AME
Offshore Solutions

Supporting Innovation – AME Super Bails

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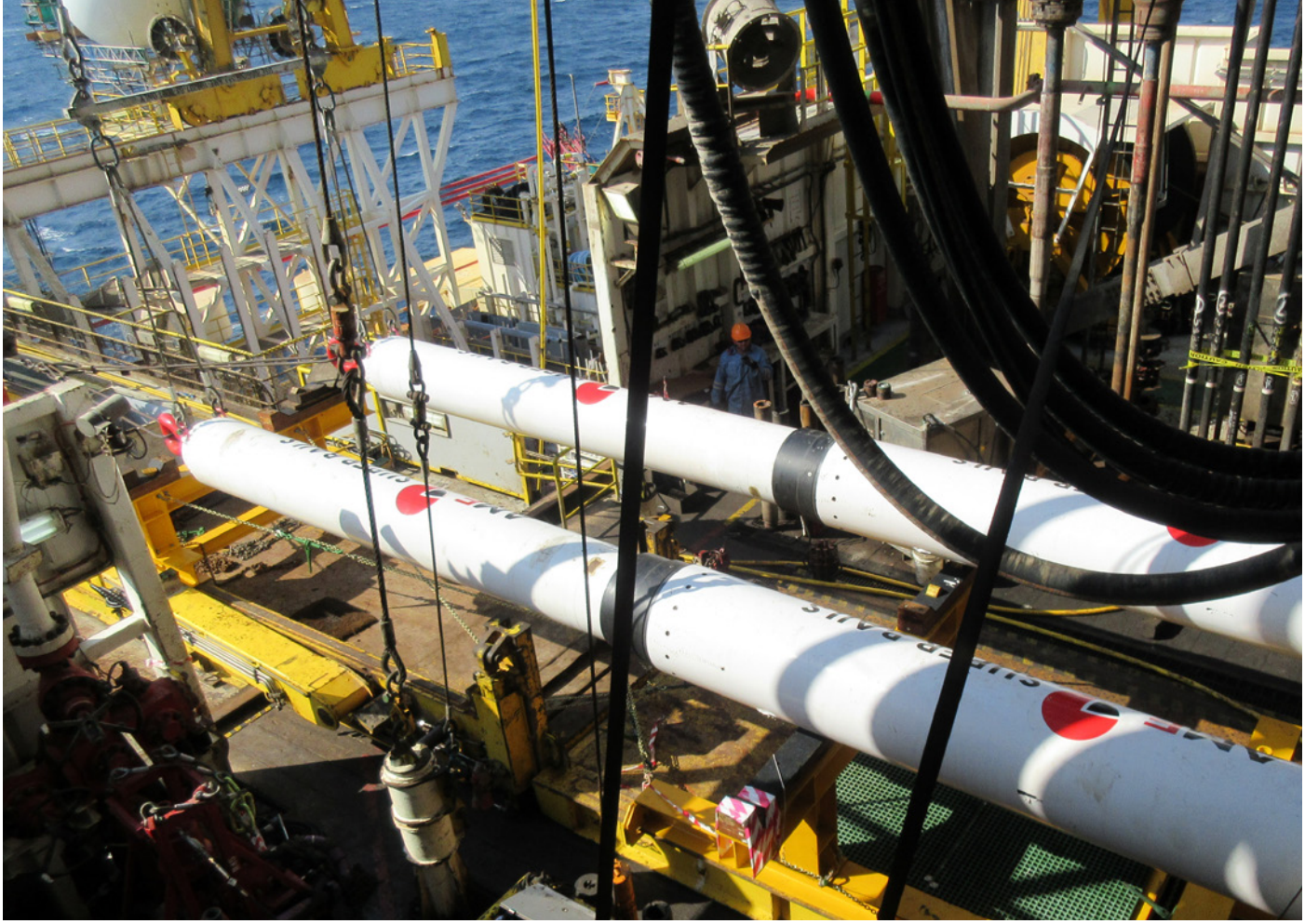
INTRODUCTION

The following case study considers ConocoPhillips' use of the AME Super Bails to provide backup compensation on the *Atwood Osprey* during drill stem testing (DST) operations.

This campaign was the first offshore use of the Super Bails, and they worked exactly as designed.



BACKGROUND

The 2017 ConocoPhillips DST campaign took place in the Barossa field in the Timor Sea, aboard the gen. 6 semi-submersible *Atwood Osprey* which utilises an "Active Heave Draw-works" (AHD) system to compensate the drill string. The Barossa 6 well was in 270m water depth with a well TD of 4200m. The landing string tubulars offer little resistance to buckling in compression and have a limited tensile strength.

In recent years, well tests in deep water have been giving increasing focus to the risk of compensator lock-up, and this concern is shared by the Australian regulator (NOPSEMA). Whilst the probability of such a failure is remote, there are numerous records of compensator lock-ups occurring in the real world, and the potential consequences of a compensator lock-up with the string "locked to bottom" during a DST or flowback are catastrophic.

The ConocoPhillips SPIRIT values (Safety, People, Integrity, Responsibility, Innovation & Teamwork) guided the team to the requirement for a compensator backup immediately after an AHD MODU was selected.

Acronyms

AHD: Active Heave Draw-works

API: American Petroleum Institute

ALARP: As Low as Reasonably Practicable

CCTLF: Compensating Coiled Tubing Lift Frame

CT: Coiled Tubing

DNVGL: Det Norske Veritas Germanischer Lloyd

DST: Drill Stem Test

MAE: Major Accident Event

MODU: Mobile Offshore Drilling Unit

MRU: Motion Reference Unit

NOPSEMA: National Offshore Petroleum Safety and Environmental Management Authority

PCE: Pressure Control Equipment

PLC: Programmable Logic Controller

PLT: Pressure Logging Tools

RAO: Response Amplitude Operators

SFT: Surface Flow Tree

TD: Total Depth

TLF: Tension Lift Frame

EQUIPMENT SELECTION

The following criteria was set for the backup compensator.

- Over and under tension protection
- Passive unit, independent of rig services
- Adequate stroke for heave and tide
- Access for intervention equipment
- Does not interfere with the function of the AHD
- Simple to transport
- Simple to rig up and down
- Industry proven technology
- Minimal space consumption, both on the deck and in the derrick
- Cost effective
- Ease of interface with the rig equipment

Three systems were identified as being available for the upcoming works.

- Weak Link Bails
- CCTLF
- AME Super Bails

Weak Link Bails are generally limited to over-tension protection only, and also cease to maintain landing string tension once activated. Given the landing string's poor resistance to buckling in compression, Weak Link Bails were not considered suitable for the Barossa-6 DST.

Given that there was sufficient drill line ton-miles to permit the use of a compensator backup for the DST (as opposed to a primary passive system), the AME Super Bails were considered for the project.

The detailed review provided ConocoPhillips confidence that the back-up system would be suitable for the project's requirements and the decision was made to proceed with the AME Super Bails.

Whilst the CCTLF could have fulfilled the requirements, the Super Bails were deemed to be more "fit for purpose" for Barossa-6, owing to a simpler design, offering:

- Lower spread rate
- Lower system complexity
- Lower space requirements
- Lower rig-up time on critical path
- Lower personnel requirements

The AME Super Bails met all of the team's requirements and provided a simple and elegant solution, however the system was still in manufacture and had not been used offshore previously. In line with ConocoPhillips' SPIRIT values, the team decided to support innovation and commenced a robust review of the equipment.

AME confirmed the following

- The design and manufacture would be fully certified by DNV to DNVGL-OS-E101 and API8C.
- Full function testing would be carried out and witnessed by DNV.

To verify that sufficient stroke was provided by the Super Bails, a full statistical review of the Barossa field MetOcean data and the MODU's Response Amplitude Operators (RAOs) was performed. This demonstrated that for all foreseeable environmental conditions there would be sufficient stroke in the system to provide offshore personnel time to react, and make a considered decision to ensure well control is maintained.

The detailed review provided confidence that the back-up system would be suitable for the project's requirements and the decision was made to proceed with the AME Super Bails.

WHY IT WORKED OFFSHORE

The Super Bails were transported in custom-built 40' offshore rated baskets, simplifying transport and logistics.

Setup and configuration of the Super Bails was performed onshore, as all critical parameters affecting the setup are known well in advance. Although fine-tuning of the setup is possible offshore, it was not required on this occasion. On-site preparation was performed "offline", minimising the impact on rig schedule.

Picking up the Super Bails was analogous to picking up a set of 45ft rigid bails commonly used for DSTs. Prior to the operation, a lift study was performed by AME, and a full set of sequence drawings were created to plan the installation. A custom trolley was built and mounted to the pusher cart, used for moving the Super Bails and flowhead to well centre. **This trolley greatly improved safety, and made an otherwise awkward operation quick and easy – ultimately taking around 30 minutes to pick up or lay down the Super Bails.**

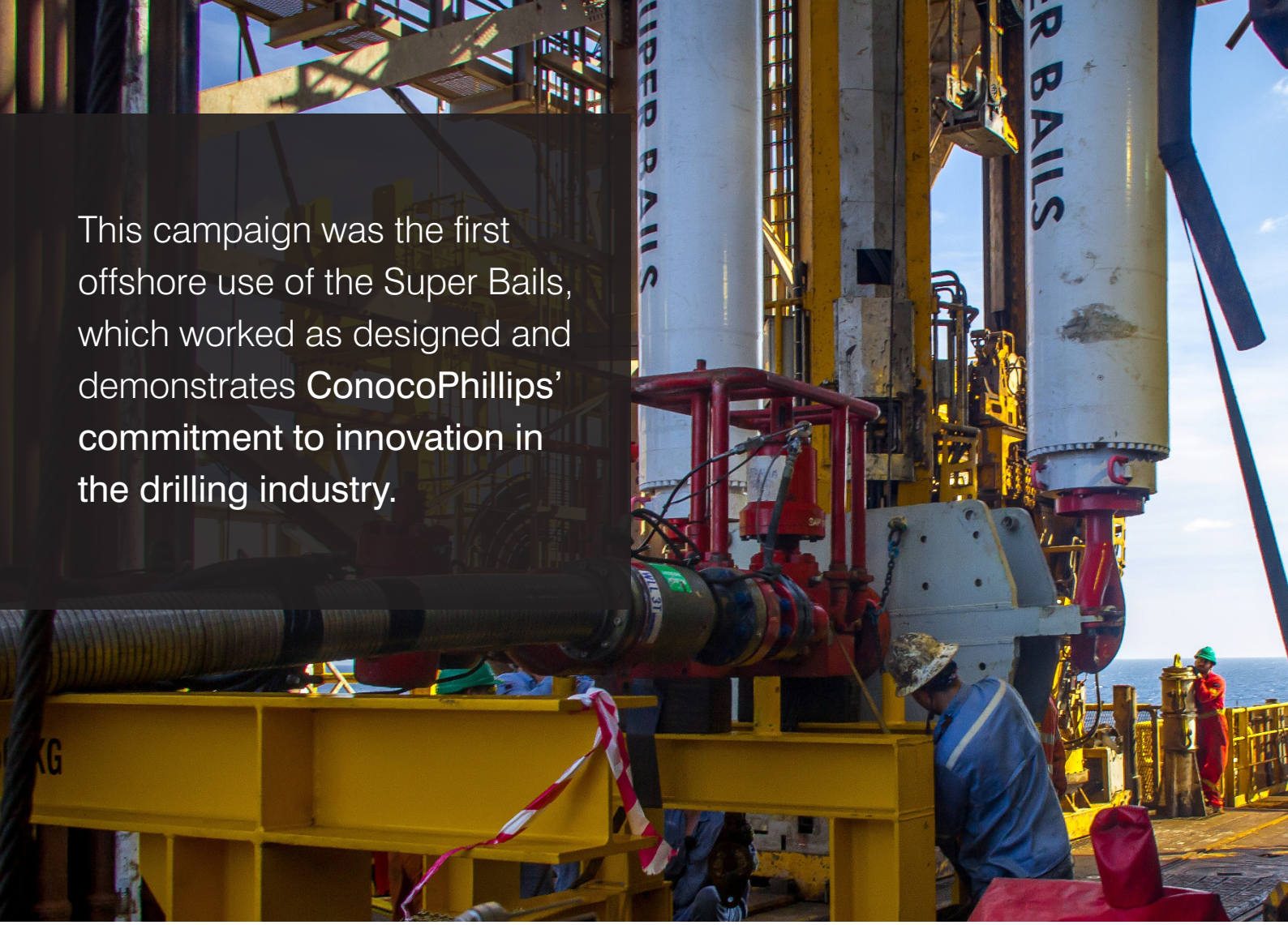
A single air line was routed to the upper spreader beam (used to operate the PCE winch), but otherwise no rig services or piping installations were required; **the Super Bails were self-sufficient, fully enclosed units.**

Prior to landing the string in the wear bushing, the function of the Super Bails was tested. The full stroke of both Super Bails was observed, and it was noted that the activation tensions matched the calculated values.

Other than being able to lock the over-tension cylinders closed, the Super Bails do not have multiple function modes – they are permanently online. The simplistic design means that the Super Bails response to changing hook loads is easy to predict, and independence from activation valves minimises both response time and potential failure modes.

On-site preparation was performed "offline", minimising the impact on rig schedule.

SUPER BAILS, TLF & SFT DURING BAROSSA 6 DST



This campaign was the first offshore use of the Super Bails, which worked as designed and demonstrates **ConocoPhillips' commitment to innovation in the drilling industry.**

During the DST, the Super Bails afforded adequate room for intervention equipment. Basic function of the rig systems (most notably the Active Heave Draw-works) remained unaffected, and the Super Bail impact on the DST operation was minimal;

- Overpull on the landing string during operations was maintained a little higher than normal – although still well within the equipment limits.
- A small reduction in height available for intervention equipment, which also posed no issue for this particular operation.

Due to operational changes the Super Bails were rigged up twice, and were operational for 20 days. Active Heave Draw-works performance was within the expected range throughout. Despite not being used "in anger", the Super Bails performed exactly as required during operations, and positive confirmation of correct stroking was obtained immediately before the string was landed out.

Furthermore, no downtime was recorded to AME equipment at any point during the project.

COST BENEFITS

There were three main areas for cost savings compared to other systems;

1. Rental costs, including offshore personnel and offline setup;
2. Transportation and logistics costs. The system was road transportable and did not require special grillage for boat transport to the rig; and
3. Critical path rig time costs. The rig-up time of the Super Bails was the same as for standard drilling bails and there would have been no rig-time penalties if the system had activated.

ConocoPhillips' commitment to the SPIRIT values has allowed an innovative solution to compensator lock-up to be used offshore for the first time, **with excellent results.**

SUMMARY

Compensator failure during locked to bottom operations presents a genuine risk. The Australian regulator, and the oil industry as a whole, is placing increased focus on compensator back-up systems.

ConocoPhillips' commitment to the SPIRIT values has allowed an innovative solution to compensator lock-up to be used offshore for the first time, with excellent results.

As an industry, we should all be working to ALARP and when there are **cost effective and simple solutions available, they should be implemented at all times.**