Case Study – A Mudline Closure Device as a Pre-Installed Well Control System

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Leader in Contemporary Subsea Solutions
Planning for the low probability, high consequence subsea well control event

Circa 1990s –

Industry adopts downhole intervention / hydraulic well kill via relief wells as standard method for bringing a subsea blowout under control.

Well design, training, procedures, computer analysis, regulations reflected the prevention provisions

Relief wells and Well Control specialist company could be considered “the response”

Relief well operations were not considered part of the emergency response and had been dealt with as standard drilling operations.

Then in 2010 Upstream/Exploration experienced their ‘Exxon Valdez’...BP’s Deepwater Horizon/Macondo incident.
The Evolution of Capping and Closure Devices

Capping Stacks date to the 1930s used since on surface wells

2010 - a capping stack was utilized to cap a deep water blowout in the Gulf of Mexico

2013- Mudline Closure Devices evolved from knowledge gained building Capping Stacks

To understand the evolution behind the development of the this new Mudline Closure Device, some background information is discussed in the next few slides
Capping Stack Examples

In the wake of the 2010 Gulf of Mexico oil incident, well capping and containment systems have become a primary focus of response to well control events for the Global offshore oil and gas industry.

Operators remain committed to operating in an environmentally responsible and sustainable ways with at least fifteen offshore capping stacks placed strategically around the world, ready to respond.

Goal: Zero hydrocarbon discharge into the environment after Capping Stack is landed and locked.
Capping Stack Philosophy

Although a brilliant solution in its own right, a Capping Stack is installed after a well control event has occurred. It is there to mitigate the consequences and provide a means of recovery, perhaps in conjunction with the drilling of a relief well.

But is this adequate well control protection methodology for the Arctic where one cannot wait on emergency response operations to mobilize vessels, people and equipment?
Why consider a different approach for well control for the Arctic?

- Geographically remote locations
- Icebergs, Mobile pack ice, Sea ice
- Sensitive environment
- Short drilling window
- Prolonged darkness
- Fast forming storms
- Gas

This presentation focuses on a new quick acting well capping and containment safety system capability that adds an additional level of safety at the seabed as it applies to the unique Arctic environment.
Mudline Closure Device – A Case Study

The Arctic is inherently more difficult to deploy traditional Capping methodology making the case for a pre-installed solution, on location and used throughout drilling operations.

- Trendsetter Engineering has developed and successfully deployed into the Russian Arctic a Mudline Closure device giving operators immediate in-situ containment and well control functionality in the event of a well control event.

- This is a real case of equipment taken from definition of problem to use in the Arctic (2014).

- Cannot disclose information on end user, specific location.

More compelling is the most likely scenario that makes the use of a Mudline Closure Device so desirable as a pre-installed reliable well containment device is avoiding entirely, intervention at the seabed during the off season when surface / ocean ice conditions generally prevent well site ops.
Pre-installed Pressure Protection at the Seabed

- Location – Russian Arctic
- Circa 2014
- Water depth - < 100 meters (shallow water case), 10,000 ft wd rated
  - Procedures were developed for both shallow water and deep water cases
- 15,000 psi rated
- Special mill run of structural steel for the cold temperature environment, all components designed for cold temperature service
- Rig – Semi submersible
  - Moored with anchor spread to seabed per rig’s mooring specifications
Bring Capping technology forward to be more Proactive

Instantaneous response is required to reduce the response time to a minimum and achieve a near ZERO discharge goal and reduce risk to the rig, personnel and environment.

To best reach this goal one needs a fully contained system --
- Pre-install in advance -- in line with the BOP
- Provide an independent power source
- Provide independent control (command to close)
- Provide redundant control – Acoustic (send and receive)

- Drill thru system
- Augments the BOP and ESD Safety Systems
- Provides an additional safety barrier at the seabed
- Serves as a well cap capable of pressure protection with monitoring, logging, and data transmission capabilities
- Facilitates immediate disconnect / drive off – drift off capability

240,000 pounds of prevention
Drilling in the Arctic benefits from features in the MCD equipment design that minimize any uncontained flow from the well

- Pre-installed in the drilling system, kept on standby, close in less approximately 30 seconds after command to actuate.
- Redundant power source
- Redundant control command capability
- Option to pre-install conduit and surface treatment to divert, treat, store, dispose of the well flow in wells that the integrity downhole is the limitation.

Mudline Closure Device & Diverter/Flare for MODU or Drilling Rig
Safety Systems
Protecting life, the Environment and our Customers Assets

Proactive
Pre Installed Mudline Closure Device

- Augmenting BOP capabilities
- Additional rams
- Independent Acoustic controls
- Long Term wall isolation
- Blow off charter if BOP pulled with well isolated
- Divert/Flow Capabilities
- Well kill/ Pumping Capability (Bulk Inhaling)
- Proactive approach to well control
- Cost Effective
- Time Saving

Responsive
Ready to Respond Capping Stack

Mitigate Consequences

- Plan for Recovery
  - Well Control Incident Plan
  - Oil Spill Response Plan
  - Oil Spill Containment Systems
  - Technical Expertise
  - TRL Readiness
  - Accepted Global Standard
Cost, Time and Commercial Implications

Mudline Closure Device

Traditional Capping Stack

Preventative response VS Mitigate consequences

Cost, Time, Barrels, Oil
Mudline Closure Device Versatility

- Can be pre-installed into different drilling systems
  - Jackups
  - MODUs
  - Intervention operations
- Drive off / drift off protection
- Capability to Pump into the well to provide more redundancy in establishing cement and mechanical barriers
Case Study Highlights / FAQs

• Structural integrity of the BOP / Riser system /rig positioning
  • The MCD did not introduce any additional requirements to maintain the structural integrity of the rigs BOP/Riser system.
  • In shallow water rig maintained a much smaller watch circle and the riser kept closer to vertical limiting side loads
  • For a Dynamic positioned vessel there would be the same watch circle in deep water, giving a much larger riser angle more side load on the riser.

• Wellhead fatigue concerns
  • Riser analysis showed bending loads for the shallow water case were near the limit of some wellhead connectors. To remedy this, a super heavy duty H4 connector was utilized during deployment to ensure full operability of the system given vessel motion and metocean criteria.

• MCD was tested after landing and latching to the wellhead, all Acoustic / ROV interfaces were tested to ensure 100% functionality.
Conclusions

This paper focused on a new quick acting well capping and containment capability that adds an additional level of safety at the seabed that was successfully deployed in the Russian Arctic in 2014.

Deploying traditional Capping methodology will be inherently more difficult in the Arctic is supports the case for a pre-installed solution, on location and used throughout drilling operations

This will require an industry step change to apply more proactive principles improving the equipment, processes and human behaviors necessary to meet the needs and commitment to challenging Arctic conditions