

## HSE Management of UBD Operations - the case for the UBD Operations HSE Case

### Introduction

Underbalanced Drilling (UBD) is a complex operation, introducing additional project and HSE risks compared to conventional (overbalanced) drilling operations. Recognizing this, PDO put significant effort into implementing international best-practice project management practices, including HSE risk management practices. This article focuses on the PDO UBD Operations HSE Case, which was one of many sub-projects worked upon as the UBD project was rolled out. The UBD Operations HSE case constitutes a formal HSE assessment of the UBD operations in PDO.

To date PDO has enjoyed in excess of 6 man-years of UBD operations with only one recordable lost time incident (LTI).

### Background

In both conventional and underbalanced drilling operations, many of the activities have the potential for negative impact on the health and safety of personnel, the environment, the asset and Company reputation. The HSE risk potential is increased in the case of new or modified activities, such as UBD operations.

The UBD Operations HSE Case was developed to cover the management of *all* HSE hazards associated with UBD operations in PDO and defines the interfaces between the UBD Contractor's HSE Management Systems (HSE MS), the PDO HSE MS, the PDO Well Engineering Management Procedure (*PR-1444*) and Sub-Contractor HSE MS's, as well as demonstrating how risks have been or will be reduced to as low as reasonably practicable (ALARP).

The HSE Case was jointly developed by Precision Drilling, Weatherford, the Company UBD Implementation Team, the Shell UBD Global Implementation Team and Risktec Solutions Limited.

## Objectives of the UBD Operations HSE Case

A HSE case is defined as *"An Operation specific demonstration of the HSE Management System in action, documenting that risk levels are tolerable and have been, or will be reduced to As Low As Reasonably Practicable (ALARP)"*.

The objectives of the PDO UBD Operations HSE Case are summarised in Box 1:

### Box 1: Objectives of PDO UBD Operations HSE Case

Demonstrate that there is a systematic approach to HSE management in place, which is designed to provide for continuous improvement in HSE performance for the UBD Operations

Demonstrate compliance with all applicable HSE legislation and standards, the PDO and contractors HSE policies as well as the relevant Shell Group guidelines

Demonstrate that there are physical and operational controls in place for all hazards that commensurate with the level of risk and that environmental hazards are evaluated and managed in accordance with *BS EN ISO 14001*

Demonstrate that safety risks have been reduced to tolerable levels as defined by the contractor / PDO / Shell Group criteria

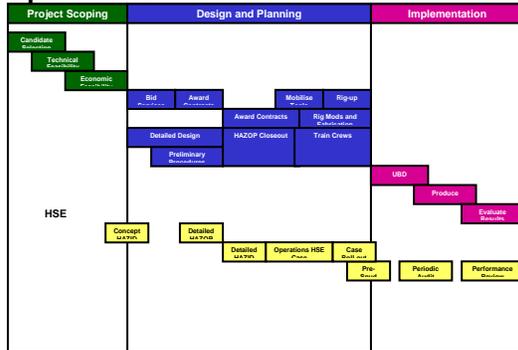
Demonstrate that measures are, or will be put in place to reduce the HSE risks to ALARP and appropriate recovery preparedness control measures are in place in the event of a realised incident

## HSE Planning for UBD Operations

In PDO, UBD operations represented a fundamental change from previous conventional drilling operations and to ensure a safe and efficient operation, it was essential that all personnel involved in the project were familiar with the process, equipment and procedures and were fully aware of the HSE hazards associated with the operations and their individual roles and responsibilities in managing the risk associated with these hazards.

It was therefore critical to the success of the project that HSE was integrated from a very early stage in the UBD planning process, through to the detailed well design and execution (Figure 1).

**Figure 1: HSE Planning for UBD Operations**

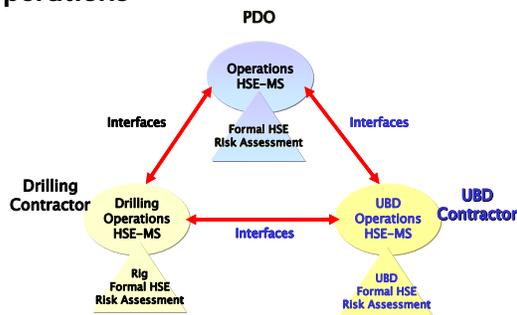


**HSE-MS Interfacing**

The PDO UBD operations involved a large number of contractors and sub-contractors as well as PDO personnel. It was therefore imperative that all parties understood how the Company and contractor HSE-MS's and procedures interfaced during the project.

To facilitate this, a HSE-MS bridging document was developed to identify how the Company and contractor HSE-MS's and procedures would interface for the UBD operations. Figure 2 shows the HSE MS interfaces for the PDO UBD operations and the scope of the UBD Operations HSE Case.

**Figure 2: HSE-MS interfacing for UBD Operations**



**Hazards and Effects Management**

The hazards and effects management process lies at the heart of the HSE MS and has four principle elements (Box 2).

Box 2: HEMP Elements	
<b>Identification:</b>	The process that results in a physical description of the hazards that may be realised
<b>Assessment:</b>	The process whereby the results of the hazard analysis are considered against engineering and operational judgement, standards and criteria which have been developed as a basis for decision making
<b>Control:</b>	Prevention of the events being realised by prevention or containment of the hazard, either by design or by procedure
<b>Recovery:</b>	Actions taken by systems or personnel in response to a hazardous event, to restrict the consequences.

For the PDO UBD operations, the overall hazards and effects management process included extensive qualitative hazard assessment (HAZOP, HAZID, Bowtie Analysis, etc.), which was integrated into the UBD planning process (Figure 1), and done jointly with the UBD Contractors, Drilling Contractors and PDO personnel.

The output from this process was summarised in the UBD Hazard Register, a key HSE Case document that lists all the significant HSE hazards for the operations. The hazard register also referenced the control and recovery measures and operational safeguards in place, or required to be in place to manage the risk associated with the hazards and effects to acceptable levels.

The level of risk that may be tolerated by PDO and the minimum level of control deemed necessary to manage the risks were evaluated using the PDO HSE Risk Matrix.

The following major HSE hazards for the PDO UBD operations, over and above the conventional drilling hazards covered in the PDO Drilling and Well Operations HSE Cases, were identified:

1. Intentional Loss of Primary Well Control Barriers (i.e. mud column).
2. Hydrocarbons under pressure in surface separation equipment.

3. Hydrocarbons at low pressure in storage.
4. Reinjection of high pressure native crude oil downhole.
5. Compressed gas in the drill-string and surface pipe work
6. Simultaneous drilling and production (SIMOPS).

### **Control of Major Accident Hazards**

Major Accident Hazards are defined as those hazards with the potential to result in severe or catastrophic consequences to people, assets, the environment and/or company reputation.

The key control measures incorporated into the UBD operations to control the major accident hazards were identified in the hazard register, and evaluated in more detail through Bowtie analysis.

Bowtie diagrams were developed for all major accident and high-risk hazards to demonstrate that sufficient controls are in place to control the potential hazards and reduce the risk to ALARP.

In accordance with PDO HSE expectations, only hazards that fall into the "High Risk" region of the risk matrix require HSE Critical Tasks to be defined. The hazard analysis concluded that none of the hazards presented by UBD operations fell into this region, however a limited number of hazards had the potential for a Level 5 consequences (Major Accident Hazard). Therefore, for these hazards, HSE Critical Tasks were derived.

### **HSE Critical Tasks**

One of the most valuable outputs from the HSE case process was the list of HSE Critical Tasks. This states a number of activities and responsibilities for individual supervisors in managing the risk associated with the UBD operations.

Between 30 and 40 HSE Critical tasks were identified which were considered specific to the UBD Contractor, spread between

approximately 10 HSE Critical Roles (depending on Contractor). These related mainly to design, operation and maintenance tasks.

In addition to these, 10-20 HSE Critical tasks were identified which were required to be carried out by Drilling Contractor and PDO, which related mainly security and emergency response arrangements.

### **Summary**

The UBD Operations HSE Case actively supported the planning and execution of UBD operations in PDO to ensure the systematic identification, assessment and management of HSE hazards to minimize the risk to people, the environment, assets and Company reputation, and provides a clear demonstration to all stakeholders that:

1. There is an HSE management system in place for the operations that is adequate to enable compliance with all relevant statutory and company requirements.
2. There are adequate arrangements in place for the audit and review of the management system at appropriate intervals.
3. All hazards and effects with the potential to cause a major accident have been identified and assessed, and controls are in place together with plans for recovery in the event of an incident.
4. HSE risks have been evaluated and measures taken to reduce these risks to a level that is as low as reasonably practicable.

To date PDO has enjoyed in excess of 6 man-years of UBD operations with only one recordable lost time incident (LTI).