Shell Petroleum Development Company of Nigeria Limited

(Operator for the NNPC/Shell/Agip/EPNL Joint Venture)

Gbaran-Kolo Creek PU

OPERATIONS HSE CASE – GBARAN - KOCR PRODUCTION UNIT

SCiN-2021-03-00000008

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(Status: Approved for Implementation)

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OPERATIONS HSE CASE – GBARAN-KOLO CREEK PRODUCTION UNIT

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Revision History

Version	Date	Pages	Reasons
A01	December 2009	All	Align with the Group standard
R02	September 2010	All	Incorporate SIEP Review comments/suggestions
R03	August 2014	All	Compliant with OI standards and HSSE CF and EP 2005-0310 Requirements
R04	November 2017	All	Compliance with organisational changes, hardware /project addition and HSSE & SP CF updates
R05	March 2022	All	Compliance with new Enwhe Project scope addition and HSSE & SP CF updates
R06	September 2022	All	To align with organizational changes and simplify the document
R07	July 2023	preliminary	Organizational change update
R08	July 2024	Preliminary	Inclusion of Enwhe West scope (post completion of Gbaran 3A – Enwhe Project), and following a Desktop Safety Review (DSR) validating that no additional MAH has been introduced

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1.0 Management Summary

The HSE Case provides a documented demonstration that all the Severity 5 and High-Risk Hazards at Gbaran Kolocreek have been managed to ALARP. The document is in 5 parts as outlined below:

- Part 1: Brief Scope of Asset and Layout
- Part 2: Applicable Legislation, Codes, and Standards
- Part 3: Safety philosophy and application in design and operation
- Part 4: Hazards & Effects Management Process (HEMP)
- Part 5: Remedial Action Plan (RAP)

This HSE Case has been developed to comply with the Shell HSSE&SP Control Framework requirements. The HSE Case covers the operations across Gbaran-Kolo Creek PU which includes; Gbaran Central Processing Facilities (CPF), Gbaran Early Production Facility (EPF), Gbaran Field Logistics Base, Remote Manifolds (Zarama, Gbaran, Kolo Creek, Epu, Etelebou, Koroama, Kolo Creek to Soku (K_2S) Enwhe East and Enwhe West), Flowstations (Adibawa, Etelebou and Ubie), Intra and Inter-field Flowlines and Pipelines, and Gbaran Security Of Supply (GSOS) Facility in the CPF.

Hazards applicable to Gbaran Kolocreek assets were primarily identified through a structured HAZID workshop involving Operations and Maintenance Staff having broad range of experience and skills in the Oil and Gas Industry.

Table 1 below presents a summary of the associated Hazards that have been identified and assessed within the Gbaran Kolocreek operations. There are 12 Severity 5 Hazards categories associated with these operations, and these are referred to as Major Accident Hazards (MAHs).

Table1: Summary of MAHs for the Gbaran-Kolo Creek Production Unit

Ref	Hazard Description	INHERENT RISK RATING				
		P	A	E	C	Overall Rating
H-01	**Hydrocarbons**					
H-01.01	Crude oil	5C	5B	5C	5C	H
H-01.05	Condensate	5C	5B	5C	5C	H
H-01.06	Hydrocarbon gas	5C	5B	3C	5C	H
H-03	**Flammable Materials**					
H-03.05	Stored flammable	5B	3C	1C	4C	H
H-05	**Pressure Hazards**					
H-05.07	Release of inventory	5C	5C	1C	4C	H
H-08	**Dynamic Situation**					
H-08.001	Land Transport (driving)	5C	2C	2C	1C	H
H-08.002	Water Transport	5C	2C	2C	3C	H
H-08.003	Air Transport (flying)	5C	4C	2C	4C	H
H-09	**Environmental Hazards**					
H-09-01	Climate extremes/Lightning	5B	3B		2C	H
H-09-02	Continuous discharges to air/soil	5B	3B		2C	H
H-13	**Biological**					
H-13.006	Virus	4D	0A		0A	H
H-27	**Security**					
H-27.02/03/04 /05	Security related Hazards	4D	5D	3D	4C	H

LEGEND					
P	People	**E**	Environment.	**XY**	Risk Rating: Severity X, Likelihood Y (e.g. 5D – Severity 5, Likelihood D)
A	Asset	**C**	Community	**H**	Overall Rating: High

Bow-tie assessment was undertaken for each of the hydrocarbon MAH, addressing the threats, likelihood, consequences, and the effectiveness of the barriers.

The bowties for the dynamic situations are contained in the Logistics Safety Management System while management of the Security MAHs is addressed by the Gbaran-Kolocreek facility Security Plan and Security Risk Assessments. Other relevant studies such as Process Safety Basic Requirement, DEM2, HAZOP Studies, Fire Risk Assessment, Encroachment Studies, Operating Envelop Studies; Process Safety Reviews (PSR), and Hardware Barrier Assessments (HBA) have also been considered with respect to the safe operation of the facilities considering the identified MAHs. Key shortfalls have been captured in the remedial action plan which is being monitored for implementation by the line management.

The 8 categories of Safety Critical Elements have been identified as applicable to the Asset are: Structural Integrity, Process Containment, Ignition Control, Protection System, Detection System, Shutdown System, Life Saving system and Emergency Response

Statement of Fitness

This statement of fitness confirms that for the Gbaran-Kolo Creek PU:

1. The HSE case has been developed in accordance with the requirements of the EP HSE Case standard EP2005-0310 and HSSE & SP Control Framework.
2. All Major Accident Hazards have been identified and the risk reduction philosophies and measures identified for ensuring the risks are tolerable have been implemented. The Remedial Actions Plan in Part 5 will be implemented to further manage the risks to ALARP.
3. There is a management system in place for the operation, adequate to enable SPDC to comply with all relevant statutory and company provisions in relation to the Gbaran-Kolo Creek Production Unit and any activity in connection with it.
4. The asset shall be operated in accordance with these arrangements.

The asset, therefore, meets the criteria to operate.

Asset Manager – SPDC East Assets
(Operations HSE Case Owner)

Part 1: Brief Scope of Asset and Layout

1.1 Objectives

The objective of this HSE Case is to provide a documented demonstration that all the Severity 5 or High-Risk Hazards in Gbaran-Kolocreek facilities have been managed to the ALARP criteria.

1.2 Scope of HSE Case

The physical boundaries covered by the Gbaran-Kolocreek HSE Case include:

- Gbaran Central Processing Facilities.
- Gbaran Early Production Facility.
- Gbaran Field Logistics Base.
- Kolo Creek, Etelebou, Adibawa and Ubie Flowstation
- Zarama, Gbaran, Kolo Creek, Etelebou, Epu, Koroama, Kolo Creek to Soku (K2S), Enwhe East and Enwhe West Remote Manifolds.
- Intra and inter-field flowlines and pipelines.

However, the Case did not capture Wells operations intensively. All Wells operations within Gbaran-Kolo Creek PU shall be managed via Electronic Well Integrity Management System (e-WIMS) under the accountability of the East Asset Manager.

1.3 Facility Overview/Asset Description

The Gbaran-Kolo Creek PU Facilities are required by Shell to meet its commitment to supply natural gas to Trains 4, 5 and 6 of the Nigeria Liquefied Natural Gas (NLNG) facilities. The facilities deliver 1.2 Bscf/d of gas to NLNG while supporting production beyond the 'flares down' and providing a platform for oil production growth.

The facilities cover an area of approximately 650km^2 in the Eastern part of the Niger Delta. The geographic centre of the Gbaran Ubie node is located 100km NW of Port Harcourt and 40km NE of Yenagoa. The area is subject to seasonal flooding and height variations of up to 5.5 metres have been recorded in the River Nun that runs adjacent to the site of the Central Processing Facility (CPF) at Gbaran.

An overview of the various facilities is provided in the table below and described subsequently.

Table 1: Overview of Facilities

Node	Facilities
Gbaran CPF	Gbaran Central Processing Facilities
	Gbaran Early Production Facility
	Gbaran Field Logistics Base
Gbaran RMF	Gbaran Oil
	Gbaran NAG
Zarama	Zarama NAG
	Zarama Oil
Kolo Creek	Kolo Creek Flowstation (bulked to K2S)
	Kolo Creek NAG

	Kolo Creek Well 39 & 40
Etelebou	Etelebou Flowstation
	Etelebou Oil MF
	Gbaran 22 MF (vztx2)
Adibawa	Adibawa Flowstation
	Adibawa AGS
	Mbiama Microwave
Ubie FS	Ubie Flowstation
Koroama	Koroama NAG
	Biseni
	Koma 10
Epu	Epu 2
	Epu 3&4
Enwhe	Enwhe NAG Manifolds (Enwhe East and Enwhe West)

Remote Manifolds and Flowstations

There are eight remote NAG manifolds located at Zarama, Gbaran, Koroama, Epu, Kolo Creek, Kolo Creek to Soku (K2S), Enwhe East and Enwhe West. In addition to the manifolds that are installed in most cases in the same location as the NAG wells, the NAG gathering facilities include flowlines to the manifolds and bulklines from the manifolds to the CPF. Gbaran NAG wells 11T and 13T are exceptions, as their flowlines run directly into the CPF/EPF. The K2S node was built due to ullage availability in Soku gas plant to deliver a maximum throughput of 400 MMScfd of gas to Soku Gas plant from Kolo Creek deep F1 and F2 reservoir. The gas from the NAG wells is gathered at Kolo Creek remote field NAG manifold and transported via a 20-inch x 40km pipeline to Soku gas plant where it is treated to NLNG specifications for export.

The remote oil manifolds collect oil with the associated gas and water from individual wells from Gbaran, Kolo Creek diverted to CPF, Etelebou and Zarama. Oil is transported to the CPF for stabilisation via bulk lines. The NAG well sites and all manifold stations are fenced, and a guard hut with small portable water storage and toilet facility to support security guard presence are provided.

There are four flowstations in the production unit. Etelebou, Adibawa and Ubie flowstations receive oil from the wells, stabilize it and then export it to Bonny terminal through the Kolo Creek Trunk Line (KCTL) - Etelebou flows to Gbaran CPF. The Kolo Creek flowstation is mothballed and the oil from the wells is bulked and directed to the CPF for processing. The Adibawa flowstation has an Associated Gas Gathering solution that sends gas to the Gbaran CPF for processing.

The Enwhe Remote Manifolds consist of 5 NAG wells (3 clustered at the East location, and 2 clustered at West Location). A bulkline transports fluid from the East wells to a common manifold at the West location. Fluid from both the East and West wells are commingled at the West Manifold and transported through a bulkline to Gbaran CPF.

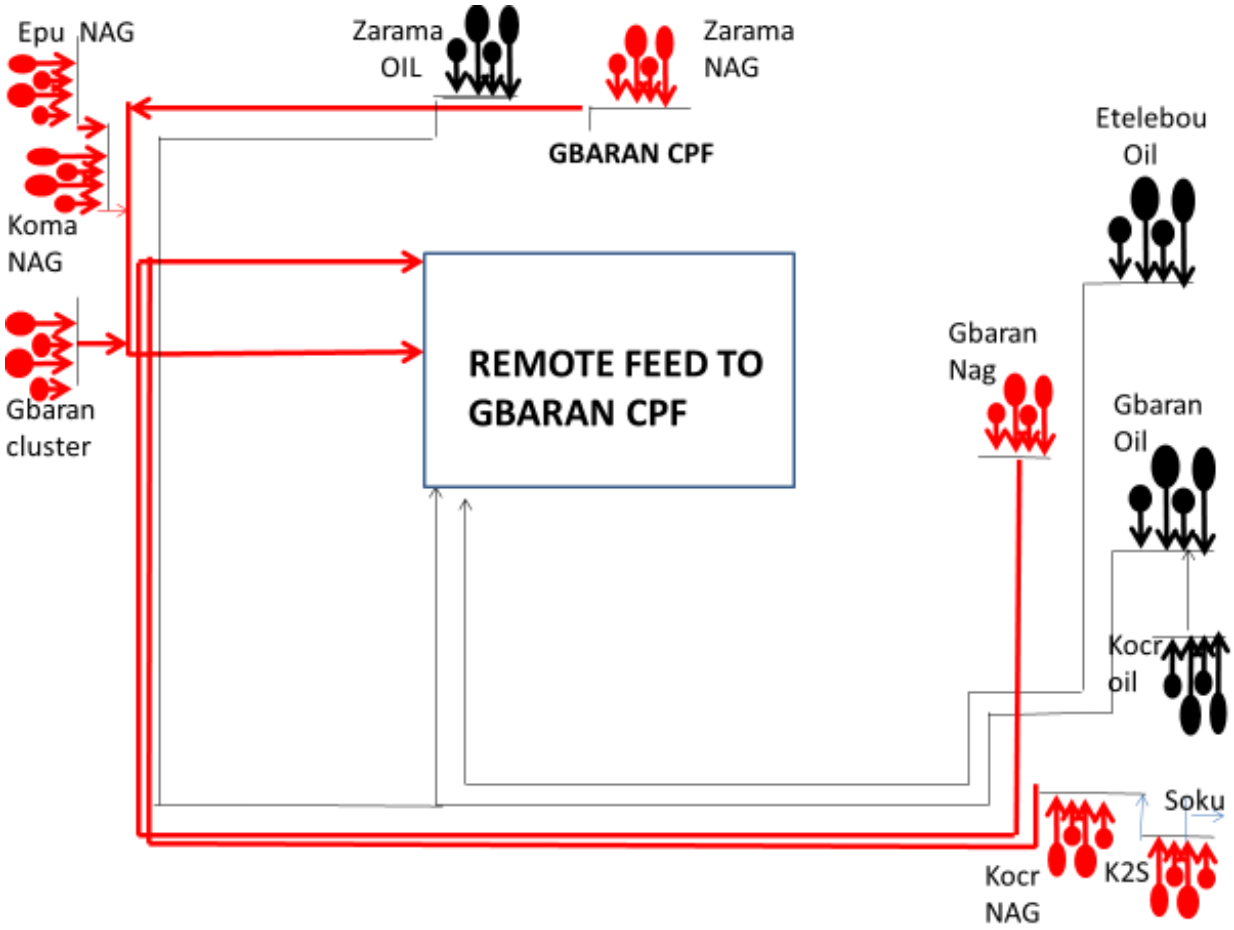


Figure 1: Schematic of Gbaran Remote Node

Gbaran Central Processing Facility (CPF)

The CPF provides a gas dehydration capacity of 1.2bcf/d (two trains), expandable to 1.4bcf/d (three trains) in future, and an oil/condensate stabilisation capacity of 120,000 bpd. The remote non-associated gas (NAG) manifolds collect gas from individual wells and transport it via bulk lines to the CPF. In addition, the CPF receives production from two wells located within the Gbaran area via individual flow lines and gas from Adibawa AGG.

Gbaran Nodal Compression Facility is installed at the Gbaran Central Processing Facility to sustain gas supply to NLNG and to improve Ultimate Recovery (UR) by 0.9 – 1.5 Tscf of Gbaran Phases 1 and 2A fields to Top quartile. The focus is primarily to harness low pressure NAG wells (arriving Gbaran CPF at pressure less than 90 barg) from Zarama, Kolo Creek, Gbaran and Koroama fields.

At the CPF, the NAG well fluids undergo gas/liquid separation, cooling and gas dehydration. The cooled gas is fed to an inlet separator to remove any carryover liquid and the condensed gas is passed to the Glycol Contactor where it is scrubbed for condensate and water removal. The gas is dehydrated using 99.5 wt% Triethylene Glycol (TEG) in a structured packing section. Gas from the contactor is finally scrubbed in the Glycol Scrubber to remove any glycol carried over from the contactor and to minimise the amount of glycol passing to the metering and EGGS pipeline. The dried gas is metered, in each train, to fiscal standard and recombined with the other train. The recombined gas is exported through the EGGS-2 pipeline via EGGS-1/GTS1 to NLNG. The

rich TEG solution from the dehydration is sent to the Glycol regeneration system where excess water is vaporized and lean TEG is reused.

Oil/condensate stabilisation facilities at the CPF consist of oil and gas separation trains. Oil stabilisation train 1 is dedicated to condensate operation while train 2 can handle both oil and condensate. However, this does not preclude the use of condensate from any of the NAG slug catchers from being used to manage wax issues in the oil train. The Associated Gas (AG) from the oil stabilization trains are compressed by booster compressors to increase the pressure prior to entry into the gas dehydration system. Oil and condensate are subsequently exported to Bonny terminal via existing Trans Niger Pipelines (TNPs).

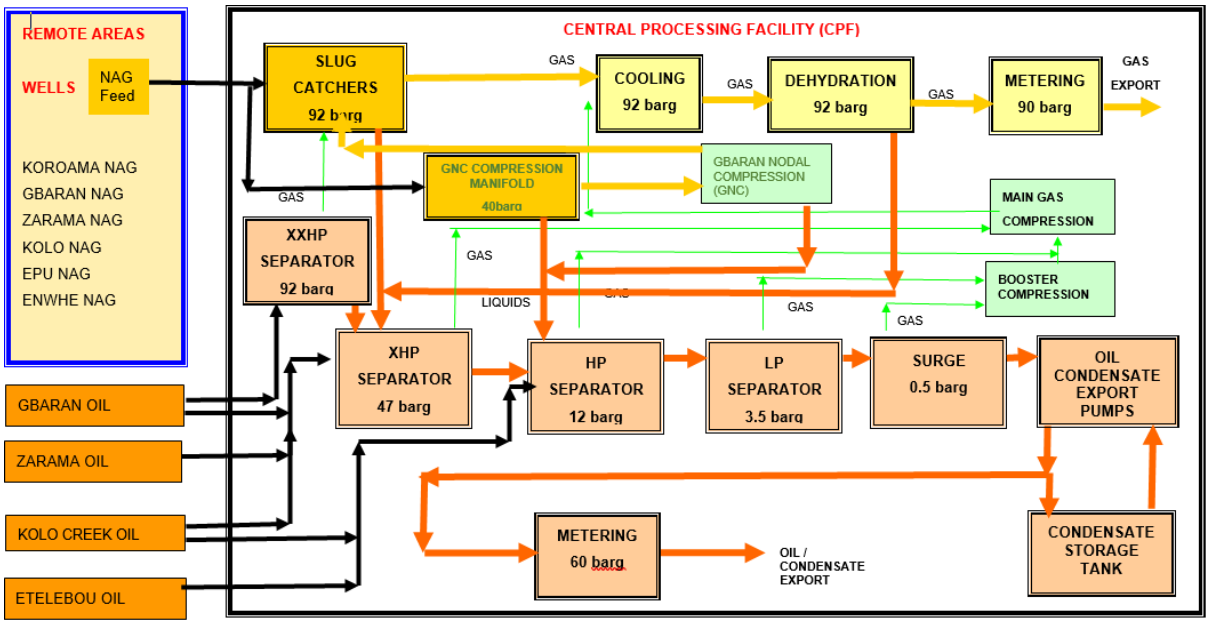


Figure 2: Overview of the CPF Process Flow

Fuel gas is taken off the combined gas stream from production to power the gas turbine generator which provides electricity to the CPF, Field Logistics Base (FLB) and the neighboring communities. However, if the CPF is down, it will be by backflow from the EGGS 2 line. In either case, it is metered to give the correct net flow from the plant. A spare metering train is provided to allow for maintenance.

In the event of unavailability of the liquid export line-Trans Niger Pipeline (TNP), oil production is suspended, and the produced condensate is stored in the condensate tank and subsequently spiked into EGGS 2 line. Produced water from the condensate storage tank is injected into the well through a package installed for the purpose. Only condensate can be stored in the storage tank, liquid from the closed drain system is no longer allowed to flow to the Condensate Storage Tank.

Other supporting units/structures in the CPF include free-standing, blast-resilient prefabricated Central Control Building and Field Auxiliary Rooms (FAR) located in the non-hazardous area of the facility, Instrument Air System, Chemical Injection unit, Fuel Gas Stabilization trains, three sets of flares (HP, LP and ATM), the Emergency Diesel Generator unit, Fire and Gas Detection

systems, Fire Protection Systems, Escape, Evacuation and Rescue Equipment, and Emergency Communication Systems.

Gbaran Early Processing Facility

The primary objective of the facility is to supply gas to the National Integrated Power Plant (NIPP) with a water dewpoint of 15^0C and hydrocarbon dewpoint of 15^0C. The plant is designed for a throughput of 80MMscf/d and is fed by 2 NAG wells (Gbaran 11 & 13T) from Gbaran NAG Cluster Facility - each well has a potential of circa 90MMcfd.

The gas stream passes through a production Separator where heavy ends of the hydrocarbons, (water and condensate) drop out and the flash gas comes out from the top. The residual moisture is removed by injecting Ethylene Glycol (EG) into the main gas stream to absorb traces of water and to prevent hydrate formation. The gas stream pressure is further dropped and chilled using the JT (Joule Thomson) effect. The gas is then passed through a cold separator where the remaining condensed liquid; condensate and water are removed. The gas leaves the Cold Separator and passes through a heat exchanger to attain the required dew point/sales specification condition before export. Part of the gas is used as fuel gas for internal consumption after going through pressure reduction.

The hydrocarbon condensate is sent to the liquid export manifold and the rich TEG solution is sent to the Ethylene Glycol regeneration system where excess water is vaporized and the Lean TEG reused. All condensate is gathered and sent to the Gbaran CPF.

The Gbaran EPF Flare has a capacity of 12mmscfd but it is designed to blow down the maximum throughput of the plant (80mmscfd) via sectionalized blowdown per API 521. In cases where NIPP is shut down or unable to receive gas, the plant would be on standby by closing in all NAG inlet valves.

Field Logistics Base

The Field Logistics Base (FLB) is located adjacent to the CPF and capable of accommodating up to 200 personnel. The following facilities are within the FLB: Accommodation Chalets, Catering Facilities, Recreation Facilities, Utilities Building, Sewage Treatment Facilities, Water Supply and Distribution Facilities, Production Laboratory, Site Clinic, Fire Station with Fire Equipment, Telecoms Facilities, Warehousing and Chemical Storage, Offices and Maintenance Workshops, Helipad and Air Operations Base, Garbage Compactor and Mini Incinerator (not commissioned), Diesel Storage and Pumping System, Electrical System and a Security Base.

Flowlines and Pipelines

There are over 600km of flowlines and pipelines including NAG and oil flowlines, oil export lines, and gas supply lines. All flowlines are fully rated i.e., designed to the full wellhead Closed-In Tubing Head Pressure (CITHP) as defined in the Pipeline Line List. The NAG flowlines will be controlled by a manual set point control choke at the wellhead. Sand detectors are provided at each wellhead.

For more details on the description of the facilities, drawings, layouts, plot plans and PEFS, reference the Gbaran Plant Operations Manual.

Part 2: Applicable Legislation, Codes, and Standards

2.1 Applicable Legislation

Applicable legislation for Gbaran-Kolocreek facilities is captured in SCiN Register of key regulatory obligations, permits and approvals from Federal and State government, international laws, Conventions, and protocols that Nigeria is signatory to and or has ratified which are relevant to Oil & Gas operations. Apart from listing them, this document outlines the references from the laws/regulations applicable to SCiN operations. **SCiN-2017-07-00000001.** LINK

2.2 Codes and Standards

Gbaran Integrated Oil and Facility like other SCiN facilities are standardized by the following HSSE codes and standards: ISO; EGASPIN; OPITO; API

Part 3: Safety Philosophy and Application in Design and Operation

3.1. Safety Systems

3.1.1. SCE Groupings from Global Maintenance Performance Standards (Document Number: EP2009-9009). LINK

3.1.2. SWISS CHEESE MODEL

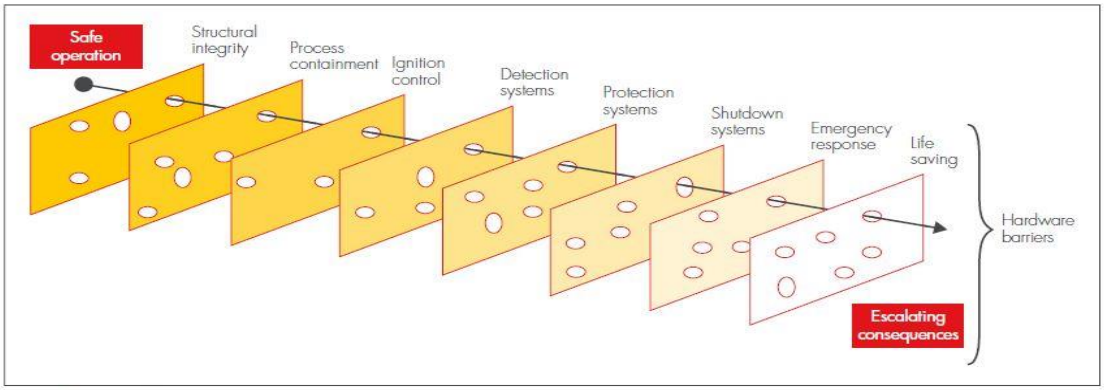


Figure 1: Hardware barriers and SCE groups

3.2. Containment & Pollution Abatement Systems

3.2.1 Drain System**:** The Drains Systems include liquids recovery and treatment from the following sources:

1. Closed drains from process equipment normally containing hazardous material.
2. Closed drains from the Glycol System.
3. Open drains from hazardous and non-hazardous areas.
4. Propane collection and evaporation areas.
5. Non-hazardous open drains from the Industrial Area.
6. Chemical Storage/Skid Areas.

Drains from non-hazardous, non-bunded open areas are collected separately in Bare Area Open Drains.

3.2.2. Pollution Abatement Systems: Effective skimming system at the saver pit is used to achieve zero or negligible PPM of hydrocarbon before discharge. However, this is an opportunity for improvement in our commitment to achieve zero discharge of water with PPM of hydrocarbon to the environment.

3.2.3. Environmental Impact Assessment: Soku has an approved EIA baseline studies for managing identified environmental aspects and carries out 3-yearly Environmental Evaluation Studies (EES) and weekly Environmental Compliance Monitoring (ECM) to monitor/assess environmental impacts of our operations EES.

3.3. Lifesaving Facilities/Equipment –Evacuation & Escape

- Gbaran Kolocreek Facilities Escape, Evacuation & Rescue Philosophy (Document No.:)
- Escape Route Drawing (Document No.: E-114279 (FS), E-082512 (Gas Plant))
- Lifesaving and Escape Equipment Drawing (E- 082511) LINK

- Compressed Air-Emergency Breathing System (CA-EBS): for evacuation/escape from toxic environment such as Confined space first entry (Refer to control framework sub manual on personal safety.

3.4 Others: Communication System

Hand-held radio and desktop/mobile telephone communication

Part 4: Hazards & Effects Management Process (HEMP)

4.1 Major Hazards & ALARP Descriptions

The below table is a summary of GBR/KCRK IOGP Major Accident Hazards (MAHs) and methodologies for ALARP demonstration.

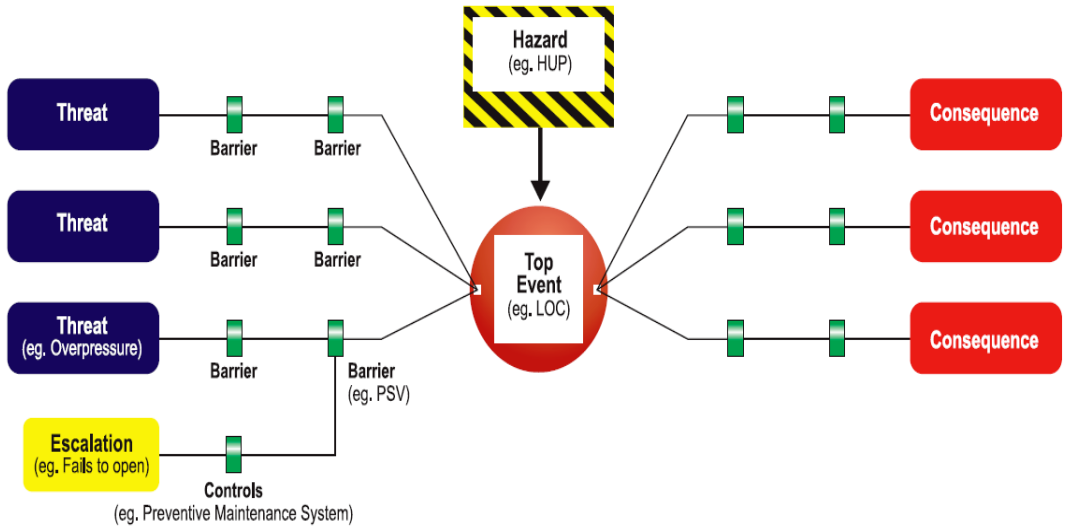
Case	Interface	Reference
HYDROCARBON (UNREFINED)	Hazards associated with unrefined Hydrocarbon in GBR/KCRK IOGP facilities	GBR/KCRK IOGP Bowties
PRESSURE	Hazards associated with pressure in GBR/KCRK facilities	GBR/KCRK IOGP Bowties
DYNAMIC SITUATIONS (Aviation)	Hazards associated with air transport (accessing the facility by Helicopter are addressed in the Aviation HSE Case.)	Aviation HSE Case/Bowties Aviation HSE Case
DYNAMIC SITUATIONS (Marine)	Hazards associated with marine logistics to and from the JETTY.	Marine Operating procedure and Guidelines (MOPAG) - SEPCiN-2019-09-00000002
DYNAMIC SITUATIONS (Land Logistics)	Hazards associated with Land transport logistics within the Terminal and in the Bonny Island network of roads.	Logistics Safety Management System - SEPCiN-2018-08-00000002 Corporate Logistics HSE Case
SECURITY	Hazards associated with security in and around GBR/KCRK IOGP Facilities	GBR/KCRK IOGP Facility Security Plan
HEALTH	Hazards associated with the health of workforce in GBR/KCRK IOGP	GBR/KCRK IOGP Health Risk Assessment . COVID19 Combination of Controls - SCiN-2020-06-00000021)

Identified HSE hazards and effects are presented in the GBR/KCRK IOGP Hazard Management Table

A comprehensive review of the environmental aspects has been completed in line with ISO14001:2015 requirements EIA/EES.

4.2. Major Hazards: Bowties, Safety Critical Elements and Performance Standards

A simple graphical tool is used to illustrate the relationships between each Major Accident Hazard, its causes, potential consequences, and controls. The following is an example of a Major Accident Hazard diagram or “Bowtie”.



4.2. Safety Critical Elements and Performance Standards

The SCE Performance Standards provides the performance criteria, which a Safety Critical Element would be required to achieve when available. The following tables present a summary of the Safety Critical Elements (SCEs) identified in GBARAN.

4.2.1 SCEs Listing

The SCEs in the production unit have been identified in line with the Management of SCEs and Performance Standards and Safety Critical Element Management Manual. The SCE Performance Standards provide the performance criteria, which they would be required to achieve when available.

The following sets of tables present a listing of the SCEs derived from various studies during the development of the GBU-KOCR Operations HSE Case, and for which Performance Standards, Assurance Tasks & Values have been developed. Each of the SCEs is grouped under one of 8 Hazard Management Barriers of Structural Integrity, Process Containment, Ignition Control, Detection Systems, Protection Systems, Shutdown Systems, Emergency Response and Life Saving Equipment.

Table 2: SCEs listing for Gbaran Ubie CPF and RIFs

S/N	SCE Coding	SCE Group	Barrier Reference
1	SI001	Foundation Structures	Structural Integrity
2	SI002	Topside Structures	Structural Integrity
3	SI003	Heavy Lift Cranes	Structural Integrity
4	SI005	Road vehicles	Structural Integrity
5	PC001	Pressure Vessels	Process Containment
6	PC002	Heat Exchangers	Process Containment

7	PC003	Rotating Equipment	Process Containment
8	PC004	Tanks	Process Containment
9	PC005	Piping Systems	Process Containment
10	PC006	Pipelines / Flowlines	Process Containment
11	PC007	Relief System	Process Containment
12	IC002	Non-Hazardous Area Ventilation	Ignition Control
13	IC003	Certified Electrical Equipment	Ignition Control
14	IC005	Earth Bonding	Ignition Control
15	IC006	Fuel Gas Purge System	Ignition Control
16	IC007	Utilities Inert Gas System	Ignition Control
17	IC008	Miscellaneous Ignition Control Components	Ignition Control
18	IC009	Flare Tip Ignition Systems	Ignition Control
19	DS001	Fire and Gas Detection	Detection Systems
20	DS002	Security Systems	Detection Systems
21	DS003	Gas Dew point Measurement	Detection System
22	PS002	Explosion Protection	Protection System
23	PS004	Fire Water Pumps (Main)	Protection Systems
24	PS004	Fire Water Pumps (Jockey)	Protection Systems
25	PS005	Firewater Ring Main and Other Distribution Systems	Protection Systems
26	PS006	Passive Fire Protection	Protection Systems
27	PS007	Gaseous Fire Protection System	Protection Systems
28	PS011	Fixed Foam System	Protection System
29	PS013	Chemical Injection Systems	Protection Systems
30	SD001	Emergency Shutdown System	Shutdown Systems
31	SD002	Depressurisation System	Shutdown Systems
32	SD003	High Integrity Pressure Protection Systems (HIPPS)	Shutdown Systems
33	SD005	Pipeline Isolation Valves	Shutdown Systems
34	SD006	Process Emergency Shutdown Valves (ESDVs)	Shutdown Systems
35	SD009	Utility Air System	Shutdown System
36	ER001	Primary Muster Areas	Emergency Response
37	ER002	Escape and Evacuation Routes	Emergency Response
38	ER003	Emergency / Escape Lighting	Emergency Response
39	ER004	Communications Systems	Emergency Response
40	ER005	Uninterrupted Power Supply (UPS)	Emergency Response
41	ER006	Helicopter Facilities	Emergency Response
42	ER007	Emergency Power	Emergency Response
43	ER008	Manual Fire Fighting Equipment	Emergency Response
44	ER010	Drain Systems	Emergency Response
45	LS001	Personal Survival Equipment (PSE)	Life Saving

Table 3: SCEs listing for the EPF.

S/N	SCE Coding	SCE Group	Barrier Reference
1	SI001	Foundation Structures	Structural Integrity
2	SI002	Topside Structures	Structural Integrity
5	PC001	Pressure Vessels	Process Containment
6	PC002	Heat Exchangers	Process Containment
7	PC003	Rotating Equipment	Process Containment
8	PC004	Tanks	Process Containment
9	PC005	Piping Systems	Process Containment
10	PC007	Relief System	Process Containment
12	IC003	Certified Electrical Equipment	Ignition Control
13	IC005	Earth Bonding	Ignition Control
14	IC008	Miscellaneous Ignition Control Components	Ignition Control
15	IC009	Flare Tip Ignition Systems	Ignition Control
16	DS001	Fire and Gas Detection	Detection Systems
17	DS002	Security Systems	Detection Systems
19	PS007	Gaseous Fire Protection System	Protection Systems
20	SD001	Emergency Shutdown System	Shutdown Systems
21	SD002	Depressurisation System	Shutdown Systems
22	SD003	High Integrity Pressure Protection Systems (HIPPS)	Shutdown Systems
23	SD006	Process Emergency Shutdown Valves (ESDVs)	Shutdown Systems
24	SD009	Utility Air System	Shutdown System
25	ER001	Primary Muster Areas	Emergency Response
26	ER002	Escape and Evacuation Routes	Emergency Response
27	ER003	Emergency / Escape Lighting	Emergency Response
28	ER004	Communications Systems	Emergency Response
29	ER005	Uninterrupted Power Supply (UPS)	Emergency Response
30	ER007	Emergency Power	Emergency Response
31	ER008	Manual Fire Fighting Equipment	Emergency Response
32	ER010	Drain Systems	Emergency Response
33	LS001	Personal Survival Equipment (PSE)	Life Saving

Table 4: SCEs listing for Kolo Creek to Soku Facilities.

S/N	SCE Coding	SCE Group	Barrier Reference
1	SI001	Foundation Structures	Structural Integrity
2	SI002	Topside Structures	Structural Integrity
3	PC005	Piping Systems	Process Containment
4	PC006	Pipelines / Flowlines	Process Containment
5	PC007	Relief System	Process Containment
6	IC003	Certified Electrical Equipment	Ignition Control
7	IC005	Earth Bonding	Ignition Control

S/N	SCE Coding	SCE Group	Barrier Reference
8	DS001	Fire and Gas Detection	Detection Systems
9	PS013	Chemical Injection Systems	Protection Systems
10	SD001	Emergency Shutdown System	Shutdown Systems
11	SD003	Emergency Shutdown System	Shutdown Systems
12	SD005	Pipeline Isolation Valves	Shutdown Systems
13	SD006	Process Emergency Shutdown Valves (ESDVs)	Shutdown Systems
14	SD009	Utility Air System	Shutdown System
15	ER001	Primary Muster Areas	Emergency Response
16	ER002	Escape and Evacuation Routes	Emergency Response
17	ER003	Emergency / Escape Lighting	Emergency Response
18	ER004	Communications Systems	Emergency Response
19	ER005	Uninterrupted Power Supply (UPS)	Emergency Response
20	ER008	Manual Fire Fighting Equipment	Emergency Response
21	ER010	Drain Systems	Emergency Response
22	LS001	Personal Survival Equipment (PSE)	Life Saving

Table 5: SCEs listing for Enwhe Facilities.

S/N	SCE Coding	SCE Group	Barrier Reference
1	DS001	Fire and Gas Detection System	Detection Systems
2	DS002	Pipeline Surveillance	Detection System
3	ER001	Temporary Refuge/ Muster Area	Emergency Response
4	ER002	Escape/ Evacuation Routes	Emergency Response
5	ER003	Emergency/ Escape Lighting	Emergency Response
6	ER004	Communications System	Emergency Response
7	ER005	Uninterrupted Power Supply (UPS)	Emergency Response
8	ER010	Open Hazard Drains	Emergency Response
9	IC003	Certified Electrical Equipment	Ignition Control
10	IC005	Earth Bonding	Ignition Contro
11	LS001	Personal Survival Equipment	Life Saving
12	PC001	Pressure vessels	Pressure Containment
13	PC005	Piping systems	Pressure Containment
14	PC006	Pipelines	Pressure Containment
15	PC007	Relief systems	Pressure Containment
16	PS006	Passive Fire Protection	Protection Systems
17	PS012	Sand Filters	Protection Systems
18	PS013	Chemical Injection Systems	Protection Systems
19	SD001	Shutdown Systems	Shutdown
20	SI002	Surface Structures	Structural Integrity
21	SI003	Heavy Lift Cranes	Structural Integrity

Facility SCE Mapping

The SCE mapping for Gbaran-Kolo creek PU operations is attached below and can be accessed via this link:

SCE Mapping 14022020

SCE Performance Standards

A Performance Standard is a statement of the performance required of an SCE and states the overall goals of the SCE. The goals are aligned with the role that the SCE has in preventing the occurrence or mitigating the effects of the major accident. The performance standard evaluates the operational success criteria of the SCE – this can be measured and expressed in pre-set qualitative or quantitative terms.

For the Gbaran-Kolo Creek PU Operations HSE Case, Performance Standards are defined in terms of Functional Criteria, Minimum Assurance Task, Assurance Measure and Assurance Value. They have been prepared by compiling the requirements from the following sources:

- **Global Shell Operate Phase Performance Standards**: Shell is a mature company and general performance requirements for most SCEs have been developed over time based on internal standards (e.g. the DEPs), external standards (e.g. API/BS) and the company's operating experience.
- **Specific Requirements from HEMP**: the technical HSE studies may identify performance requirements over and above generic standards that require adjustment to the Preventive Maintenance (PM) tasks.
- **Specific Local Requirements:** based on the specific hardware selected (e.g. a unique/new type of pump that requires a different type of performance checks), or local legal requirements (e.g. mandatory SCSSV change-out frequency) the generic performance standards will be changed.

Completed facility Performance Standards are reviewed and approved by the relevant Technical Authorities in Discipline - Design (TA1) and Maintenance Engineering (TA2) prior to implementation.

The detailed Performance Standards (PS), Assurance Task & Values are referenced in GBU-NG01005046-GEN-PS01-00001 and the critical activity/tasks, linked to roles and hazards and accountability packs are shown in Appendix 2**.** The requirements in the PS are translated into SAP Preventative Maintenance (PM) tasks which specify clearly, concisely and realistically the nature of the tasks and the frequencies at which they are to be completed. All tasks identified in the PS for SCEs are flagged in SAP as safety-critical tasks and are prioritized for completion.

Performance Deviation Control

Deviation control is vital in the management of Major Accident Hazards. It is a primary objective to ensure that SCEs always perform to 100% of their required functionality, but there may be times when this does not occur due to breakdown or other causes. It is therefore important to have a process that controls (temporary) deviations in performance in a safe manner. The Technical Integrity Framework sets the requirements for deviation management, and the Management of Change Process Elements within the Maintenance and Integrity Management

Standard (MIMS) provides the basis for controlling deviations in performance. This process in SPDC is called PD Operations Deviation Control.

PD Operations Deviation Control is used to control the decision whether or not to continue operating either after the discovery that an SCE is not meeting its Performance Standard (e.g. during testing) and can't be quickly fixed, or when it is known in advance that an SCE will stop meeting its performance standard because the planned work can't be executed (e.g. due to operational constraints). Deviation Control administration is handled by the Shell FSR system.

If an SCE at the facility is not meeting (or will not meet) the defined performance standard the following occurs:

- The asset raises a deviation request in the FSR system - highlighting the performance issue, risk assessment of continuing operations with the degraded performance, mitigation measures and actions/timeframe to reinstate to full functionality.
- The deviation is sent to Technical Authorities (TA2) - who are experts in SCE hardware and competent in assessing if the risk assessment is correct as well as making an informed judgment if it is safe to continue under deviation.
- The deviation is approved or rejected – If approved, operations continue under deviation and the actions to reinstate the SCE to full performance are completed in the agreed timeframe. If rejected by the TA, the Operations Team Leader/ Superintendent has the option to continue production (after approval of the Asset Manager) fully understanding the risk exposure, or initiate a partial/full shutdown.

In addition, if any permanent/temporary physical or electronic modifications are required to an SCE, it must also be managed through FSR by raising a Management of Change (MOC) which shall be approved by the relevant Technical Authorities. All modifications to SCEs should only be done after consulting the HEMP section of this Operations HSE case to determine the impact on Major Hazards Management. Changes to the facility must be reflected in an updated HSE Case which is to be kept current and in accordance with the latest HSE Case standard.

Integrity Management System

The Operations HSE Case and Technical Integrity Framework are linked through the Performance Standards. The responsibility of the HSE Case (through the HEMP assessment during design) is to identify the correct SCEs required to control Major Hazards and detail any specific performance requirements. The central aim of Technical Integrity aim is to keep the SCEs always identified in the Operations HSE Case in an effective state. Installation maintenance schedules for SCEs are set into SAP, and tasks are set in accordance with the prescribed Performance standards. Performance is monitored against these standards.

The Maintenance and Integrity Management Standard (MIMS) implements the following during the operations phase of the facility:

- Performance Standards (PS) which are fully defined and agreed by Technical Authorities.
- SAP Assurance PM Tasks which are set according to the PS.
- Performance monitoring of the SCEs against the required standards.
- Temporary deviation in performance controlled through an approval process.
- Permanent change to SCE hardware/facilities controlled through robust management of change (MOC) process detailed in SPDC Management of Change Procedure

Maintenance Management System

The status of the technical integrity of SCEs in Gbaran-Kolo Creek PU is monitored in two primary ways:

- **Continuous monitoring through Facility Status Reporting (FSR) system**: the FSR system provides a continuous status of preventative (PM) and corrective maintenance (CM) tasks in SAP and provides an indication of the state of the technical integrity of the facility. Operations/Asset Management and Technical Authorities can review FSR at any stage and look into performance issues of a specific piece of equipment on the facility, or gain an overall picture/trend of the integrity of the facility. FSR can be accessed here.
- **Periodic monitoring through Audits**: there are several specific audits which assure the performance of SCEs and validate the daily monitoring/control through FSR:
  - Hardware Barrier Assessment (HBA) – regular Barrier Health Checks by TA2s, Maintenance, Operations and Asset team members and other relevant disciplines.
  - Structured technical integrity audits - such as FAIRs, by technical authorities (or external).
  - TI Framework Review – to validate the process underpinning the TI monitoring e.g., Process Safety Review (PSR).

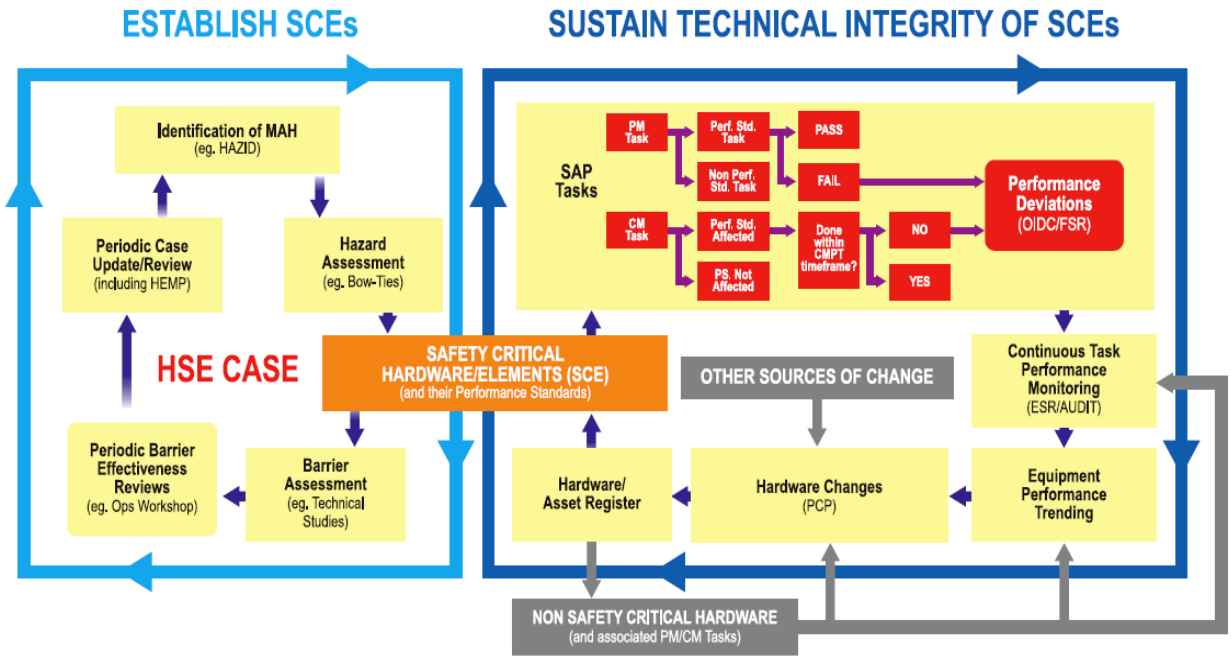


Figure 3: Link between HSE case and technical integrity framework.

Compliance with Process Safety Basic Requirements (PSBR)

PSBR gap analysis/studies were carried out for all Gbaran-Kolo Creek PU assets and the gaps identified have been closed. Compliance to the applicable PSBRs has been demonstrated and documented in the embedded documents. This is routinely updated to reflect current realities and reports reside with the asset management team.

Gbaran Ubie PU PSBR Compliance requirement
Kolo Creek PSBR Compliance requirement


Gbaran Ubie PU PSBR Compliance re


Enwhe DEM 2 Compliance Report_


Enwhe DSR_Revalidation_N

4.3.1 General

All the hazards in Gbaran – Kolocreek Production Unit are known and the decision type to reduce the risks to ALARP is Type A/B, based on the HSSE&SP-CF, MOSR, EGASPIN 2018, etc The key risk reduction philosophies are based on this premise.

4.3.2 Overpressure Protection

The philosophy is to provide overpressure protection systems but reduce the frequency of the initiating events for overpressure, to reduce the demand on the protective systems. Initiating events of high pressure include:

- Blockage in the process.
- Inadvertent/Mal-operation of valves.
- Spurious closure of valves/Control loop failure.
- Sabotage, etc.

4.3.2 Corrosion Management

For the oil & gas flow lines and Pipelines, external corrosion management is based on coating/wrapping and Cathodic Protection System. For internal corrosion management, Corrosion Resistant Alloys (CRA) (Duplex Stainless steel), corrosion Monitoring Systems (Corrosion Coupons) and Corrosion Inhibition Injection Systems are deployed. The strategy is also based on the replacement of the flowlines at the end of the design life.

For the surface facilities, external corrosion is managed with the surface painting of on-plot piping and vessels.

4.3.3 Fire Protection

Key fire protection measure in the facilities is the separation distance between equipment, to mitigate the risk of escalation and isolation of the inventory feeding the fire. Separation distances have been optimised to provide sufficient clearance distance for maintenance and minimise the risk of escalation between inventories, but minimise land-take and piping lengths. Jet fires are mitigated by containment - isolation and blowdown.

4.3.3.1 Active Fire Protection

For the CPF & FLB, a fire hydrant system supplied from the Nun River through fire water pumps and ring mains is installed for extinguishing non-hydrocarbon and hydrocarbon fires except gas fires.

The remote installation facilities and EPF are equipped with portable fire extinguishers for firefighting at the incipient stage. The FLB has an equipped fire station for fire emergency response to the Gbaran-Kolo Creek PU axis of the East Asset.

4.3.4 Explosion Overpressure Protection

Process modules have been designed with no specific blast resistance. The CPF Central control room is blast resistant while the FARs and switch rooms are enhanced blast resilient. Occupied fixed buildings are sited where the individual risk of explosion overpressure is below tolerable levels and ALARP.

FAR at Enwhe East and West have also been designed with no specific blast resistance based on the findings from the Quantitative Risk Assessment as per D.E.P 34.17.10.33.

4.3.5 Prevention of Ignition

The separation between process modules and strong sources of ignition – flares, is maintained to ensure that any gas will be dispersed below the lower flammability level for releases from hole sizes up to 50 mm.

Hazardous areas are classified per the Institute of Petroleum's Model Code of Safe Practice IP, Part 15 Edition 4. All electrical equipment on site are rated for use in Zone 1&2 hazardous areas and are installed out of Zone 0 hazardous areas. All electronic equipment (transmitters/sensors) installed in Zone 0 are intrinsically safe.

Lightning protection (bonding and earthing) is provided on all structures where appropriate, e.g. Pipping, Vessels, Towers, Etc.

4.3.6 Instrumented Protective Systems

All safety instrumented systems (SIFs) are designed to be a maximum of SIL2, except for the HIPPS which is designed to SIL3 based on provisions of IOG 107.

4.3.6 Fire and Gas Detection

The F&G System is designed to carry out all logic and shutdown functions associated with the detection of flame, heat, smoke and flammable or toxic gas. Shutdowns will be performed as an integrated but distinct part of safeguarding. The F&G System is classified as a SIL 2 system.

The F&G system at the CPF and EPF will monitor the facility via field detectors for any potentially hazardous escapes of gas or outbreak of fire or smoke. In the event of an incident, it will either raise an alarm, initiate the release of relevant extinguishing medium e.g. CO_2 into a turbine enclosure and/or issue an executive command via the SIS for a process/equipment trip, as appropriate.

4.3.7 Design and Material Selection

All flowlines and bulklines for oil are designed to maximum Closed In Tubing Head Pressure (CITHP). For the NAG wells, the flowlines are fully rated to CITHP, also the bulklines are fully rated except for Kolocreek and Zarama bulklines (which have HIPPS for overpressure protection).

The fire water ring main is designed/constructed with Glass Reinforced Epoxy (GRE) material.

4.4 DEM 2 Compliance (PSBR)

2022 DEM2 Assessment Report for East Asset

4.5. Other HSSE Related Deliverables

SN	HSSE Related Deliverables	Reference (Document Numbers)
1	GBR/KCRK HSE PLAN	SPDC-2023-01-00000060
2	HEALTH RISK ASSESSMENT (HRA)	IN PROGRESS
3	ENVIRONMENTAL MANAGEMENT PLAN (EMP)	SPDC-2020-10-00000009
4	EMERGENCY RESPONSE PLAN (ERP)	SPDC-2012-04-00000283
5	SECURITY RISK ASSESSMENT (SRA)	GBR/KCRK Facility Security Plan
6	ENVIRONMENTAL IMPACT ASSESSMENT (EIA)	Uzu FDP Gbaran phase 2 Gbaran 007
7	HAZOP	SPDC-2021-03-00000015
8	WASTE MANAGEMENT PLAN	SEPCiN-2010-07-00000001
8	HAZID/HMT	SPDC-2021-03-00000081
9	PTW/SSoW PROCESS	SCiN-2019-07-00000017
10	MOPO/SIMOPs	EP 2005-0300-SP-04 - MOPO
11	W@H PROCEDURE	SCiN-2017-07-00000004

4.5. Safety Critical Persons and Positions

This section of the HSE Case provides a description of the roles and tasks of HSSE Critical personnel that manage the performance and integrity of the barriers required to manage MAH. It focuses on:

- What needs to be done – these are the activities for managing MAHs. (Safety Critical Tasks)
- Who is available to do it – people and resources available (Safety Critical Positions)
- What skills are required – competency assurance.

Additionally, it outlines the procedures that are considered critical for maintaining these barriers

4.5.1 GBR/KCRK Organisation

The Gbaran-Kolo Creek PU organisation is designed to provide the required level and number of personnel to adequately manage the risks associated with the hazards of operating the facilities. Frontline and support resources have been made available to undertake HSE critical tasks identified to provide and maintain the barriers in managing the Major Accident Hazards (MAHs) specified in the bow-tie assessments.

The Gbaran-Kolo Creek PU organogram showing organisational arrangements and key positions (HSE Critical Positions) that have been assigned responsibility for HSE critical tasks can be found on this link.

4.5.2 Critical Manning Levels

All Remote Installation Facilities (RIF) in Gbaran-Kolo Creek PU are unmanned stations. The Production crew visit the facilities daily to carry out operational checks and/or maintenance activities. However, contractor station attendants otherwise called facility operations support (mostly indigenes of the neighbouring host communities) guard the facility and enforce access control on a 24-hour basis. There are two station attendants on duty at any time and they are trained and authorised to trip the facility/station manually should an emergency occur. They also

alert SPDC Gbaran-Kolo Creek Control Room, manned 24 hours daily, of any station upsets or equipment trips using telephone or radio links.

The Central Processing Facility (CPF) is manned continuously on a 12-hourly shift basis. All field staff work on 21-days work cycle. Government Security Agents (GSAs) are stationed at the CPF and the RIFs (where applicable) on a 24-hour basis to provide security coverage.

4.5.3 HSE Critical Tasks

HSSE critical tasks are tasks supporting HSSE critical activities - those established for directly or indirectly managing hazards with severity 5A/5B and Red risks. These have been identified as activities that provide or maintain one or more controls (barriers and recovery measures) for managing MAHs - these include both direct and interface activities.

The Gbaran-Kolo Creek PU HSE Critical Tasks and Accountability Sheet have been collated from the MAH Bowties. Personnel assigned responsibility for HSE Critical Tasks are informed of the task details and understand the significance. They can demonstrate that they have the necessary competencies to perform the task to the required standards. The communication of task details and confirmation of understanding and necessary competencies by the personnel is managed through the HSE Critical Task & Accountability Sheet (Appendix 2). These sheets also specify who is responsible for the tasks.

The safety critical activities can be classified into four types:

- **Design** - This specifies the necessary hardware (e.g. safety critical equipment). These tasks are usually completed before the facility is operated except where modifications are made.
- **Inspection & Maintenance** - to ensure that equipment integrity is sustained in line with the performance standards.
- **Operational** - to ensure that the equipment is used within the defined limits of the controls provided and that change is managed appropriately.
- **Administrative** – covering aspects such as training and auditing etc.

Figure 3.3 below shows the relation of Activities, to barriers and controls.

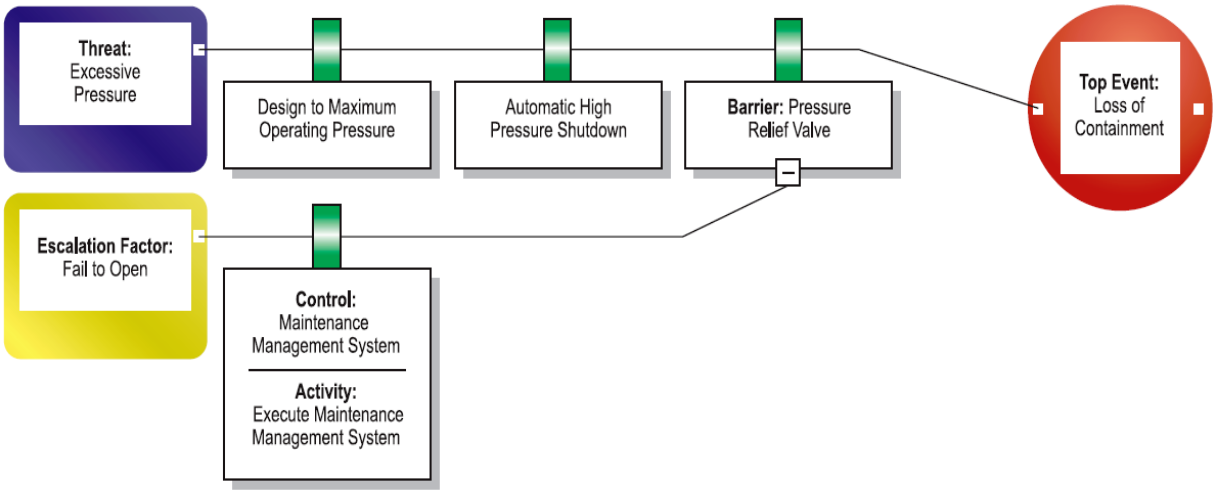


Figure 4: Relation of activities to barriers and controls.

Activities are not aimed at the "nuts and bolts" level (e.g. "maintain actuator on riser isolation valve") but at the level which ensures that the nuts and bolts task are identified and executed (e.g. "Prepare and Schedule Maintenance Activity Tasks" is a defined Activity, and this activity ensures that the actuator on a riser valve is maintained along with the maintenance of all other SCE).

The focus of this Operations HSE Case is on the activities that need to be done to maintain effectiveness in the operating phase.

4.5.4 Safety Critical Positions

These are positions derived from tasks that have been identified as discussed above to manage MAHs. This reflects positions in Gbaran-Kolo Creek PU that are allocated HSE critical tasks in their job description to assure the integrity of the Safety Critical Elements and execution of Safety Critical tasks/activities.

The categories of Safety Critical Positions applicable to Gbaran Ubie IOGP Production Unit are presented in the table below;

Table 6: Gbaran Ubie IOGP Safety Critical Positions.

Positions	Category	No. of Positions
Asset Manager	Leader	1
Asset Integration Lead	Leader	1
Production Unit Manager	Leader/ FLBM	1
Production Operations Team Leader	FLBM	2
Maintenance Team Leader	FLBM	1
Operations Supervisor	FLBM	2
Operations Technician	FLBM	4
Control Room Operator	FLBM	4
Maintenance Supervisor, PACO	FLBM	1
Maintenance Supervisor, Mechanical	FLBM	1
Maintenance Supervisor, Electrical	FLBM	1
Fire Chief	FLBM	1
Fire Men	FLBM	
Maintenance Technician, PACO	FLBM	5
Maintenance Technician, Mechanical	FLBM	6
Maintenance Technician, Electrical	FLBM	5
Permit Coordinator	FLBM	1
Facility Production Support (Station Attendant)	FLBM	34

Absence management and stand-ins for HSE critical positions will be managed through the existing deviation process where competence gaps exist.

4.5.5 Safety Critical Task Competencies

A critical success factor in making certain that barriers remain effective is having an individual with the right competencies to undertake activities/tasks identified in the bowties. HSSE Critical

positions do need Competence Assurance to demonstrate that they meet the proficiency levels set for their positions.

There are three categories of HSSE Critical Positions that require competence assurance as defined in the HSSE & SP Control Framework Competence Guide;

- Frontline Barrier Management positions;
- Technical Authority Level 1 or 2 roles in DCAF (or equivalent);
- Leadership positions.

If a person is not in HSSE Critical position they do not require competence assurance – he or she needs to be competent to perform their work, but does not require competence assurance.

The Shell-wide process for implementing the assurance of Safety Critical Positions is adopted as per the requirement of the HSSE&SP Control Framework Competence Manual. The refreshed approach for the Assurance of HSSE Critical positions is summarized below:

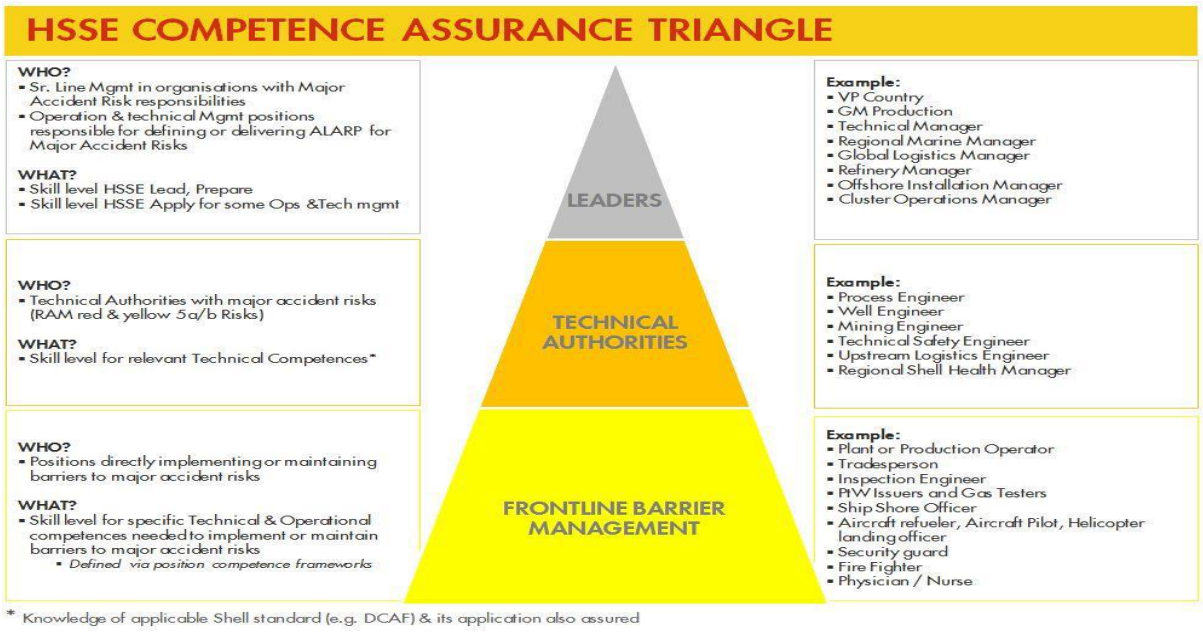


Figure 5: HSSE Competence Assurance Triangle

4.5.6 Contractor HSE and Competency Management

Managing contractor HSE shall be in accordance with the provision in the "Contractor HSE Management Manual" of the HSSE SP CF. The basic principle of the standard is that HSE management controls are appropriate for the level of the contract HSE risk/mode, organizational relationship with the contractor and the capabilities of the contractor to manage HSE within the scope of the contract. The Competency Matrix is provided in Appendix 5.

4.5.7 Critical Procedure Listings

A review of the hazard analysis and the Bow-Ties identified some procedures are critical to the management of the MAHs in operating Gbaran-Kolo Creek PU facilities to their ALARP criteria. The procedures are listed in the embedded document.

Critical Procedures Listing.docx

4.5.8 Emergency Response Arrangement

This section describes the emergency systems in place in Gbaran-Kolo Creek PU e.g., Fire & Gas detection and alarm systems, Fire protection/fighting system, mustering, evacuation, lifesaving equipment etc available to be deployed following an incident resulting from the release of any of the Severity- 5A/5B and RAM Red as identified in this HSE Case. The emergency systems can be found in section 2 above.

Potential emergency situations/incidents applicable to Production Gbaran-Kolo Creek PU have been identified and drill scenarios developed for each to ensure adequate preparedness of the workforce. The drill exercises are carried out in the field locations with the relevant emergency response units (Medical, Fire and community disturbances etc) participating. There is on site emergency response activation plan on display at each facility which contains emergency response numbers/persons to call in the event of emergencies at the facilities.

The detailed Gbaran-Kolo Creek Production Unit Operations Emergency Response Capability and process following an incident resulting from the release of any of the Major Accident Hazards identified in this HSE Case is described in the asset-specific Emergency Response Procedures for Gbaran-Kolo creek PU facilities (SPDC 2006-11-00000032).

4.5.9 Interface Activities/Bridging Documents (Internal and External)

There are several interface activities (internal and external) inherent in the operations of Gbaran-Kolo Creek PU. These are detailed in the table below with the links provided to the HSE Cases of some of the internal service providers. Currently, there are no bridging documents in Gbaran-Kolo Creek PU but SLA exist with the teams that render these services. However, bridging documents would be developed when necessary.

Some of the activities and their associated hazards are not entirely limited to the normal operational mode. Thus, there are interactions with other HSE Cases.

Interface Activities/Bridging Documents (Internal and External)

Some Interface activities (Internal and External) are undertaken to sustain SPDC's Gbaran-Kolo Creek Asset Team's Health, Safety and Environmental Policies and Objectives, in managing Gbaran-Kolo Creek PU Severity 5A/ 5B, and RAM red Risk Hazards. These Internal Interfaces comprise activities provided by other Shell departments (Land Transport Corporate Pipelines, Marine Logistics, Aviation and the Security Department,) and are guided by regular Service Level Agreements (SLAs), while the External Interfaces comprise activities/services provided by Mode 2 Contractors and are guided by HSSE SP-MS Bridging documents to align with HSSE SP-MS requirements.

All Service Providers and Company employees assigned to Gbaran-Kolo Creek PU work sites described within this document or directly responsible for the support operation shall be made aware of the content of this document and relevant supporting information. Copies of all required

Permits and procedures relevant to the management of HSE of the contract shall be provided at the worksite.

All work activities on Gbaran-Kolo Creek PU shall therefore be carried out under HSSE SP-MS, except for Mode 2 Contractor operations where Bridging Documents are employed to cover interface activities.

Table 7: Interfaces with other HSE Cases.

4.5.10 Audits & Reviews/Assurance Process HSE Case

The effectiveness of the various HSE controls would be verified to identify gaps for closeout and areas for continuous improvement through the execution of Gbaran-Kolo Creek PU Internal Audit/Inspections schedules.

The audits are risk-based in accordance with HSSE & SP Control Framework. Audit findings shall be recorded, and corrective actions raised and tracked to close out using the appropriate assurance tool - SONAR / RADAR.

Part 5: Remedial Action Plan

The Remedial Action Plan (RAP) below addresses the shortfalls and improvements identified whilst developing the HSE Case, and may, for example, be a direct or indirect result of missing, inadequate or ineffective controls to manage the hazards arising from the following:

- Outstanding actions from HEMP and supporting safety and risk studies.
- Remedial actions from HSE Reviews including Process Safety Reviews and Audits.
- Shortfalls identified in the bowtie risk assessments.
- Shortfalls in the compilation of the Hazards and Effects Register.

It is the responsibility of the HSE Case Owner to ensure that these actions are satisfactorily completed. If the remedial actions are not fully and successfully implemented, then the effectiveness of the barriers in Hazard release prevention and mitigation in Gbaran Ubie IOGP Operations would be weakened.

This Plan would be updated in the Sonar/Radar tracking tool as action items are completed or new action items are identified.

The attached is summary of the Remedial Actions the bowtie validation

BOWTIE VALIDATION RAP AC

Glossary

ALARP	As Low As Reasonably Practicable
Bbls	barrels
bbls/d	barrels per day
DEP	Design Engineering Practice
DPR	Department of Petroleum Resources
EAT	Environnemental Aspect Tables
EER	Environnemental Evaluation Report
EGASPIN	Environmental Guideline and Standards for Petroleum Industry
EIA	Environnemental Impact Assessment
EMS	Environnemental Management System
EP	Exploration and Production
EPBM v4	Exploration and Production Business Model, version 4
ERT	Emergency Response Team
ESD	Emergency Shut Down
ESI	Environmental Sensitivity Index
EVABAT	Economically Viable Application of Best Available Technology
FEPA	Federal Environmental Protection Authority
FMEnv	Federal Ministry of Environment
FIREPRAN	Fire Protection Analysis
GWP	General Workplace Practice
Ha	Hectare
HAZID	Hazard Identification
HAZOP	Hazard and Operability Review
HAT	Health Aspect Tables
HEMP	Hazard and Effects Management Process
HIR	Hazard Identification Report
HP	High Pressure
HRA	Health Risk Assessment
HSE	Health, Safety and Environment
HSE MS	Health, Safety and Environment Management System
IOS	Integrated Operations Standards
IPP	Integrated Production Plan
IRP	Incident Review Panel
ISO	International Standards Organisation
JHA	Job Hazard Analysis
THESIS	The Health Environment & Safety Information Systems

Heading	Explanation
Hazard Reference	Unique reference number (ref. EP20050300SP01)

Heading	Explanation
Hazard Source	Activities involving hazard or that exposes personnel to hazard (hazardous activities)
Location/Process/Area:	Where to find the hazard
Threats	What can go wrong (that can trigger the release of the hazard to cause harm or damage)
Responsibility	Overall responsible party for providing /managing identified controls.
Top Event	Undesired Outcome/ Event (first outcome that occurs when a threat releases a hazard).
Consequences	The effect or impact on HSE. This can be: **P:** Personal **A:** Asset **E:** Environment **C:** Community
Inherent Risk	The risk if we were not managing the hazard – no barriers nor recovery measure is working. Credible worst case scenario.
Barrier	All management activities that prevent the threat from releasing the hazard into a top event.
Recovery	If the Top Event (accident/incident) has happened; what do we do to limit the severity of the effect/impact/consequence.
Residual Risk	The risk as it is now in Production facilities; taking the effectiveness of all barriers and recovery measures (controls) into consideration.

Appendices.

Appendix 1: Bowtie Diagrams

Bowtie Diagrams

Gbaran Ubie IOGP Barrier Validity Assesment

Appendix 2: Hse Critical Activities/Tasks & Accountability Packs

HSE Critical Activities/Tasks & Accountability Packs

Appendix 3: Manual Of Permitted Operations

Gbaran Mopo

Appendix 4: Hazard and Effect Management Table

Gbaran Ubie Hmt

Appendix 5: Generic HSSE Competency Matrix/Training Plan

Generic HSSE Competency Matrix /Training Plan

Appendix 6: Adibawa Operations Safety Case

Adibawa Operations Safety Case

Appendix 7: NUPRC Approved Adibawa Operations Safety Case

APPROVAL - OPERATIONS SAFET'

NUPRC Approved Adibawa Operations Safety Case

Appendix 8: GNC ALARP Design Demonstration Report

GNC-NG01017640-GBRG1-HX7506-000(

GNC ALARP Design Demonstration Report

Activities	Interface	Reference link
Aviation.	Hazards associated with air transport (accessing the facility by Helicopter are addressed in the Aviation HSE Case). The interface is at the landing facility which is covered under the Gbaran-Kolo Creek PU HSE case.	Aviation HSE Case
Logistics	Hazards associated with marine logistics and the usage of Gbaran Jetty for logistics are addressed in the Marine HSE Case. The corporate logistics HSE Case serves as a guide	Corporate Logistics HSE Case
Well Intervention & Completion	Hazards associated with Well intervention and completion activities are addressed in the Well completion and intervention HSE Case.	Completion and Well Intervention HSE Case
Pipeline Operations	Interface is at the hook up to the delivery lines. All facilities downstream of the delivery line hook-up are covered under the corporate Pipelines HSE Case (these include, delivery lines and pipelines). Pig launcher and receiver facilities are also outside the scope of Gbaran-Kolo Creek PU HSE case and are covered in Pipelines HSE case.	Pipeline Operations HSE Case
Security Operations	Management, Interface and Hazards associated with security operations & personnel are managed under corporate security HSE MS	Corporate Security HSE MS
Projects	Management, Interface and Hazards associated with Project are managed under relevant project HSE Case as applicable	HSE Case as applicable