100 purification machine, which rejects over 99% of non-methane components in the Sludge stream. The 4.4% methane loss in the Sludge stream is a modest economic penalty and waste management issue. Recovering C_2-C_5 hydrocarbons as NGL byproducts might enhance project profitability.

E. Equipment Sizing Specifications

The equipment size findings show that the modular CNG compression plant can be constructed to simulation output-based mechanical criteria. Engineering methods were used to size all key equipment pieces, demonstrating that the design idea is internally coherent and technically feasible.

Separator size reveals that the V-100 intake separator is small (DN600 × 2.0 m) for volumetric gas flow. Due to the combination of 5 °C chilling before separation, a high-density gas phase is achieved, reducing cross-sectional area, and low absolute liquid loading (139.4 kg/h water) compared to gas throughput. This tiny size is ideal for skid-mounted applications, where reducing footprint is a key design goal.

The Stage-3 hyper-pressure compressor (K-103), with a design pressure of 250 barg and operating at 218 barg, is the most technically challenging plant equipment. For high-pressure reciprocating compressors, hyper-pressure design concepts such as PTFE-based packing systems, high-strength alloy steel pistons and rods, and premium valve materials are necessary. The unit is thermally benign (36 °C temperature increase) because to its low-pressure ratio of 1.47, but high

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operating pressure necessitates careful attention to pressure boundary integrity and materials certification.

At 1,702 kW, the final CNG Cooler (E-103), the highest thermal duty item in the plant, requires a separate mechanical refrigeration system (propane cascade or mixed refrigerant) to maintain a −40 °C product temperature. This CNG plant's unique architecture, compared to room-temperature CNG storage solutions, drives the cryogenic heat exchanger cost premium.

Table 6: Compressor Sizing

Tag	Service	Key Simulation Data	Proposed Mechanical Specifications
K-100	Inlet Compressor	Suction: 1.05 barg, 14.6°C; Discharge: 6.08 barg, 120.9°C; Pressure Ratio: 5.8; Shaft Power: 517 kW	Type: Screw or Reciprocating. Driver: 600 kW electric motor; Carbon Steel casing; Stainless Steel internals.
K-101	Stage 1 Main Compressor	Suction: 10 barg, −36.1°C; Discharge: 65 barg, 125.7°C; Pressure Ratio: 6.5, Shaft Power: 1,398 kW.	Type: Multi-stage high-speed reciprocating; Driver: 1,600 kW; Design Pressure: > 70 barg .
K-102	Stage 2 Compressor (High-Pressure)	Suction: 62.5 barg, 44.5°C ; Discharge: 150 barg, 133.0°C ; Pressure Ratio: 2.4 ; Shaft Power: 779 kW	Type: Double-acting Reciprocating ; Driver: 900 kW ; Design Pressure: 165 barg .
K-103	Stage 3 Compressor (Ultra-High-Pressure)	Suction: 148.1 barg, 43.8°C ; Discharge: 218 barg, 79.7°C ; Pressure Ratio: 1.47 ; Shaft Power: 308 kW	Type: Hyper-pressure Reciprocating ; Driver: 350 kW ; Design Pressure: 250 barg ; Special PTFE packing, hardened valve trim, hyper-compressor seal design.
K-102	Odorant Injection Compressor	Suction: near atmospheric ; Discharge: ~1 barg,	Type: Small diaphragm or hermetically sealed compressor. Materials: compatible with methyl mercaptan (sulphur compound). Driver: fractional-kW electric motor.

Table 7: Heat Exchanger Sizing

Tag	Service	Thermal Duty (Simulation)	Process Conditions (Hot Side)	Preliminary Sizing Parameters
E-100	Inlet Cooler	3.431×10^6 kJ/h (953 kW)	In: 76.6°C / Out: 5°C; P = 6.0 barg ; wet multi-component gas	Shell-and-Tube ; U ≈ 500 W/m²·°C ; ΔT_{lm} ≈ 25°C ; Area A ≈ 76 m².
E-101	Stage 1 After-Cooler	3.128×10^6 kJ/h (869 kW)	In: 125.7°C / Out: 45°C; P = 64.5 barg ; dry HP gas	Shell-and-Tube (HP tubes) ; U ≈ 600 W/m²·°C ; ΔT_{lm} ≈ 40°C ; Area A ≈ 36 m².
E-102	Stage 2 After-Cooler	3.880×10^6 kJ/h (1,078 kW)	In: 133.0°C / Out: 44°C; P = 149.1 barg ; HP gas	Multi-tube Hairpin or S&T ; U ≈ 550 W/m²·°C ; ΔT_{lm} ≈ 45°C ; Area A ≈ 44 m².
E-103	Final CNG Cooler	6.126×10^6 kJ/h (1,702 kW)	In: 79.7°C / Out: −40°C; P = 216 barg ; HP methane	Brazed Aluminium Plate-Fin (cryogenic) ; Propane cascade refrigerant

Table 8: Inlet Separator V-100 Sizing

Parameter	Value	Code Reference
Inside Diameter	600mm (DN 600)	ASME VIII Div. 1
Tangent-to-Tangent length	2,000 mm (with 500mm boot)	L/D =3.3
Design pressure	5 barg	ASMEVIII
Design temperature	-10 to +50℃	
Material of Construction	SA-516 grade 70 (CS hell); SS 304 internals	ASTM A516
Mist Eliminator	Wire mesh, 150 mm depth, 99% efficiency for 10 µm	GPSA Engineering data Book

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IV. CONCLUSION

The process modelling and equipment sizing analysis show that a modular skid-mounted CNG compression unit for Western Niger Delta stranded gas is feasible. Perfect steady-state convergence with near-zero mass and energy balance mismatch in the Aspen HYSYS simulation confirmed the Peng-Robinson equation of state's thermodynamic compatibility for high-pressure, multi-component natural gas. With balanced stage pressure ratios of 6.5, 2.4, and 1.47 and optimal interstage pressures of 65 and 150 barg, three-stage compression reduces compression effort compared to single-stage adiabatic compression The Stage-1 compressor (K-101) has the highest installed power at 1,398 kW (46.6%) due to its high-pressure ratio and gas throughput.

ISO 15403 vehicle use standards are met with 99.9% methane purity, 205 barg storage pressure, 40°C, and no water or inert gas. Over 99% of non-methane components are rejected by the X-100 purification unit, producing pure sludge. Equipment size finds all key plant components meet modular skid-mounted applications' strict mechanical requirements. The compact V-100 inlet separator (DN600×2.0 m), 5°C cooling, and fast liquid knockout make it ideal for skid-mounted deployment and space optimisation.

At 218 barg and 250 barg, the Stage-3 (K-103) hyper-pressure compressor is the most complex. Special seals and materials required. Reduces thermal stress (36°C temperature rise) with 1.47 low-pressure ratio. To maintain ISO-compliant −40°C product temperature for the E-103 CNG cooler, a specialised mechanical refrigeration system is needed with 1,702 kW thermal duty. Cryogenic storage and transport prevent hydrate formation and protect product quality, but it costs more.

A 4.4% sludge methane leak costs waste management money. Recovery of C_2-C_5 hydrocarbons from sludge as NGL by-products can boost project profitability, particularly for Feed F with high concentrations. Modular skid-mounted design may monetise stranded gas resources in distant or scattered fields with reduced capital investment and construction time than stick-built facilities, according to robust modelling and equipment sizing.

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REFERENCES

[1]. N. Mohammad, K. Kidam, and I.A. Azid, "Natural gas as a transitional fuel in ASEAN: Opportunities and challenges," Renew. Sust. Energ. Rev., vol. 148, pp. 111-128, 2021.
[2]. S. Smart, N. Eleni, and P. Odesk, "Global gas flaring: Economic losses and health impacts revisited," Nat. Energy, vol. 10, no. 2, pp. 133-148, 2025.
[3]. TRACTEBEL ENGINEERING S.A., Small-Scale CNG Infrastructure for Remote Gas Fields: Technical and Economic Framework. Brussels: TRACTEBEL Engineering, 2015.
[4]. Honeywell UOP, Modular LNG and CNG Solutions for Remote and Stranded Gas Applications. Des Plaines, IL: Honeywell International, 2019.
[5]. Clean Energy Fuels, Off-Grid and Virtual Pipeline CNG Solutions: Technical Reference Manual. Newport Beach, CA: Clean Energy Fuels, 2016.
[6]. O. Ebrunu and D.E. Akpoturi, "Analysing flared gas from selected stations and its prospects for liquefied petroleum gas (LPG) production in the Western Niger Delta of Nigeria," SPE J. Pet. Sci., vol. 18, no. 2, pp. 44-63, 2025.
[7]. A. Funakpo, P.N. Amah, and C. Ihejirika, "Aspen HYSYS simulation of compressed natural gas production from associated gas," Int. J. Eng. Res. Technol., vol. 14, no. 2, pp. 89-102, 2025.
[8]. A. Kumar, R. Singh, and P. Patel, "Process simulation of natural gas processing using Aspen HYSYS: A case study of the ONGC Hazira Plant," Energy Sources, Part A, vol. 44, no. 3, pp. 7235-7252, 2022.
[9]. D. Matovu, M. Lubwama, and J.B. Kirabira, "Optimisation of multistage compression for natural gas liquefaction using generalised disjunctive programming," Energy Convers. Manage., vol. 278, pp. 116-135, 2023.