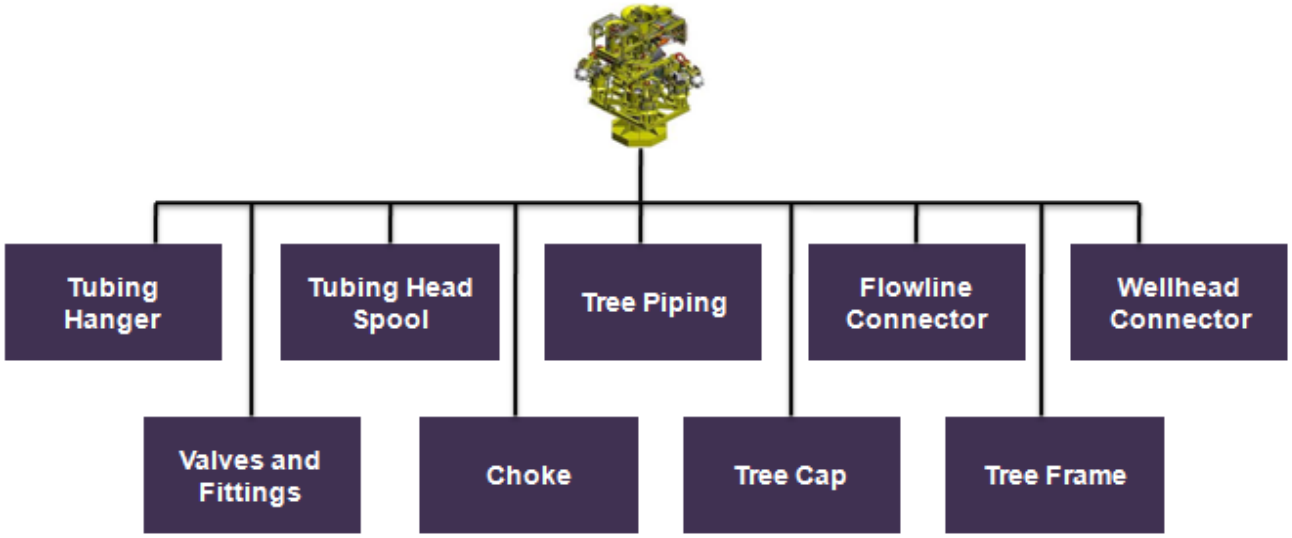
Introduction to Subsea Xmas Tree – Part 3

Main Component of XT System

Typical main components in an XT assembly required to perform its functions is shown diagrammatically below.



The Tubing Hanger (TH) provides means of communication between the XT and the downhole hydraulic and electric functionalities. Wet mate couplers / connectors are located on the top and bottom of the hanger and engage with the XT and downhole equipment

Tubing Hanger (TH)

The Tubing Hanger (TH) system is designed to suspend and seal the downhole tubing. Installation is with BOP stack and locked into the internal landing profile of either the casing hanger in the wellhead, the tree bore or in the THS.

Main configurations are dual bore or mono bore TH. The monobore TH only have a production bore, with the annulus rounded around the bore. The dual bore TH is designed with a main production bore and an annulus.

TH Monobore Configuration – Courtsey GE

Reference

Bai,Y.,& Bai,Q.(2012).Subsea Engineering Handbook.Gulf Professional Publishing.

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Wellhead Connectors

The wellhead connectors are the mechanism to lock and seal a Xmas Tree to the Wellhead, Xmas Tree to the Tubing Head Spool and Tubing Head Spool to the Wellhead. The connectors maybe both mechanical and pressure connections. If remote operated, it may be hydraulically actuated. If not remote, divers can actuate the screws in the mechanical connections.

Two types of tree connectors exist:

- H4 connector
- Collect connector

The H4 connector is the most commonly used connectors. It is a hydraulically actuated connector applicable for H4 type of wellhead profiles.

Flow Control Module - FCM

A Flow Control Module (FCM) is often included in an XT assembly. A FCM on XT enables partly standardization by integrating the custom and field specific components into the retrievable module. This gives the advantage of packing less reliable components into the FCM for easy retrieval such as the choke, sensors and the Wet Gas Flow Meter (WGFM).

With the field specific components into the retrievable FCM, the XT can easily be converted from a production XT into an injection XT by switching out the FCM.

Valves

Tree valves are designed in the XT assembly to control and safely stop fluid flow. The various valves are used for servicing, testing and regulating oil, gas, water or chemicals.

The most common types of valves in a XT is a gate valve. Gate valves are operated either hydraulically, mechanically and or by remote operated vehicles (ROVs). XT valves are designed, fabricated and tested in accordance with API 17D, API 6A and API 6D.

All main valves are power operated fail safe closed valves. Swab and control valves are fail ‘’as it is’’ due to production regulations.

Typical valve sizes include:

- Production and Injection valves (typ. 5-7” gate valve) for controlling the process medium.
- Annulus or Injection Valve (typ. 2” gate valve) for annulus access.
- Service valves (typ. 3/8” gate valve) for chemical injection.
- Isolation valves (typ. 3/8”to 1”) for pressure test and downhole lines.
- Check valves (typ. 1/2”- 1”) for preventing back-flow of well fluid to service lines.

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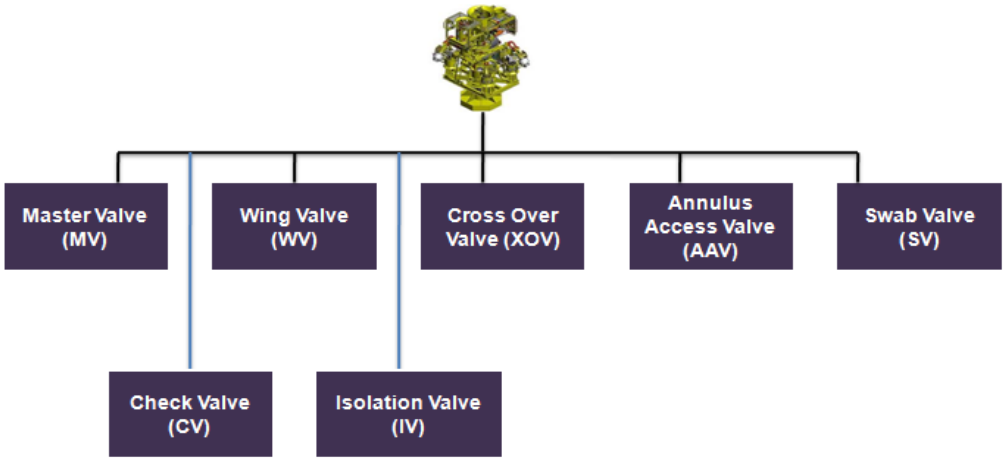
Types of XT Valves



Annular Master Valve - AMV

Master valve is used to completely shut down the production tubing and / or the annulus. The Production Master Valve (PMV) is situated between the production bore and the wellhead while the Annular Master Valve (AMV) is situated at the bore into the annulus. The AMV is used to shut down any injection or production in annulus i.e. gas lift and pressure monitoring.

Wing Valve – WV

Primary Wing valve (PWV) controls the production of hydrocarbons. Annulus Wing Valve (AWV) controls injection of fluids or gas for reservoir control or the annulus bore. If necessary to shutdown fluid stream through the well, the wing valves are the first valves to close.

Tree Cap

Note: The WVs is located downstream of the PMV and the AMV respectively.

An ROV operable tree cap provides the secondary barrier during operation. It is designed to prevent fluid from leaking into the environment and to protect the equipment against dropped objects that may cause damage to the equipment. The tree cap is landed and locked into the tree head via dog interface in the production bore.

Crossover Valve (XOV)

Allows communication between the annulus and the production bore via a crossover service line, which is normally isolated. XOV might be used for fluid passage, for well kill operations or to overcome obstructions caused by hydrate formation and pressure-build up.

Annular Access Valve (AAV)

AAV is used together with the AMV to equalize the pressure between the upper and the lower space of the tubing hanger during normal production operation.