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Decommissioning Services

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Decommissioning

Abrasive Water Jet Cutting Technology

Introduction

Oil States has been an Abrasive Water Jet cutting service provider to the oil and gas industry since the 1980s. Our cutting systems, which are primarily used during the decommissioning and removal of redundant offshore platforms, pipelines and subsea structures, are also used during platform maintenance and upgrade programs.

The incisive penetrating cutting action of the Abrasive Water Jet system makes it suitable for both surface and subsea applications. A high energy jet of water-borne abrasive particles is used to cut through steel alloys or multiple layers of material.

This is achieved by entraining abrasive into the high-pressure water stream at the surface and pumping the pressurised slurry mixture through a single hose to the cutting nozzle to produce a clean, accurate cut with a good surface finish.

All our Abrasive Water Jet cutting equipment and tooling is designed, built and operated by Oil States' personnel. We continually develop and improve our cutting equipment from experience gained in the field. All operations undertaken are fully documented and in accordance with ISO 9001:2008 Quality Assurance and ISO 14001 Environmental Management accreditation systems.

Our design team use the latest 3D design and stress analysis software to provide optimum tooling solutions to meet project requirements. We have supplied subsea cutting solutions during numerous critical decommissioning operations and provide internal, external, standard and bespoke cutting tools to suit all applications. Real-time cut monitoring and positioning features are integrated into the tooling packages enabling cutting in the harshest of subsea, sub-mudline environments, often where there is zero visibility. Through the use of carefully planned and adjustable operational parameters each cut is assured, in every situation and with complete confidence.

Topside and Subsea Structural Removal

Abrasive Mixer Unit (AMU)

Oil States' Abrasive Water Jet (AWJ) cutting system has been continually refined since the first system was developed in the 1980s. Our abrasive mixer units, which are designed, built, maintained and operated exclusively by Oil States' personnel, are rated to a pressure in excess of 1,000 bar (14,500 psi).

Two configurations are available, either a containerised unit, housed within a purpose-built 10ft shipping container or a standalone skid-mounted unit. Both benefit from having identical hydraulic (water) circuits that incorporate over-pressurisation safety features, control panel layouts and utilisation of standard pressure-rated component parts, resulting in complete consistency of performance, rating and operation across the range.

Each mixer unit comprises two separate pressure vessels, which are loaded with abrasive that is discharged into a pressurised water stream to form concentrated “slurry”. This pressurised slurry mixture flows down an umbilical supply line and out through a nozzle mounted on the cutting tool to provide a clean and efficient cutting action. Because the pressure vessels are operated alternately, when one vessel has been discharged it can be refilled whilst the second vessel is being operated, allowing an almost continuous cutting process.

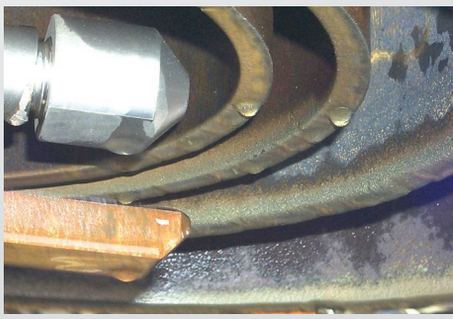
1000 bar containerised Abrasive Mixer Units (AMU) with grit-loading hoppers

Subsea Template Removal

Features

- Standard operating control layout
- Over-pressurisation safety systems
- Working pressure 1,000 bar +
- Project-specific certification and calibration
- Dual vessels provide near-continuous cutting
- Real-time adjustable operating parameters

20" Pile cut & video monitoring of the Abrasive Water Jet



Casing Assembly Cut

Abrasive Grit

Two types of abrasive grit are used as standard; either iron silicate, a relatively cheap and readily available material commonly used in general grit blasting activities, or garnet, a naturally occurring mineral that is a more expensive, harder, but less readily available material.

High-Pressure Water Pumps

High-pressure water is supplied to the abrasive mixer unit by diesel-driven fixed displacement pumps, which are certified for offshore use in Zone II areas.

The pumps are generally housed within purpose-built 10ft shipping containers for ease of transport. The operating pressure and water flow rate provided by the pumps are carefully controlled to ensure that the required pre-determined cutting parameters are achieved at all times.

30" – 60" ICMS

42" – 72" Internal Cutting Manipulator

Internal Cutting Manipulator (ICM)

Features

- Fully remote controlled
- Operable in zero visibility
- Robust design
- Interchangeable sub-assemblies and component parts
- Real-time nozzle tracking system
- Real-time adjustable nozzle travel speed
- Fail-safe tool recovery design
- Subsea cuts performed in 300 metre water depth

Oil States' Internal Cutting Manipulators are remotely controlled subsea cutting tools. Ranging from 20" to 120" diameter, tool diameters include 95/8" - 12", 20"- 30", 30"- 60", 36"- 60", 42"- 72" and 72"-120".

Primarily used for subsea internal pile or combined jacket leg and pile cutting operations, the Oil States' ICM range has successfully completed operations in water depths down to 300 metres. Frequently performing cutting operations at elevations between 1 to 6 metres below mudline in the most arduous of conditions, generally in zero visibility, each tool supports a proven range of positioning and cut monitoring features.

42" to 72" ICM Pile Cutting Tool Configurations

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Operations

The robustly constructed tools are generally deployed from a platform or construction vessel, suspended from the crane and connected to the surface control spread via a service umbilical, comprising bundled hydraulic hoses, electrical and abrasive slurry lines.

The ICM is lowered to a pre-determined cut elevation and positioned via a fixed datum point such as the pile top. Once positioned, the hydraulic supply is energised to activate the tool's centralising system to align it along the axis of the pile. The nozzle arm then extends to contact the pile wall, maintaining an "active" pressure against the wall to keep the cutting nozzle at a pre-set stand-off distance at all times.

The abrasive water jet is brought on-line and quickly penetrates through the pile wall, after which the cutting nozzle is rotated at a controlled rate around the internal circumference, cutting through the pile wall as it proceeds. The service umbilical relays the cut monitoring and positioning data back to a surface control computer station, providing the operator with "real-time" data from the tool, enabling immediate intervention where necessary to ensure that every operation is completed successfully.

ICM Direct Deployment - Skirt Piles Cuts

Internal Cutting Manipulator (ICM) Deployment Methods

The direct deployment method can be used for either subsea or surface cutting tool deployment applications. With this method, the tool is suspended from the vessel crane via a positioning frame and sling. Stabbed directly into the pile/jacket leg, the cutting tool is lowered until the positioning frame lands on the pile/jacket leg top. A fixed length sling fitted between the positioning frame and cutting tool ensures that the tool is located correctly at the required cutting elevation. A simple adjustment mechanism allows the positioning frame to be altered to account for variations in pile/jacket leg top elevation, ensuring that all severances are made at the same elevation. The crane deployment rigging is either slackened off to remove vessel motion or disconnected prior to performing cutting operations.

Operational Advantages

- Direct Deployment
- Simple cut depth adjustment
- Rapid deployment
- Launch Frame Unit
- 30" - 72" diameter
- Releases vessel crane for other operations
- Multiple cuts at varying elevations
- Cut and Recovery
- 20" up to 120" diameter
- Pile stick-up removal in one operation
- Fail-safe tool operation

Direct Deployment Method

Oil States' Internal Cutting Manipulators can be deployed using two handling options, either the direct deployment method or the Launch Frame deployment method.

Pile Stick-up Removal

As a variant of the direct deployment method, Oil States offers a system for cutting and recovering pile stick-up sections in a single tool deployment. With this arrangement, the positioning frame incorporates purpose-built hydraulically actuated fail-safe clamping units, which can be adjusted to handle pile sections ranging from 20" up to 120" in diameter.

Launch Frame Deployment Method

With the Launch Frame deployment method, the cutting tool is deployed from a purpose-built frame, which is stabbed into the jacket leg pile, releasing the vessel crane for other activities.

The Launch Frame houses the cutting tool and incorporates two winch units; one to lower and recover the cutting tool, the other for running the tool's service umbilical. The cutting tool is positioned using elevation markings on the tool lift wire set against a fixed indicator on the launch frame. A tool-mounted pressure transducer confirms the tool's elevation within the pile. This deployment method is ideal for performing multiple cuts on main leg piles during a single tool deployment, i.e. a sub-mudline cut followed by a midwater cut on the same pile when removing larger jackets in sections.

Platform and Subsea Well Cutting Operations

Oil States has developed a range of cutting tools to facilitate the removal of platform and subsea well multiple casing assemblies. The tools, which utilise the Abrasive Water Jet cutting technology, can be configured to run inside standard 9 - 5/8", 13 - 3/8" and 20" casing sizes or stand alone 30" conductors.

Features

- Real-time nozzle tracking system
- Remotely adjustable nozzle travel speed
- Multi-string cutting both cemented and voided annuli
- Tool sized to run in standard casing sizes
- Tool sizes available 9 - 5/8", 13 - 3/8" and 20"

LFU deployed on tripod jacket

Operations

For subsea well removals, the tool is deployed overboard suspended from a Direct Deployment Frame, which in turn is suspended from the vessel crane. The tool is lowered down the inner casing until the Direct Deployment Frame lands on the wellhead, positioning the tool at the required cutting elevation, typically 3 metres below the mudline.

Single, triple & quadruple subsea well casings cut configurations

The tool is centralised within the inner casing using an integral casing packer, after which the pressurised abrasive slurry mixture is pumped down to the tool cutting nozzle, penetrating through the well casings regardless of whether the annuli between them are cemented or voided.

Following penetration of the abrasive water jet through the well assembly into the surrounding seabed, the tool cutting head rotation begins, with all parameters monitored and adjusted as necessary in "real-time" as the cut progresses around the outer conductor circumference. The parameters used for each cut depend upon the well casing configuration, whether the annuli between the casings are cemented or voided and if the casings are arranged concentrically or eccentrically within each other.

Bespoke Solutions

In addition to the array of standard internal and external remotely controlled subsea cutting tools, Oil States also designs launch runner legs builds and operates bespoke cutting tools to provide solutions for non-standard applications.

Each bespoke tooling solution is subject to a design review processes which includes a 'Failure Mode and Effect Analysis', an evaluation of the tool's operating procedure and the production of PUWER and Task Risk Assessments associated with completing the scope of work.

Prior to putting the equipment into service, a submerged cutting trial will be performed at Oil States' test facility, using the proposed operating procedure to confirm that the tool functions as intended.

Tooling solutions have been offered to meet increasingly varied requirements extending beyond simple cutting activities into aspects as diverse as:

- Cut and recovery of access panels & grout densitometers
- Inspection/access hole provision
- Anchor chain and wire sling cutting / Anode, service line and grout line cutting
- Pipeline weight coat removal / inspection coupon cutting
- Caisson internal/external hole cutting
- Caisson crash barrier cutting and recovery
- Full Caisson removal

Bespoke Subsea Cutting Tools

Features

- Intake holes in firewater or seawater caissons
- Caisson crash barriers
- Shackle pin holes in jacket legs and piles
- Pipeline test/inspection coupons
- Jacket trunnion keeper plates
- Wire rope slings
- Anchor chains
- Docking piles
- Jacket leg inspection holes
- Access panels
- Grout densitometer cutting and recovery
- Anodes
- Pipeline weight coating
- Jacket launch runner legs

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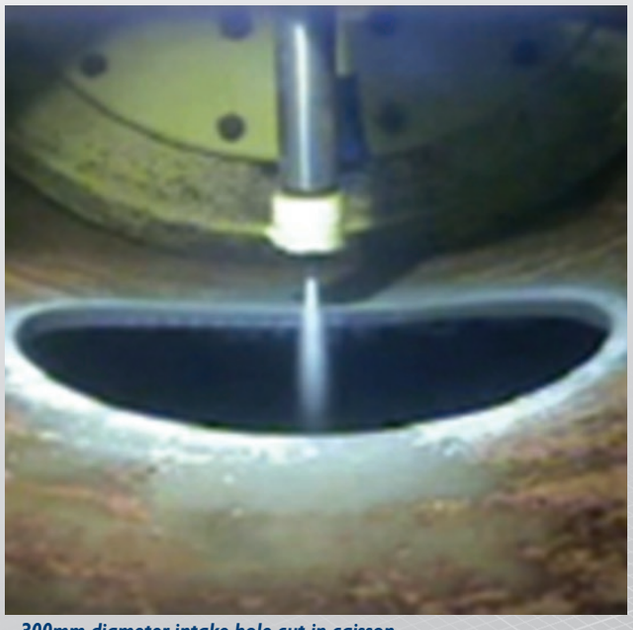
12"-24" External Cutting Manipulator
Castellated cut made around the circumference of a 24" tubular

Togi Template Removal - 300m Water Depth Cutting



300mm diameter intake hole cut in caisson

Simple Diver-Installed External Cutting Manipulators (ECM)

Features

- Range of tools to cut tubular from 3" to 60"diameter
- Robust design
- Real-time tool function monitoring
- 360 degree continuous rotation
- Cuts through single and multiple layers
- Cut monitoring

These simple and reliable Abrasive Water Jet external cutting tools are generally installed by divers and operated remotely from the surface.

The tools, which utilise standard interchangeable sub-assemblies, drives and components, are available in a variety of configurations covering tubular sizes ranging from 3" to 60" in diameter. Each tool size covers a range of tubular diameters through manual adjustment of the clamping system and nozzle stand-off distance.

Prior to commencing subsea operations, detailed on-deck training is given to the dive team to cover the safe installation, set-up and recovery of these cutting tools.

The tools are deployed overboard, with the crane vessel connected to the surface control spread via a service umbilical, which comprises hydraulic, electrical (video) and abrasive slurry lines. The tool is suspended from the crane's deployment rigging, lowered subsea to the required elevation and installed by divers using either a manual or hydraulically powered clamping system.

Once installed, the divers perform a series of checks before disconnecting the deployment rigging and leaving the cut location.

The Abrasive Water Jet is brought on-line and quickly penetrates the target material. The cutting nozzle is hydraulically driven around the external circumference of the tubular at a controlled rate, while the umbilical relays cut monitoring video pictures to the surface control station so that the cutting parameters can be adjusted if necessary.

On completion of cutting operations, the system is shut down to allow the divers to return to the tool location. The divers reconnect the rigging to the tool before releasing the clamping system to remove the tool from the tubular.

ROV-Deployed External Cutting Manipulators (ECM)

Features

- Range of tools to cut tubular from 3" to 60"diameter
- Uses ROV valve chest technology
- Real-time tool function monitoring
- Tool clamping using surface or ROV hydraulics
- 360 degree continuous rotation
- Vertical nozzle travel
- Remotely adjustable from surface
- Castellated cuts
- Cuts through single and multiple layers
- Cut monitoring

Cut size range from 3" to 60" diameter, our ROV-deployed external cutting manipulators utilise the very latest in remote control technology. The tools incorporate a selection of options, which provide for very simple square cuts, angled cuts and more complex castellated (stepped) cut profiles, depending on specific project requirements. The robust manipulators feature state of the art software-controlled functions, which are operated and monitored in real-time at the surface through a laptop computer.

The tools, which are connected to the surface control equipment via a service umbilical, can be deployed subsea, either suspended from a vessel crane or alternatively in a tool basket for collection and installation by a Work Class ROV fitted with an Oil States' Rotary Docking Module (RDM).

The RDM, which is secured to the ROV chassis and powered via its hydraulic power pack, provides the interface between the external cutting tool and Work Class ROV. It allows the ROV to dock with the cutting tool, release its clamping system and transfer the tool from the deployment basket to the required cut location. The RDM incorporates both a pitch and roll function, which allows the ROV pilot to align the cutting tool with the work piece before clamping it in position.

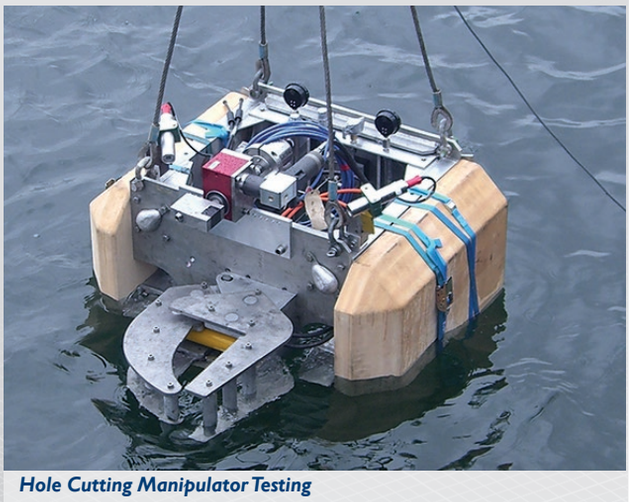
Once installed, the ROV undocks from the tool, leaving it to perform its remote cutting operation.

Topside Cutting Capabilities

Oil States are constantly developing with the market expectations in supporting topside platform integrity problems i.e. caisson or conductor removal. Oil States offer a range of hole boring tooling, clamshell cutting or diamond wire in assisting the asset for long term longevity in working towards a 'one stop shop' service.

Diversify is key not just for the Oil & Gas sector but also the Wind Energy sector and the offshore commercial market sector.

12"- 30" External Cutting Manipulator



Hole Cutting Manipulator Testing

Lomond C6 Caisson Destruct

Caisson Assembly lowered into Support Pinning Frame

Oil States sales and manufacturing facility, Heartlands, UK.

oilstates.com

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decommissioning@oilstates.com

OIL STATES INDUSTRIES

MANUFACTURING, ENGINEERING & SALES

UK
2 Heartlands Terrace
Heartlands Business Park
Whitburn, West Lothian, EH47 0SF
Scotland, UK
Tel +44 1506 896000

Asia
SINGAPORE
42-H Penjuru Road
Singapore 609158
Tel +65 6773 7555
Fax +65 6773 7667

SALES OFFICES

Europe
FRANCE
5 Allée des Mésanges
13012 Marseille, France
Tel +33 491 95 60 51

UK
Moss Road, Gateway Business Park
Nigg, Aberdeen, AB12 3GQ
Scotland, UK
Tel +44 1224 290000

Eurasia
AZERBAIJAN
Suite 5, 1 F. Amirov Street
Baku, AZ1000 Azerbaijan
Tel/Fax +994 125 981 125

Middle East
UAE
Jumeirah Lake Towers
Cluster F HDS Tower
Unit 2209
Dubai, United Arab Emirates
Tel +971 4 452 8482

South America
BRAZIL
02 Corporate & Offices
Ed. Evolution III
Bloco 2, Sala 105
Av. Paisagista José Silva de Azevedo Neto, No. 200
Barra da Tijuca, RJ, Brazil
CEP 22775-056
Tel +55 21 3503 2400

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