MODUS
SMART SUBSEA SERVICES

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Abbreviations

Abbreviation	Definition
BMS	Business Management System
CoG	Centre of Gravity
DP	Dynamic Positioning
DGPS	Differential Global Positioning System
DPO	Dynamic Positioning Operator
DVL	Doppler Velocity Log
FLS	Forward Looking Sonar
GMT	Greenwich Mean Time
GPS	Global Positioning System
HAUV	Hybrid Autonomous Underwater Vehicle
HD	High Definition
HIRA	Hazard Identification Risk Assessment
Hs	Significant Wave Height
Hz	Hertz
INS	Inertial Navigation System
ISO	International Standards Organisation
kHz	Kilohertz

Abbreviation	Definition
km	kilometre
LBL	Long Baseline
m	metre
MBES	Multi Beam Echo Sounder
MOC	Management of Change
Ms	Millisecond
OSHAS	Occupational Health and Safety Assessment Series
PTW	Permit to Work
QHSE	Quality Health Safety & Environment
ROV	Remotely Operated Vehicle
SBP	Sub Bottom Profiler
SSS	Side Scan Sonar
TBT	Toolbox Talk
UHF	Ultra-High Frequency
USBL	Ultrashort Baseline
UV-SVP	Underwater Vehicle Sound Velocity Profiler
WLAN	Wireless Local Area Network

Reference Documents

Ref No.	Document Title	Document Number
[101]	Management of Change Procedure	HS-PR-009
[102]	Permit to Work System Isolation Requirements	HS-PR-015
[103]	Risk Identification & Management Procedure	HS-PR-003
[104]	Toolbox Talks	HS-FM-001
[105]	HSE Plan	FESL-SPDC-HSSEP-1909/2201
[106]	Project HIRA	TBC
[107]	HAUV3 Mobilisation & Demobilisation Procedure	23-0022-ENG-PR-001
[108]	HAUV3 Launch and Recovery Procedure	23-0022-OPS-PR-002
[109]	Survey Operations Procedure	23-0022-SUR-PR-001
[110]	HAUV3 Emergency Recovery Procedure	23-0022-OPS-PR-003
[111]	Project Execution Plan	FESL-SPDC-WEP-1909/2201

1 INTRODUCTION

Modus have been contracted by Fadfae Engineering Services to complete a subsea survey of the 251km 32" offshore gas gathering system (OGGS) pipeline from the RPA platform in EA field to the Bonny Land Fall. In addition to this, Modus will also complete the survey of 54km of EA field infield pipelines, and the 16" Bonga pipeline. The ultimate client for this project is Shell, and the project location will be offshore Nigeria.

1.1 SCOPE OF DOCUMENT

The purpose of this document is to provide a high-level overview of the organisation and structure to be employed, and to define and control the chain of command and communication to be employed relating to project operations using the HAUV3 system. It should be read in conjunction with the Project Execution Plan [111], HAUV3 Mobilisation & Demobilisation Procedure [107], the HAUV3 Launch & Recovery Procedure [108] and the Survey Operations Procedure [109].

The intention of this procedure is to ensure that the operations meet all necessary contractual requirements and conform to all relevant project HSEQ requirements within the Project HSE Plan [105].

1.2 SCOPE OF WORK

Modus will conduct the subsea survey with the use of the HAUV3 vehicle fitted with the appropriate survey equipment in order to deliver the MBES, TSS660, FIGS CP and SSS survey specification laid out by Fadfae Engineering Services. The HAUV3 will be A-frame launched from the vessel and recovered to the vessel at the start and end of daily operations. Refer to Launch and Recover Procedure [108], for further information.

Refer to the Survey Operations Procedure [109] for the technical aspects of the operations for this project.

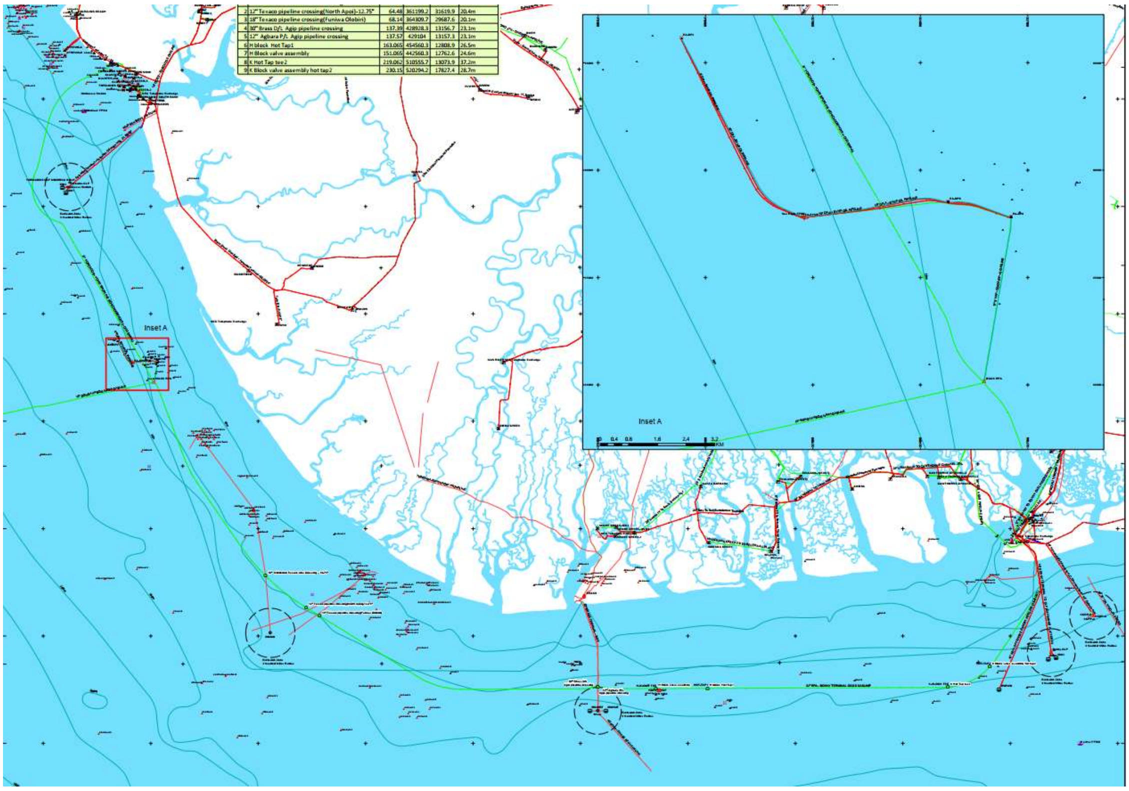

Figure 1: EA Field & OGGS Pipeline, Nigeria

2 HSEQ

2.1 HSEQ - General

All work described within this document shall be performed in accordance with requirements given in the Modus Business Management System (BMS) which is accredited in line the ISO:9001, ISO:14001 and OSHAS:45001 Standards.

The work shall in addition be performed in accordance with the requirements given in the Contract.

All internal documents for the project relating to HSEQ are referenced in the referenced documents section and should be read in conjunction with this procedure. Any additional task related safety awareness that needs to be highlighted will be addressed in the body of this document.

2.2 Risk Assessments

All offshore operations will be executed in accordance with the Modus Risk Identification & Management Procedure, HS-PR-003, (Ref. [103]).

The Modus specific Risk Assessment should identify the risks associated with specific elements of Modus operational activities. The Risk Assessment also identifies the controls required, which also consider the different human behaviour traits that are exhibited performing the same task under different conditions. The Risk Assessment shall be completed by the Team Leader/Chairman and a minimum of two experienced personnel in the activity to be assessed.

A Project HIRA will be completed prior to operations (Ref. [106]).

2.3 Management of Change

In the event of any unplanned circumstances which affect this procedure, then this procedure can be changed to ensure the safety and efficiency of the operation. Any change to this procedure will be performed in accordance with the Modus Management of Change Procedure, HS-PR-009, (Ref. [101]), and in clear understanding between the involved parties.

2.4 TOOLBOX Talks

Toolbox Talks are always required at the start of each shift and/or during shift if required. These should be repeated at shift handovers (if applicable). TBT's, ref [104]: HS-FM-001 Toolbox Talks, are identified within Procedure Task Plans.

Relevant operating procedures and associated risk assessments must be reviewed during the TBT.

2.5 Permit to Work

All vessel-controlled operations and related work will be controlled and co-ordinated using the vessel PTW system, as required. The implementation of the vessel PTW is the responsibility of the Vessel Captain. MODUS will ensure that all applicable works undertaken are conducted in full compliance with the vessel PTW system.

The need to conform to these requirements should be clearly highlighted within the vessel induction, which will be undertaken by all Modus personnel embarking on the support vessel.

3 ORGANISATION

3.1 GENERAL

The following personnel will be required for the operations:

- 1x Superintendent/ Party Chief
- 1x HAUV3 Supervisor
- 3x HAUV3 Pilot Technicians

- 1x Senior Surveyor
- 1x Surveyor
- 1x Data Processor

3.2 ORGANISATIONAL CHART

During all offshore operations, the HAUV3 Superintendent shall be in overall command of the operation. They will orchestrate the operation and pass on instructions direct to the staff at each pertinent location.

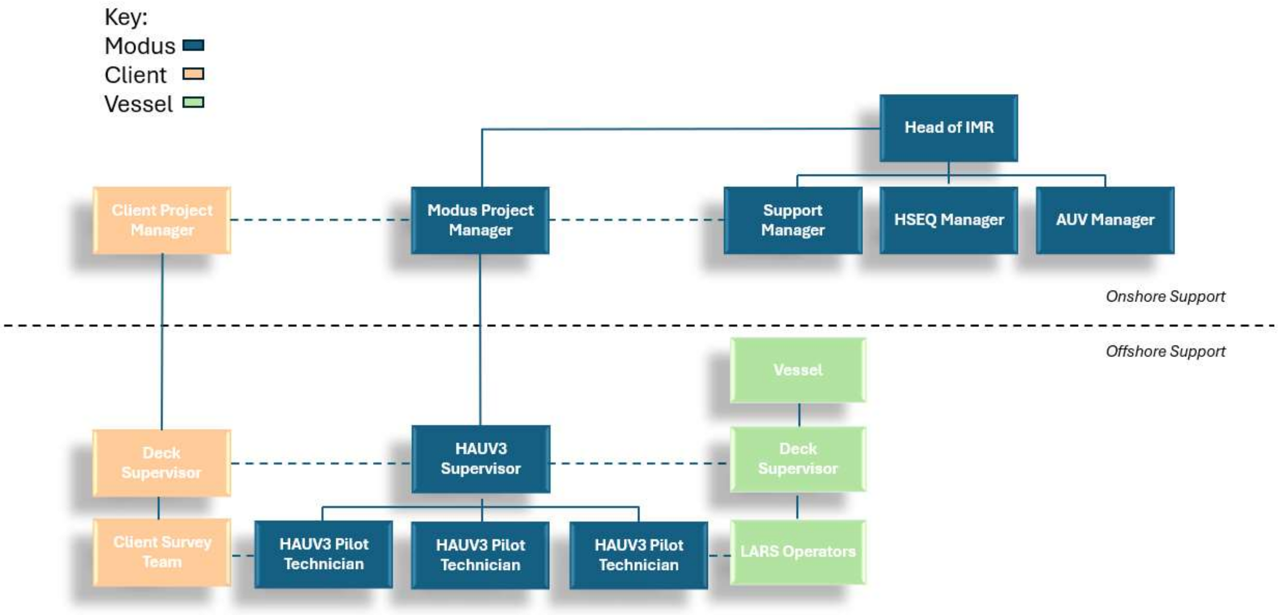

Figure 2: Organisational Chart

3.3 Communications

The primary form of communication between all parties and the HAUV3 crew will be via Clear COMM's / VHF radios, UHF radios may be utilised if required as a secondary or backup means of communication. It is especially important that the emergency channels are agreed, communicated to relevant parties, and tested prior to the commencement of operations.

For launch and recovery operations, the primary form of communication will be via UHF radio. The secondary form of communication will be hand signals/verbal face to face.

The vessel will have sufficient Wi-Fi on board to allow external communications back to the onshore support team when required.

In case of an emergency or an urgent requirement, there will be a dedicated onshore Duty Manager who will always be accessible by mobile phone. The Duty Manager role will rotate around the onshore management team on a weekly basis, and the dedicated individual will be clearly communicated to the offshore team.

3.4 Modus/ PXGeo Contact List

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4 Project Equipment

4.1 HAUV3 General Specification

The HAUV3 is a hovering ROV/AUV with deep water capability, long excursion range and 360° manoeuvrability with 6 degrees of freedom. HAUV3 is ideal for autonomous and tethered inspection and maintenance of subsea installations and offshore survey work.

Max Length	4.3 m
Max Width	1.7 m
Max Height	1.4 m
Mass	1200 kg excl. payload
Mass (including survey equipment)	1580 kg

Figure 3: MODUS HAUV3

4.2 Subsea Garage

The HAUV3 will be launched and recovered inside the subsea garage. A bespoke garage has been designed to ensure that it fits suitably within the clients A-frame launch and recovery system (LARS).

Refer to Launch and Recovery Procedure, ref [108] for method of launching and recovering HAUV3 within the subsea garage from the A-frame LARS.

The Subsea Garage will require 2 off USBL beacons to monitor rotation during launch & recovery operations.

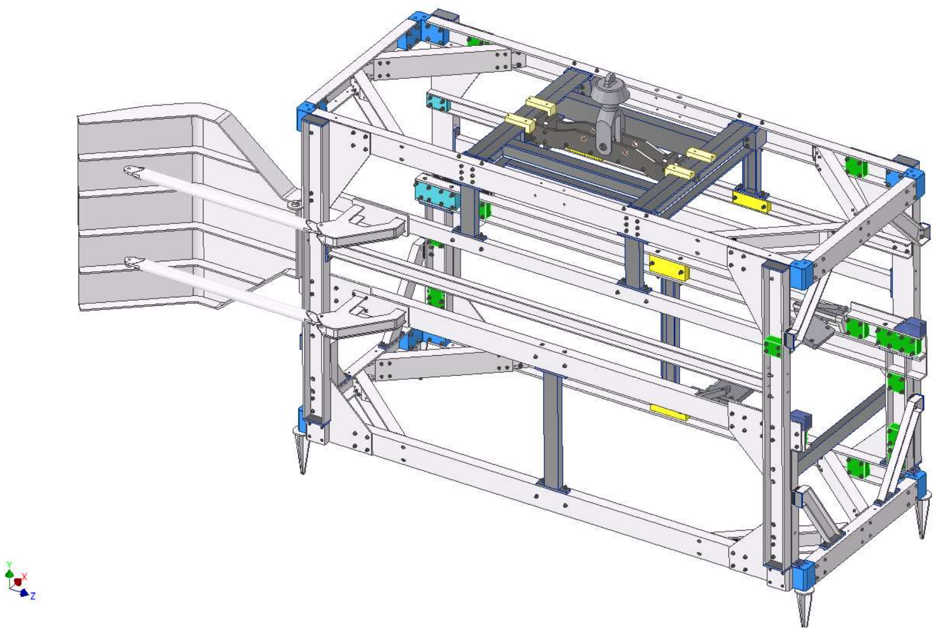

Figure 4: HAUV3 Subsea Garage Design

The top section of the garage is detachable, this allows for safer loading and unloading of the garage plus it will provide a stable work stand to conduct maintenance and other tasks as required.

The subsea garage will be fabricated in-country by Fadfae Engineering Services.

4.3 Survey Equipment Spread

HAUV3 will be installed with a pre-determined set of standard and project specific Survey Equipment. All systems will be mobilised and calibrated using industry standard techniques. When operational, online systems will be monitored and logged ensuring data quality.

For further information see HAUV3 Survey Operations Procedure [109].

4.3.1 STANDARD HAUV3 EQUIPMENT

The standard, permanently installed, HAUV3 Equipment are as follow:

- **Positioning** – SprintNav 500
- **Surface Comms** – WLAN
- **Wireless Comms** –Novatel OEM 729 GNSS
- **Acoustics Comms –** Sonardyne AvTrak 6 with Sonardyne ROVNAV 6G dunker c/w 100m cable
- **Cameras** – Axis Q1614 IP HD; Bowtech Explorer low light Camera; Fisheye Camera & Rear Camera
- **Flood Lights** – 4x Bowtech
- **OAS** – Imaginex 881L
- **Misc** – Valeport UV-SVP; Valeport MiniIPS, Iridium GPS position Tracker, RJE emergency locator pinger

4.3.2 ADDITIONAL HAUV3 PROJECT SPECIFIC SENSORS

- **MBES** – MBES Single Head R2Sonic 2024
- **Edgetech 2205 –** SSS & SBP
- **Depth Sensor** – Valeport Mini IPS
- **TSS660** – Pipeline Tracker
- **Gemini720s** – Imaging Sonar
- **FiGS CP** – Cathodic protection sensor

5 Operations

The following operations are expected as part of the project. All operations will be performed in tethered mode within the normal capabilities of the HAUV3 system and within the limitations discussed in Section 6.

5.1 General Operations

HAUV3 is to be operated in line with normal manufacturers operating guidelines, within the normal capabilities of the system and at the discretion of the AUV Manager.

Prior to any operation, the work scope is to be assessed to ensure there is no additional risk, with specific consideration given to the implications of emergency scenarios. Refer to HAUV3 Emergency Recovery Procedure [110] for further emergency information scenarios.

5.1.1 Tether Management

Tether management is extremely important and will be continuously monitored both subsea by the Pilot and topside by the tether Winch Operator at all times. If at any time it is deemed unsafe or if there is any doubt by the Pilot or Winch Operator all operations/vessel movements are to be brought to a controlled stop and investigated accordingly. An ALL STOP can be implemented at any time by anyone MODUS Supervisor that subsea conditions impede (or is likely to impede) the safe operation of the system, the vehicle must be returned to the TMS and may require to be recovered to deck. To this end, continuation of operations is solely at the discretion of the MODUS Supervisor.

5.2 Stopping Operations

All team members are permitted and encouraged to stop an evolution/operation if they deem it to be unsafe, dangerous, risk of personnel injury, risk of damage to an asset or infrastructure, at no point will any blame be placed on the individual calling a stop.

Two example methods of stopping an evolution/operation are shown below, however, the methods to be used during the project will be fully briefed during the onboard kick off meeting:

5.2.1 ALL STOP

This method of stopping an evolution/operation is the most urgent and is normally initiated by the way of depressing an emergency stop or calling **"ALL STOP"** over the preferred communication medium. All operations, vessel moves will be instantly stopped and the reasons investigated.

5.2.2 Controlled All Stop

This method is to be used if the ALL STOP in not appropriate and will bring evolution/operation to a controlled and safe stop for e.g. reducing the speed of a vessel move to gradually bring the vessel to a stop, likewise with the HAUV. This action would normally be initiated by calling for a **"CONTROLLED ALL STOP"** over the preferred communication medium.

5.3 Launch And Recovery Location

HAUV3 is launched and recovered in accordance with the HAUV3 Launch and Recovery Procedure, [108].

5.4 Shallow Water Operations

During operations in shallow water, the following is to be considered and assessed prior to commencing operations:

- Support Vessel position relative to HAUV3 working position
- Support Vessel heading and HAUV3 position relative to prevailing current ("Blow off" condition)
- Planned operational Support Vessel maneuvers

5.5 Pre-Dive Checks

A robust schedule of pre-dive checks is an integral part of HAUV3 operations, the HAUV Pre Dive Checklist can be found in **Appendix A.**

5.6 Data Management

Refer to Survey Operations Procedure [109]

6 Operational Limitations

6.1 Weather And Sea State

The ultimate decisions with regard of standby due to weather, sea state, currents and visibility shall be that of the HAUV3 Superintendent and the HAUV3 Supervisor jointly. In the event of disagreement, the ultimate decision to not launch or recover the HAUV3 is that of the HAUV3 Superintendent.

With the same respect, the decision to operate the Support Vessel, will be that of the Vessel Skipper.

Significant wave height (Hs) and wind speed only play a part in the environmental conditions to be considered when determining if HAUV3 is operable in a given scenario. The decision to operate HAUV3 is dependent upon all the conditions at the time and how the vessel is behaving in that scenario. In all cases, the safe limit to launch, recover or operate the HAUV3 will be judged by the HAUV3 Superintendent on a case-by-case basis.

6.2 Currents

HAUV3 has relatively high current capabilities, however, the actual operational limit will depend on several factors including, but not limited to, current direction and vehicle payload.

In all cases the decision to launch HAUV3 or abort a dive in any current, regardless of what may be indicated by any predicted or live current monitoring device will be made by the HAUV3 Superintendent and will be considered on a case-by-case basis.

6.3 Visibility

HAUV3 is designed to operate in reduced and even zero visibility. However, under some circumstances, a minimum level of visibility may be required to continue operations safely.

If under such circumstance's visibility is not sufficient to continue, operations will be suspended and the HAUV3 Superintendent will inform the HAUV3 Supervisor. Operations will resume as soon as visibility conditions permit.

Any support vessel movements must be clearly communicated to the HAUV3 pilot technicians via clear comms / VHF radio when HAUV3 is conducting operations.

6.4 Emergency and Contingency Procedures

Contingency procedures for recovery of the HAUV3 are included in the Emergency Recovery Procedure [110]. In the event of an emergency with the HAUV3, the Vessel Master and the Client Representative shall be informed by the HAUV3 Superintendent.

The vehicle will be trimmed so that it will float to the surface in a dead sub situation. The vehicle is fitted with Iridium GPS position Tracker, Emergency Locator Pinger and a Strobe to allow it to be located subsea or on the surface.

No emergency or contingency procedures shall be put into operation until all relevant parties have agreed on the course of action and the necessary Risk Assessments have been put in place along with any risk mitigation measures required.

6.5 VESSEL MANOEUVRES

If the vessel is required to manoeuvre or change heading during operations, this is to be considered in operational planning. The manoeuvre is to be conducted with all usual considerations regarding HAUV position relative to the vessel and the tether path throughout the manoeuvre. Manoeuvring the HAUV as well as the vessel is to be considered.

The vessel should always rotate about the HAUV launch and recovery point if possible. If this cannot be achieved, then the point of rotation should be defined and communicated to the HAUV.

If a previously unplanned manoeuvre is required during HAUV operations, this is to be communicated to the HAUV team so that they may assess the vessel manoeuvre on their operation and positioning.

If there is any uncertainty regarding the effect of vessel manoeuvres the HAUV should be recovered to deck.

In all instances, if a dead sub situation occurs the vessel is to stop the manoeuvre and to hold position and heading until the situation is resolved.

6.6 SIMOPS

Simultaneous operations increase the level of risk of injury and/or damage to personnel, assets, equipment or the environment. Where ROV operations are required alongside other operations, possible operational conflicts should be defined prior to commencing operations.

6.6.1 Communications During SIMOPS

Communications are of prime importance in maintaining safe and efficient operations. Simultaneous activities shall be co-ordinated by single point of contact (Party Chief) through the normal communications channels and protocols. It is important that any vessel movements are communicated by the HAUV Superintendent to the HAUV Supervisor/Pilot, and HAUV’s position is altered accordingly. Conversely, all HAUV launches and recoveries and any significant HAUV movements shall be communicated to and approved by the Party Chief.

6.6.2 Mitigations During SIMOPS

The following mitigations shall be adhered to during all SIMOPS:

- HAUV tether length and position shall be regularly monitored and adjusted as necessary
- Subsea currents shall be monitored and their effect on the HAUV tether position
- Unique HPR transponder signals shall be used for the HAUV and the live position shall be plotted on the navigation screen
- HAUV position and offset from all subsea assets (including cable on seabed or cable catenary) shall be monitored using obstacle avoidance sonar and/or cameras (visibility permitting)

Important: At no time during planned operations shall the HAUV be positioned where the vehicle or tether are at risk of entanglement.