

## Landing String (LS), Subsea Test Tree (SSTT), & Associated Kit by Grant Pierce



Expro Group SSTT - BP Shah Deniz

We are at a point in time where the utilization of Landing Strings, Subsea Test Trees (SSTT), and associated kit are an important aspect of Completion commissioning and Subsea Tiebacks so I thought it would be pertinent to let people know what exactly is in the market.

A landing string is used to run a Subsea Test Tree (SSTT) for well test (DST) or completion operations. The SSTT is run on a landing string inside the marine riser and is installed so that the SSTT spans the BOP with critical joints aligned to the BOP rams.

For well testing operations the SSTT is normally run on a 3" landing string and is landed on the wellhead with an adjustable hanger which supports the weight of the test string. For completion operations the larger SSTT is typically run on a 7" landing string and is attached to the Tubing Hanger Running Tool (THRT) which lands in the Wellhead or Horizontal Tree and supports the weight of the completion string. The diameter of the SSTT is relatively large, especially for completion operations. The 18.5" SSTT has to be run inside the 18.75" marine riser system and so there is very little clearance. This makes running operations difficult especially when the large diameter SSTT spans the upper and lower flex joints.

During running operations, it is very important to maintain low flex joint angles to ensure smooth passage of the equipment. Once the SSTT is run, a pressure test is performed and for completion operations this is generally done prior to landing the THRT to avoid damage to the Tubing Hanger seals; if the test is unsuccessful and the Tubing Hanger has to be retrieved. Operations can be significantly limited for this condition because of the high tension resulting from the full suspended weight of the completion and the landing string. During landed and latched operations the flex joint angle limits can be relaxed a little, however, during a planned unlatch operation the Latch tool has to be disconnected and pulled through the lower flex joint. This can also result in restrictive angle limits and these must be maintained during all connected operations to allow a disconnect sequence to be performed at any time.

Since I covered SSTT in detail in a previous exercise I will just briefly go through the make-up so as not to repeat previous info (more than needed) and then will list the major suppliers and what they have to offer.

The SSTT is a vital component in the landing/intervention string for any well equipped with a horizontal tree, as it provides the essential well control barriers up until the time the tubing hanger and crown plug are installed.

To perform an intervention on a well equipped with a horizontal tree, the BOP and marine riser are first installed. The THRT is connected to the SSTT and the assembly is run into the riser on production tubing (normally with premium connections). The THRT is hydraulically latched onto a sealing profile in the top of the high-pressure internal tree cap.

A Surface Flow Head (Surface Test Tree) would then be rigged up on top of the riser and wireline pressure control equipment would then be hung off on a Coiled Tubing Lift Frame (CTLF) and rigged up on the Flow Head. Wireline would then be used to pull both Crown and Tubing Hanger plugs. With the plugs removed, valves in the SSTT are used to control flow from the well. They become the primary well control barrier until the wireline plugs are replaced.

The purpose of the subsea test tree (SSTT) is to provide well barriers within the high pressure upper completion string, and to facilitate well control in the event of an emergency disconnection of the rig from the well, without requiring the blowout preventer (BOP) to shear the shear joint.

The SSTT should be composed of two major parts:

The lower part (below the emergency disconnect latch) remains attached to THRT and contains a minimum of two barriers in the production fluid conduit capable of containing the anticipated well shut-in pressure from below.

The upper valve is strongly preferred to be a flapper type valve. A ball type valve in this position will be considered. The lower valve should be a ball valve capable of cutting wireline and coiled tubing.

The SSTT valves should be fail safe close. In the failed closed condition the barriers and the cutting device should permit the passage of kill fluid at a suitable flow rate into the well, so that

the well can be killed by bullheading in the event of a total failure of the SSTT or its control system. This feature is commonly known as 'pump through' capability.

The upper part of the SSTT (above the emergency disconnect latch) should be capable of disconnection from the lower part of the SSTT and retrieval to the surface, and should be provided with hydraulic connections to suit the attachment of the hydraulic hoses surrounding the shear joint. The unlatch operation should be operable without altering the rig top tension. The unlatch function should be fail-as-is.

Ensure there is a retainer valve to prevent unlatching under tension that may cause the upper SSTT to jump, and may damage the interface when it lands on the lower half.

So, who has what? In alphabetical order the following gear is available:

Enovate Systems Ltd – Enpower 7 – 7.3875” ID, Enpower 5 – 5.125” ID

<http://www.enovate.com/system/landing-string/>

Expro Group – ELSA-EA - 3” ID, ELSA-HD - 6.75” ID, ELSA-HP - 6.045” ID, ELSA-LB – 7.3875” ID, NGLS - 7.3875” ID

<https://www.expro.com/products-services/subsea/subsea-test-tree-assemblies/next-generation-landing-string>

Halliburton - Veto 3 - 3” ID, Veto 6 – 6.3875” ID, Veto 7 – 7.3875” ID

<https://www.halliburton.com/en/products/veto-subsea-safety-systems-landing-strings>

Interventek Subsea Engineering – In Riser LS – 5.1875” ID, In Riser LS – 6.3875” ID, In Riser LS – 7.3875” ID

<https://www.interventek.com/systems/in-riser-landing-string-system>

PRT Offshore – Landing String Assembly – 7.3875” ID

<https://prt offshore.com/subsea-landing-string-2/>

Production Technology & Services – MODUtree Landing String Assembly & MODUtree SSTT – 3” ID

<http://pts-technology.com/en/technology/22-x/>

Schlumberger - Sentree 3 – 3” ID, Sentree 7 – 7.375” ID, Sentree HP (15k psi) – 6.375” ID, Sentree 20k psi - no product sheet yet available

<https://www.slb.com/well-intervention/subsea-intervention/subsea-landing-string-services>

TechnipFMC – Landing String Assembly - 7.0625” ID

<https://www.technipfmc.com/media/t4hhewyc/landingstringsystem-brochure-web.pdf>

United Subsea Specialists - USS Submarine 15m - 6.25” ID

<https://unitedsubsea.com/>

In addition to downhole equipment, surface flow package, hydraulic power unit, & controls PRT Offshore & United Subsea Services also provide CTLF and deployment equipment.

Also worth mentioning as they have been a mainstay in this business for quite a number of years, Advanced Tool & Supply provide surface flow package, CTLF, & High Pressure Debris Unit.

[http://advtoolinc.com/deep\\_water.html](http://advtoolinc.com/deep_water.html)

Additionally in this general space Optime Subsea Services in partnership with Halliburton offer Remote Operated Completion System (ROCS) which gives you the ability to land your completion without an umbilical.

ROCS removes the requirements for reelers, control umbilicals, and hydraulic pressure units (HPU), which drives increased operational safety and efficiency, reduced rig footprint, and smaller crew size for offshore operations. The in-riser ROCS module is remotely controlled topside using an advanced telemetry control unit in conjunction with Halliburton’s DynaLink® Wireless Acoustic Telemetry System. ROCS provides improved digital functionality through a custom Human Machine Interface (HMI), without the use of traditional surface controls.

<https://www.halliburton.com/en/products/rocs-remotely-operated-control-system>

Last, but certainly not least also from Optime Subsea Services, the Subsea Controls and Intervention Light System (SCILS). SCILS is an industry first, field-proven closed-loop subsea controls unit complete with redundant subsea pumps, control modules, and a hydraulic reservoir.

SCILS is perfectly suited for well interventions and workover systems, providing intervention workover control (IWOC) services during initial subsea production Xmas Tree (XT) commissioning, interventions, or plug and abandonment (P&A) operations, in an extremely light/compact package

SCILS can be run off service vessels and rigs and can be temporarily deployed or permanently installed, without any modification or interfaces.

<https://www.halliburton.com/en/products/scils-subsea-controls-intervention-light-system>