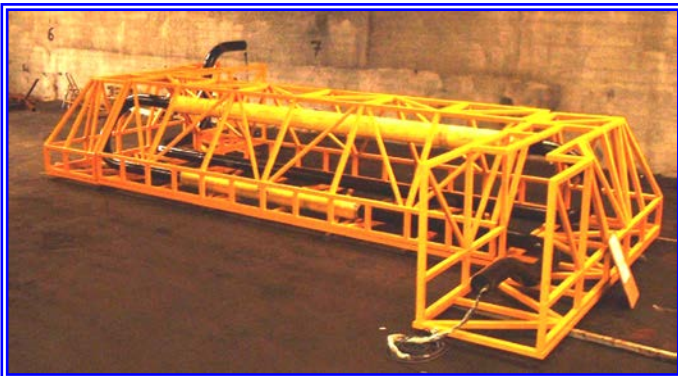


Udecom Tie-in System

Subsea Spool, Connection & Installation System

Doc. No.: IN-UDE-180-DS-063, Rev. 01

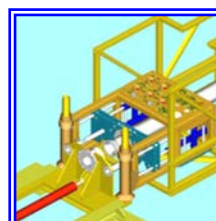
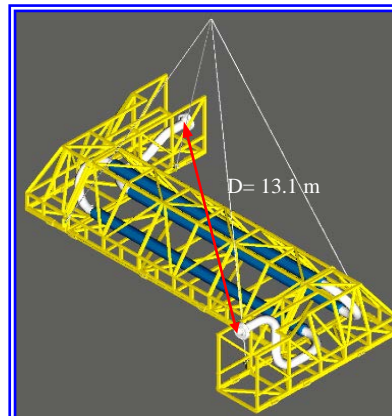
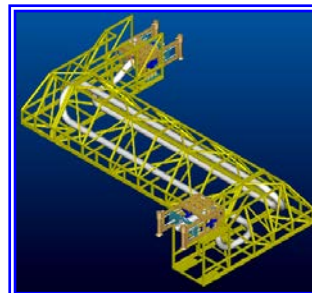
The **Udecom Tie-on System** is a rigid single and multi bore tie-in system. It is a fully integrated spool, connection, protection and installation system with unique system features and characteristics. The system offer large cost savings potential related to spool, interfacing subsea equipment and offshore installation (see page 2). It permit batch load out and installation of multiple tie-in spools. Easy and fast spool recovery is also accommodated. The system can incorporate / accommodate all main subsea suppliers' connection system. Other non-system suppliers, 'off the shelf' connections with short lead-time, inclusive of necessary connection tooling (rental), may also be used.



Construction & Features

- Small size system that accommodate all application comparable to today's 'standard' rigid tie-in spool arrangement. A 55-60% reduction in overall assembly size can be achieved. See illustration – fabricated in year 2001.
- Very low stroking forces. Limited flowline expansion forces transferred into interfacing structures (e.g. PLEM, PLET, Manifold and Xmas Trees). 600 kg force measured during 0.5 m stroke testing of 10", 13% Cr. Spool, 345 bar design pressure.
- Spool sizes investigated and analysed is ranging from 6" to 30", Z-shaped, L-shaped, other shapes, dual spools, spools with valves and whys, vertical connectors, with tie-in tees, etc.
- The tie-in spool softness is obtained by the tie-in spool 'spring' like geometry.
- Low friction frame / spool interface.

- The frame arrangement gives possibilities for backstroking the spool ends prior to deployment, thereby limiting the required stroking force, especially for larger diameter tie-in spools.
- Can include low weight 'off the shelf' three-parted clamp connection or similar.
- Can utilise simple hydraulic or mechanical stroking and connection tool (e.g., final alignment and stoking by jackscrew arrangement & clamp closed with ROV torque tool).
- No spreader required for the installation, as the integrated spool, installation and protection structure will act as a lifting frame for the complete assembly including simple stroking & connection tools attached to each end of the spool / spool frame.
- Spool frame is provided with protection / impact panels.
- Cylinder shaped Ubags Type A can placed along the frame on both sides of the protection structure for stabilisation, protection and over trawl-ability purposes. If required PS Umats, Permanent Seabed Support Mattresses, can be used for seabed support (i.e. no rock dump).



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Cost Saving Potential

The Udecom system characteristics and features can reduce overall costs related to subsea systems and tie-ins, including interfacing equipment. The degree of cost saving will depend on field specific requirements. These cost reduction potentials relates to:

Various

- o No onshore lift spreader required since the spool protection frame also serves as an installation frame / spreader.
- o No lift analyses required in order determine the lift rigging for each individual spool (only total system).
- o Spreader to spool lift rigging not required.
- o Any onshore (or offshore) lift trials and rigging adjustment are not required, or limited.
- o The spool can be deployed with a connection tooling arrangement attached the spool / frame structure, allowing the connection to be performed directly after the landing (i.e. combined installation guide frame, stroking and connection tool). Separate connection tool runs is thereby eliminated. Any integration of the tool package with a ROV is not required.
- o No porch for landing of the spool terminations needed. Terminations are supported by the frame structure. Together with the limited stroking and expansion loads, this reduced design / capacity requirement for interfacing subsea equipment. This represent a large cost saving potential.
- o In case of a multibore tie-in spool, the hydraulic tubes and electrical cables do not need to be piggybacked to the main spool pipe as they can be integrated in the frame structure.

Load Out & Transportation

- o The compact spool dimensions make it easy / fast to move onto the quayside.
- o Lifting onto a transportation vessel with a standard 100 Mt mobile crane or similar.
- o Several types of vessels can be used for transportation (Supply boat, barge, or DSV). I.e. maximum selection flexibility when selecting the transportation vessel implies reduced cost.
- o No grillage required for sea fastening / transportation of tie-in spools.
- o Easy / fast sea fastening since only frame system need be fastened to the deck.
- o A large number of spools can be transported to installation site offshore at the same time.

Offshore Installation

- o A range of vessel types can be used for the installation. The Udecom spool lifting height requirements are considerable less than for a conventional tie-in spool and spreader lift.
- o The Udecom spool is a significantly shorter spool than a conventional spool and is therefore easier and faster to manoeuvre. There would be no spreader to deploy or recover, and no spool to spreader lift rigging to release subsea, and recover onto the deck.
- o Larger weather window for spool installation operations due to the integrated and limited assembly size (I.e. Harsh Environment Applications). If several spools are transported offshore on the same vessels, batch setting of several spools could also be performed within a relative short weather window (i.e. connections performed later).



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- If required, the spool assembly can be easily disconnected and retrieved.
- Due to the integrated spool protection frame there is no need for fabrication, transport and offshore installation of protection structures / tunnels / covers or similar.
- Due to the overall spool size, the stable support the frame provide for the tie-in spool, possible use of PS Umats, Permanent Seabed Support Mattress, and possible use of Ubag A stabilisation and protection bags (cylinder type), the need for rock dumping of spool corridor and / or spool covers may be eliminated.
- In the case of multibore spools the umbilical jumper / flying lead installation is eliminated as these items are integrated onto the Udecom assembly.
- Simple and 'low cost' connection tooling can be used for the stroking and connection of the tie-in spool. Moreover, installation contractor / ROV personnel could therefore operate some of these systems. This may eliminate the requirement for mobilising separate tooling packages and personnel.
- Metrology requirements may be reduced, as the distance between the connecting hubs are short. This may allow the use of a jig to determine the position, orientation and elevation of the hubs. The 'soft' tie-in spool will also accommodate a larger tolerance envelope.

Other Aspect

The fact that the spool is short, placed within a protective frame, and lifted without a spreader makes it less vulnerable to damage during transportation and installation.