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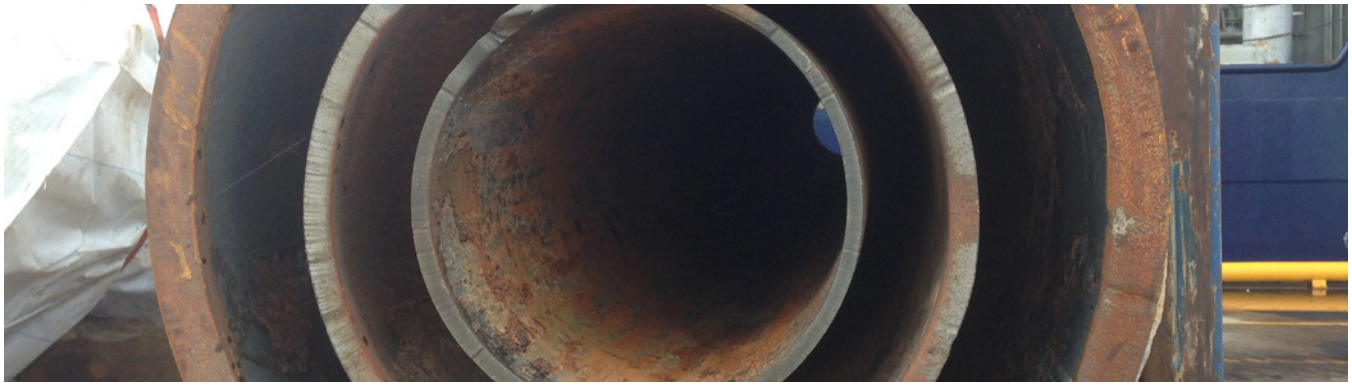
Rigless Plug and Abandonment



Project Overview

In 2013, Oceaneering was approached by a major North Sea, Danish Sector operator who requested a review of their legacy inventory of 28 suspended Exploration and Appraisal (E&A) wells. The majority of the wells were mudline suspension types with spud dates ranging from 1966 through to 1998 and water depths ranging from 110 to 237 ft (33.5 to 72.2 m).

The operator was interested in benefiting from the flexibility and cost effectiveness of a vessel based solution. As the wells were not all in the same area, multiple rig moves would have been cost prohibitive. The flexibility in approaching the project with a vessel-based program during project execution would also provide contingency for accommodating unknown challenges.

The Oceaneering Solution

Oceaneering identified the requirement to complete its own, independent re-assessment of the well files to check for omissions or alternative interpretations and to generally apply the UK's P&A categorization principles, as applicable at the time. This subdivision enabled us to determine if a vessel based solution was acceptable and to identify any information gaps requiring further inspection to ascertain the actual condition of the wells.

The categorization exercise resulted in the following summary:

Category	Condition / P&A approach	Number of wells
Category 1	Ready to remove / well severance and clearing seabed / vessel based	7
Category 2*	Require additional cement barriers / vessel based	16
Category 3	Rig based	5

Developing Outline Methodologies

The project team decided to approach the methodologies from the point of undertaking the well works in a multi-phase, batch process based on the age and known physical arrangement of the wells as documented by the client's historic ROV surveys of each well location. The multi-phase, batch approach optimized cost efficiency and offered benefits including the strategic deployment of equipment (saving valuable deck space) and ability to address unknown challenges as efficiently as possible, as they presented.

Operational Solutions

All identified operations could be completed by Oceaneering work class ROVs eliminating the need to deploy divers and reducing the operational risk and cost profiles. Our experience in subsea well abandonment and our operational processes and procedures enabled us to optimize vessel selection for efficiency in functionality and cost. A suitable vessel was identified, meeting the minimum requirements for DP2, work class ROV, a subsea construction crane, and a main deck moonpool.

The project team assessed all project activities to develop appropriate operational solutions.

Debris clearance and structure recovery: All debris clearance and structure recoveries were assessed to be well within the scope of standard ROV, rigging, and construction crane operations.

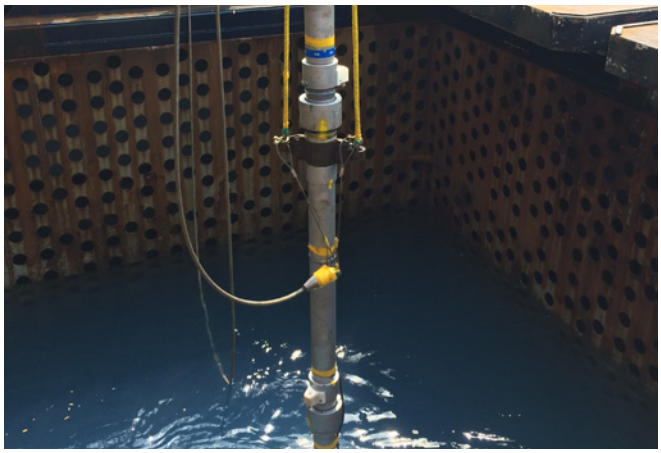
Well flushing: Existing records and ROV survey footage revealed that extensive well flushing operations were required to clear numerous wellbores of sediment infill to provide access to below mudline TA caps. The project required high volume/low pressure and low volume/high pressure flushing solutions.

Wireline: Several of the wells' TA caps had been retrofitted, at installation, with wireline plugs. A simple, low-cost, wireline spread (complete with subsea pressure control equipment) capable of vessel deployment was identified and sourced enabling the wireline plugs to be safely vented and/or recovered.

TA cap recovery: Given the requirement to vent, pressure test, and recover numerous TA caps (multiple OEMs, stab-in, threaded, vented, and back pressure valve [BPV] types), vessel-deployed drill pipe tooling solutions were employed to provide the highest level of flexibility.

Casing cutting and pulling: With the project equipment spread already committed to using vessel deployed drill pipe tooling solutions, Motor-driven downhole casing cutters and spears were added to the suite of vessel deployed drill pipe tooling. The casing sizes for the internal cutting and pulling of casings included: 7 in, 9 ⅝ in and 13 ⅜ in to 800 ft below mudline.

Casing Scraping: To ensure full bore access and water-wetted casing bores, a cable deployed casing scraper arrangement was supplied to the project (7 in, 9 ⅝ in, 13 ⅜ in and 20 in to 800 ft below mudline).



Cementing: Two techniques were available to place the cement plugs as per the applicable regulations; punch and squeeze or pump and pull. The client's preference, based on assurance of the optimum quality, was to employ the pump and pull technique.

Well Severance: Oceaneering-supplied internal abrasive water jet and diamond wire cutting solutions were identified as the only appropriate options for final well severance. Explosive severance is still sometimes used in the industry; however, given the unknown consequences of peak pressure shock waves on the integrity of the remaining well barriers, let alone the damage caused to the marine flora and fauna, the use of explosives use, even as a backup, was not considered viable.

Our P&A experience enabled us to anticipate and prepare for unplanned scenarios that often presented during operation. Deployment of multitask tooling and personnel capable of efficiently overcoming issues including potential fishing net removal, cement patio break-up, residual fluid sampling/recovery, and downhole junk fishing helped mitigate these eventualities.

Challenges

The client also wanted to minimize project waiting on weather (WOW) downtime by completing all operations during the summer season. Given the volume of work to be undertaken and the seasonal constraint, the well works were, based upon the well categories, broken into two tranches scheduled for 2013 and 2014 with a contingency to rollover to 2015, if required.

In **2013**, Oceaneering was contracted to complete P&A related scopes of work on 15 wells (category 1 and 2.0). The works were completed in three phases.

- Phase 1: Debris clearance and inspection
- Phase 2: Well flushing, inspection, TA cap recovery, wireline, and cementing
- Phase 3: Wellhead/Conductor severance and recovery

In **2014**, Oceaneering completed the P&A related scopes of work on 14 wells (category 2.1 and 2.2). The works were carried out in four phases.

- Phase 1: Debris clearance and inspection
- Phase 2: Well flushing, inspection, and TA cap recovery
- Phase 3: Casing cutting and pulling (total casing recovered 1,484 ft [452 m]).
- Phase 4: Cementing

The operator decided to suspend all P&A operations during 2015 and reschedule for 2016.

In **2016**, Oceaneering completed the P&A scope of 13 wells (now category 1). In addition, six other wells (category 3) were added to the scope for cleaning, inspection, and preparation. The works were carried out in two phases.

- Phase 1: Debris clearance, well flushing, and inspection
- Phase 2*: Conductor severance and recovery

* To reduce the cost of the Phase 2 operations to the client, Oceaneering rolled this scope into its annual, multi-client, wellhead removal campaign**.

Results

The use of integrated Oceaneering project teams and services enabled the client to benefit from reduced cost, optimized engineered solutions, and the successful removal and clearance of 22 wellsites.

The client also benefited from the flexibility of the vessel-based solution and using it to address the differing work scopes. Employing the batch solution allowed a reduction in cost on equipment spread throughout each phase. While progressing with work on other wells, solutions were planned for unexpected challenges, which provided additional contingency and flexibility. This was translated in a low non-productive time (NPT) and reduced waiting on weather (WOW).

Project Highlights

	2013	2014	2016
Wellsites visited	15	14	19
Wells abandoned (site cleared)	9	1	13
TA caps recovered	2	26	-
Casing mechanically cut	-	8	-
Well cementation	2	13	-
Operational days (offshore)	75	149	36

**For more information on our successful multi-client campaigns, please reference our 2015 and 2016 Wellhead Removal Case Studies.