HORIZONTAL SPOOL TREE WELLHEAD SYSTEM AND METHOD

Field of the Invention

This invention relates generally to a subsea wellhead system for use in the drilling and completion of oil or gas wells at substantial depths beneath the water surface and, more particularly, to a wellhead system with a horizontal spool tree.

Background of the Invention

Conventional wellhead system includes a wellhead housing mounted on the upper end of a subsurface casing string extending into the well bore. A riser and blowout preventer (BOP) are then installed. During the drilling procedure, the BOP is installed above a wellhead housing (casing head) to provide pressure control as casing is installed, with each casing string having a hanger on its upper end for landing on a shoulder within the wellhead housing. Upon completion of this process, the BOP is replaced by a Christmas tree installed above the wellhead housing, with the tree having a valve to enable the oil or gas to be produced and directed into flow lines for transportation to a desired facility.

In accordance with a relatively recent development in this field, the conventional casing and tubing heads making up the Christmas tree are replaced by a horizontal tree which comprises a spool with a generally horizontal through port mounted above and in axial alignment with a horizontal through port in the wellhead housing. In this application, the hangers for the casing strings are supported one above the other within the bore of the wellhead housing, and the tubing hanger for the production or tubing string is supported in the bore of the spool to suspend the production string within the casing strings.

The vertical bore through the tubing hanger of a horizontal tree may be closed by a wire line tool to direct production fluid through aligned side ports (generally horizontal through ports) in the hanger and spool for recovery and delivery of

production fluid to a suitable location. A redundant seal may be provided by a well cap installed in the tree above the tubing hanger, with the vertical bore aligned with that of the tubing hanger closed by a wire line plug to permit vertical access to the production tubing string upon removal of the plug.

The completion of a well with a horizontal tree conventionally includes an isolation/orientation sleeve which is installed within the tree bore in order to isolate and thus allow testing from the exterior of a metal seal between the adjacent ends of the wellhead housing and spool. A portion of the sleeve also carries a guide tube with an upwardly contoured guide surface positioned to cooperate with a lug on the tubing hanger to rotate the tubing hanger into a desired position as it is lowered onto a shoulder in the bore of the spool. This technique automatically aligns the side port in the hanger with the side port in the tree bore.

A BOP stack then is lowered onto the upper end of the spool with a bore in alignment with the spool bore, and a tubing hanger then lowered through the BOP and into the spool bore. A lug on the lower end of the hanger cooperates with the guide surface to orient the hanger into a proper landed position on a seat in the bore of the spool. A tree cap is then lowered into a landed position, following which the BOP may be removed to permit installation of a cover on the top of the tree.

More particularly, the complete drilling and completion operation involves lowering a wellhead housing at the upper end of a production casing string onto an outer housing at the upper end of a conductor casing surrounding the production casing string. The conductor casing and housing at its upper end conventionally have been lowered onto the ocean floor to suspend the production casing string within a well bore by means of a permanent base having guide posts, using cables extending to the surface.

The wellhead housing is lowered with the casing by a running tool on a drill pipe into the upper end of a BOP whose lower end is connected to the wellhead housing by means of a releasable connector, with the bores of the wellhead housing,

the BOP and drill pipe in axial alignment. The BOP is normally of the ram type well known in the art and having a stack including at least one pipe ram and at least one blind ram. The upper outer diameter of the wellhead housing may have grooves thereabout to receive teeth of the releasable latch of the connector.

An outer casing hanger on the upper end of the casing may be lowered for landing onto a shoulder in the bore of the wellhead housing to suspend it within the conductor casing. An inner casing hanger in turn may be lowered into a landed position on the outer casing hanger to suspend an inner production casing within the casing. The hangers and the strings on which they are mounted may thus be lowered into the well on running strings through the riser and BOP bore.

A wear bushing may then be lowered through the riser and BOP for landing with its bore aligned with that of the casing hanger and extending upwardly within the bore of the wellhead housing so as to prevent wear on the seal at the upper bore of the wellhead housing during drilling of the production well. The lower portion of this bore is aligned with the bore of the upper casing hanger, while the upper end is enlarged to provide a tapered seat at its lower end. Each of the casing hangers and the wear bushings are releasably locked in place and the outer diameters of the hangers are sealed with respect to the bore of the wellhead housing.

At this stage, the wear bushing may be raised by a suitable running tool, and the BOP and connector at its lower end are released from the upper end of the wellhead housing and raised to the surface to enable the spool of a horizontal tree to be lowered on a running tool releasably connected to its upper end. The tree may then be guidably lowered onto the upper end of the wellhead housing by means of sleeves lowered over the guide posts. The tree may be releasably connected at its lower end to the upper end of the wellhead housing. Thus, the connector has latches on its lower end which move over the upper end of the housing for locking thereto with their bores aligned.

Upon landing of the horizontal tree on the wellhead housing, a lower end of an orientation sleeve in the tree moves into the upper enlarged end of the casing hanger to form a continuation of the bore therethrough. This lower end of the orientation sleeve carries a seal assembly for sealing between it and the upper enlarged bore of the casing hanger. A seal which was lowered with the upper casing hanger seals off the annulus between the casing hanger and well bore housing. A metal seal ring is carried by the tree to land upon and form a seal with a tapered seat on the inner diameter of the upper end of the bore of the housing so as to be energized as the tree is connected to the housing by a connector.

The upper portion of the bore through the horizontal tree may be enlarged to receive an elongated wear bushing which is lowered with the tree to land on an intermediate shoulder in the upper enlarged bore of the tree. The wear bushing has an inner diameter somewhat less than that of the bore of the tree so as to prevent wear on the seal surfaces of the tree bore as tools are lowered into and raised from the well bore during drilling of the hole to receive the tubing.

In accordance with one of its functions, the sleeve isolates the metal seal ring to permit the ring to be tested from the outside of the tree. In addition, the sleeve has an upwardly extending guide surface which cooperates with a lower guide surface on a tubing hanger to orient the tubing hanger into a desired rotational position as it is lowered into the tree bore. Thus, for horizontal trees of this type, a side port in the tubing hanger is aligned with side port in the tree to direct production fluid to a flow line.

In accordance with horizontal tree practices, a first plug is lowered on a wire line and locked within the upper end of the hanger bore above its side port, and a tree cap that may contain another wire line plug is lowered into and locked within the bore of the tree. The BOP is then removed and replaced by a protective cover which is axially aligned and rotationally oriented into a position over the upper end of the tree.

The conventional procedure for installing a horizontal tree on a subsea wellhead involves the installation and the removal, and the subsequent reinstallation, of the BOP stack. U.S. Patents 5,465,794; 5,544,707; 5,555,935; 6,062,314 and 6,039,119 disclose different equipment for horizontal tree applications. Each such installation is time consuming and expensive.

The present invention provides an improved horizontal spool tree wellhead system and method in which only one installation of the BOP stack is required. The disadvantages of the prior art are overcome by the present invention, and improved horizontal spool tree wellhead system and method are hereinafter disclosed which does not require repeated installation and removal of the BOP stack.

Summary of the Invention

In accordance with a first aspect of the present invention, there is provided a method of drilling and completing a subsea production well with a casing installed in the wellbore and a wellhead housing having a wellhead housing bore installed on the upper end of the casing, the method of comprising: lowering a spool of a horizontal tree into connection with an upper end of the wellhead housing, the spool having a spool bore and at least one spool side port extending radially from the spool bore; installing a BOP at the upper end of the spool, the BOP having with a BOP bore aligned with the spool bore and the wellhead housing bore; drilling a first hole with a first bit having first cutting diameter by passing the first bit through the BOP and the tree spool; lowering a casing string carrying a casing hanger through the bores of the BOP and the spool tree and landing the casing hanger in the wellhead housing; after lowering the casing string, drifting at least one second note with a second bit having a second cutting diameter less than the first cutting diameter by passing the second bit through the BOP, the tree spool, and at least a portion of the casing string; and thereafter installing an orientation sleeve between the wellhead housing and the spool, the orientation sleeve having a predetermined rotational orientation with the spool of the tree.

In accordance with a second aspect of the present invention, there is provided a system for drilling and completing a subsea production well with a casing installed in the well bore and a wellhead housing having a wellhead housing bore installed on the upper end of the casing, the drilling operation including drilling a hole with a drill bit having a cutting diameter, the system comprising: a horizontal spool tree connected with an upper end of the wellhead housing, the spool tree having a spool with a spool bore and at least one spool side port extending radially from the spool bore; a BOP connected with the upper end of the spool tree and having BOP bore aligned with the spool bore and the wellhead housing bore; a casing string supported on a casing hanger within the bore of the wellhead housing; an orientation sleeve between the wellhead housing and the spool, the orientation sleeve having a predetermined rotational orientation with the spool and an internal diameter less than the cutting diameter of the drill bit; and a tubing hanger having a side port extending radially from a tubing hanger central bore for landing on the orientation sleeve and rotationally oriented by the orientation sleeve to align the tubing hanger side port with the spool side port.

In accordance with a third aspect of the present invention, there is provided a method of drilling and completing wells with a casing installed in the wellbore and a wellhead housing having a wellhead housing bore installed on the upper end of the casing, the method comprising: lowering a spool of a horizontal tree into connection with an upper end of the wellhead housing, the spool having a spool bore and at least one spool side port extending radially from the spool bore; installing a BOP at the upper end of the spool, the BOP having a BOP bore aligned with the spool bore and the wellhead housing bore;

drilling a first hole with a first bit having a first cutting diameter by passing the first bit through the BOP and the spool on the wellhead; lowering a casing string carrying a casing hanger through the bores of the BOP, the spool and the wellhead housing into the first hole; landing the casing hanger on a shoulder within the wellhead housing; drilling a second hole with a second bit having a second cutting diameter lees than the first cutting diameter by passing the second bit through the BOP and the spool on the wellhead, through the casing hanger and at least a portion of the casing string; thereafter installing an orientation sleeve between housing bore and the tree bore, the orientation sleeve having in a predetermined rotational orientation with the spool of the tree; and lowering a tubing hanger having a side port extending radially from a tubing hanger central bore for landing on the orientation sleeve and rotationally oriented by the orientation sleeve to align the tubing hanger side port with the spool side port.

In accordance with a fourth aspect of the present invention, there is provided a method of drilling and completing a subsea production well with a casing installed in the wellbore and a wellhead housing having wellhead housing bore installed on the upper end of the casing, the method comprising: lowering a spool of a tree into connection with an upper end the wellhead housing, the spool having a spool bore along substantially its axial length greater than the wellhead housing bore below the spool; installing a BOP at the upper end of the spool, the BOP having a BOP bore aligned with the spool bore and the wellhead housing bore; drilling a first note with a first bit having first cutting diameter by passing the first bit through the BOP and the spool; lowering a casing string carrying a casing hanger through the bores of the BOP and the spool tree and landing the casing hanger in the bore of the wellhead housing; drilling a second note with a second bit having a second cutting diameter less than the first cutting diameter by passing the second W through the BOP, the tree spool, and at least a portion of the casing string; and lowering a tubing string carrying a tubing hanger through the bore of the BOP, and landing the tubing hanger in the bore of the spool.

In accordance with a fifth aspect of the present invention, there is provided a system for drilling and completing a subsea production well with a casing installed in the well bore and a wellhead housing having a wellhead housing bore installed on the upper end of the casing, the system comprising: a spool of a tree connected with an upper end of the wellhead housing, the spool having a spool bore along substantially its axial length greater than the wellhead housing bore below the spool;

a BOP connected with the upper end of the spool and having BOP bore aligned with the spool bore and the wellhead housing bore; a first casing string supported on a first casing hanger landed on a shoulder within the bore of the wellhead housing; a second casing string supported on a second casing hanger landed on the first casing hanger within the bore of the wellhead housing; and a tubing string supported on a tubing hanger landed within the spool bore.

In example embodiments, the size of the drill bit for drilling the large diameter hole is not restricted by the tree bore, which may be the full bore of the wellhead. In example embodiments, a drill bit at the end of a drill string passes through the BOP through the tree and wellhead housing, and into the formation to drill the casing hole. Also, the size of the bit used to drill the production hole need not be restricted by the orientation sleeve. The orientation sleeve may have an internal diameter substantially less than the cutting diameter of the drill bit used to drill the production hole, since the orientation sleeve is installed after drilling the production well. A sleeve-shaped subsea tree bore protector may be provided within the bore of the tree while drilling the well, and may be removed prior to installing the orientation/isolation sleeve.

In example embodiments, the orientation/isolation sleeve seals at its lower end to a casing hanger and its upper end to the tree. This sleeve preferably includes an upper guide surface for engagement with the tubing hanger to orient me tubing hanger with respect to the tree. The orientation sleeve also is preferably fixed to the tree to resist vertical and rotational forces applied to the orientation/isolation sleeve.

The tubing hanger preferably includes a fluid production port which extends laterally from the central tubing hanger bore for producing fluids from production tubing extending from the tubing hanger into the production well. During completion, an internal tree cap may be positioned above the production tubing hanger and secured to the tree. One plug may be positioned within a central bore of the tubing hanger, and another plug positioned within a central bore of the tree cap.

The casing hanger is preferably landed on a shoulder within the wellhead housing. The orientation sleeve preferably extends from within the wellhead housing into the spool bore of the horizontal tree, while the tubing hanger is positioned within the spool bore of the tree and is supported on the orientation sleeve. A conventional BOP stack may thus be used above the tree.

These and further features, and advantages of example embodiments will become apparent from the following detailed description, wherein reference is made to the figures in the accompanying drawings.

Brief Description of the Drawings

Figures 1-4 illustrate the improved procedure in accordance with this invention for drilling and completing a well. In the figures, the steps of the procedure are numbered sequentially.

Figure 1 illustrates a horizontal spool tree wellhead system according to the present invention, with a tree as shown in dashed lines installed on a wellhead housing, and a BOP stack shown in dashed lines positioned above the tree. Conventional tree components and the BOP stack are thus illustrated in dashed lines, with a drill-through tree bore protector lining an interior of the bore through the tree.

Figure 2 illustrates an outer casing hanger landed in the wellhead housing, and an inner casing hanger landed on the outer casing hanger, with both hangers being positioned within the wellhead housing. Bach hanger supports a respective casing which extends downward into the well.

Figure 3 illustrates an orientation/isolation sleeve installed on the inner casing hanger, with the isolation sleeve including a tapered upper guide surface.

Figure 4 shows a tubing hanger landed on the isolation sleeve and oriented with respect to the tree by the upper guide surface on the orientation/isolation sleeve.

Detailed Description of Preferred Embodiments

Figure 1 illustrates the first stage of operation with the improved system in accordance with the present invention, wherein a horizontal tree 22 has been guidably lowered on a running tool (not shown) onto the upper end of the wellhead housing 20. When so lowered, the tree 22 is releasably connected with the upper end of the wellhead housing 20 by a connector 26. A metal seal ring 24 carried in the lower end of the bore lands upon a taper on the upper end of the housing 20, and is caused to seal with the tree 22 upon makeup through the subsea connector 26. As shown in Figure 1, an outer casing 16 may be supported on an outer casing housing 11, which in turn is fixed to the guide base 14 configured for landing the tree 22 onto the guide base. The inner casing 12 is supported on the inner casing housing 20 discussed above. Conventional tether lines 18 may be used for lowering and landing the tree 22 onto the guide base 14.

Referring still to Figure 1, the running tool has been removed and a BOP stack 28 has been lowered onto the upper end of the tree 22 for releasable connection thereto by means of another releasable connector. At this time, the system is prepared for drilling therethrough, with the outer casing 10 and the inner casing 12 suspended within the well bore. For this purpose, the bore at the upper end of the tree is preferably protected by a protector sleeve 40 landed and held down on a shoulder of the tree. The large diameter hole which subsequently may receive the casing strings 18 and 19, as shown in Figure 2, may thus be drilled into a subsea formation with a large diameter bit 90 as shown in Figure 1 at the lower end of drill string 92. The bit 90 may have a cutting diameter which is only slightly less than the internal diameter

of the housing 20, since the bore through the tree 22 preferably is at least as large as the most restrictive bore through wellhead 20.

After drilling of the large diameter hole, a casing hanger 38, as shown in Figure 2 for supporting the casing string 18 may be landed on a shoulder 39 in the bore of the housing 20, and a hanger 42 for the inner casing string 19 may be landed on the hanger 38, or alternatively the hanger 42 may land on the hanger 38 and/or a shoulder on housing 20. With the BOP and drilling riser still in place, a wear bushing (not shown) having a diameter less than the sleeve 40 may be lowered on a running tool into the bore of the tree and landed on the upper end of the hanger 42 for axial extension through the bore of the tree and into the bore of the housing 20. The lower end of the wear bushing may fit closely within and seal with the enlarged upper end of the upper casing hanger 42. In this position, the wear bushing, like the protector sleeve 40, covers the production port 50 in the left side of the spool 23, and the upper and lower ports 52, 54 in the right side of the tree spool.

Following drilling of another hole to receive a production tubing string, the wear bushing and the protector sleeve 40 are removed, as shown in Figure 3. With the BOP and drilling riser still in place, an orientation/isolation sleeve 60 is then lowered into the bore of the tree 22 and oriented, landed and locked down to the tree above the upper casing hanger 42, as shown in Figure 3. Various mechanisms may be used to orient the sleeve 60 with respect to the tree 22, including an orientation key on the sleeve that fits within a groove in the casing hanger 42. A lower extension 62 of the sleeve 60 extends into and is locked to the enlarged upper end of the upper casing hanger 42, while the upper end 64 of the sleeve seals with the tree spool 23. In this position, the orientation sleeve 60 thus seals with the bores of the tree and wellhead housing to isolate the metal seal ring 24 and thus provide two pressure barriers. One or more lock down mechanisms 66 may be used to axially secure the orientation sleeve to the spool 23.

The upper end 64 of the orientation sleeve 60 does not block access to the side ports 52, 54 in the tree bore, so that a production tubing hanger 70, as shown in Figure 4, may be lowered through the drilling riser and the BOP 28 to land on the upper end of the orientation/isolation sleeve 60, as shown in Figure 4, in which position a key or lug on the upper tubing hanger engages the tapered guide surface 72 on the orientation sleeve 60, so that the key moves into a vertical locking slot in the sleeve 60. In this position, a shoulder on the tubing hanger lands on a shoulder of the sleeve 60 and is held down in the bore of the tree 22.

A production tubing will thus be suspended from the tubing hanger 70 and passed through the orientation/isolation sleeve 60 and into the production well bore. More particularly, the drilling and completion system has reached the same stage as discussed above in connection with the prior art without having to remove the BOP and drilling riser.

The well may thus be completed in essentially the same way as described above. A tree cap 74, as shown in Figure 4, has been lowered through the riser and BOP and installed in the tree bore above the tubing hanger, with its bore aligned with that of the tubing hanger of the subsea tree. Plugs 76 and 78 are installed in the tree cap and bore of the upper tubing hanger. The completed assembly 10 is thus shown in Figure 4. The riser and BOP may then be removed, and the upper end of the bore of the subsea horizontal tree 22 closed by the protective cover.

The tree 22 and spool 23 may include one or more side ports leading to various conduits and controlled by valves to permit various workover tests and other functions to be performed, as shown and described in U.S. Patent No. 5,544,707. Alternatively, the tree may be constructed in accordance with one or more of those shown and described in provisional application Serial No. 60/295,857, entitled "HORIZONTAL TREE," filed May 25, 2001, and in utility application Serial No. 10/155,482 filed May 24, 2002, entitled "HORIZONTAL SPOOL TREE ASSEMBLY." Thus, the tree 22 may have different conduit connections with its side port or ports. From the

descriptions of the present invention as discussed above, its advantages are attained regardless of the type of horizontal tree.

A significant advantage of this invention is that the bore through the horizontal spool of the tree may be at least as large as the most restrictive diameter of the bore through the wellhead. Accordingly, the size of the large diameter well is only restricted by the bore size of the wellhead, even though the tree is already in place on the wellhead when drilling this large diameter well. The maximum bore of the tree is thus significantly greater than the bore through the one or more casing hangers, which is unlike the prior art operation wherein the BOP was removed and the tree first installed after the casing hangers were hung in the well.

Another significant advantage of the present invention is that the orientation/isolation sleeve need not be installed until just prior to running the tubing string in the well, and after drilling the portion of the hole intended to receive this tubing string. Accordingly, the bore through the tree is not restricted by an orientation/isolation sleeve while the production tubing well is being drilled. By running the sleeve in after the drilling operation is complete, a highly reliable orientation/isolation sleeve may be used. The present invention thus makes possible the drilling of a production well for receiving the production tubing string wherein the bit diameter used to drill the production hole is not restricted, and may be only slightly less than the diameter of the casing hanger, and only slightly less than the diameter of a protector sleeve provided within the spool 23. Referring to Figures 2 and 3, for example, Figure 2 depicts a bit 94 suspended on a drill string 96 which may be passed through the tree 22 and through the casing hangers 38 and 42 to drill a production hole. The cutting diameter or bit diameter BD of the bit 94 as shown in Figure 2 may thus be greater than the bore diameter SD of the orientation sleeve 60 as shown in Figure 3, which again is not possible in the prior art technique since the orientation sleeve was installed with the tree before drilling the production hole.

The orientation/isolation sleeve as disclosed herein may be a single sleeve that achieves three purposes: (1) sealing between the casing hanger (or the wellhead) and the tree, (2) providing orientation for the tubing hanger so that the side port of the tubing hanger is properly oriented with respect to the side port in the spool, and (3) securing the orientation sleeve to the tree to resist vertical forces, either upward or downward, that may be imparted to the orientation sleeve. If desired, separate components could be used to perform each of these functions. Orientation of the tubing hanger could be achieved with a device separate from the function of sealing between the casing hanger and the tree. In many applications, it will be desirable to lock the sleeve to the tree, although in other applications the sleeve could be locked to the wellhead housing, or could be axially fixed between the casing hanger locked to the wellhead housing and the tubing hanger locked to the tree. In most applications, other functions of the orientation/isolation sleeve are to support the weight of the tubing hanger and thus the tubing string, and to safely withstand the fluid pressure levels in the tree.

While preferred embodiments of the present invention have been illustrated in detail, it is apparent that modifications and adaptations of the preferred embodiments will occur to those skilled in the art. However, it is to be expressly understood that such modifications and adaptations are within the spirit and scope of the present invention as set forth in the following claims.

Claims

1. A method of drilling and completing a subsea production well with a casing installed in the wellbore and a wellhead housing having a wellhead housing bore installed on the upper end of the casing, the method of comprising:

lowering a spool of a horizontal tree into connection with an upper end of the wellhead housing, the spool having a spool bore and at least one spool side port extending radially from the spool bore;

installing a BOP at the upper end of the spool, the BOP having with a BOP bore aligned with the spool bore and the wellhead housing bore;

drilling a first hole with a first bit having first cutting diameter by passing the first bit through the BOP and the tree spool;

lowering a casing string carrying a casing hanger through the bores of the BOP and the spool tree and landing the casing hanger in the wellhead housing;

after lowering the casing string, drilling at least one second hole with a second bit having a second cutting diameter less than the first cutting diameter by passing the second bit through the BOP, the tree spool, and at least a portion of the casing string; and

thereafter installing an orientation sleeve between the wellhead housing and the spool, the orientation sleeve having a predetermined rotational orientation with the spool of the tree.

2. A method of drilling and completing a subsea production well as defined in Claim 1, further comprising:

thereafter lowering a tubing hanger having a side port extending radially from a tubing hanger central bore for landing on the orientation sleeve and rotationally oriented by the orientation sleeve to align the tubing hanger side port with the spool side port.

3. A method of drilling and completing the subsea production well as defined in Claim 2, further comprising:

positioning a sleeve-shaped subsea tree bore protector within the bore of the spool when drilling at least one of the first hole and the second hole.

4. A method of drilling and completing a production well as defined in Claim 3, further comprising:

removing the subsea tree bore protector before installing the orientation sleeve.

5. A method of drilling and completing a subsea production well as defined in Claim 1, further comprising:

sealing the orientation sleeve at its lower end to the casing hanger and at its upper end to the spool.

6. A method of drilling and completing a subsea production well as defined in Claim 1, wherein the orientation sleeve includes an upper guide surface for engagement with the tubing hanger to orient the tubing hanger with respect to the tree.

7. A method of drilling and completing a subsea production well as defined in Claim 1, further comprising:

fixing the orientation sleeve to the tree to resist vertical and rotational forces applied to the orientation sleeve.

8. A method of drilling and completing a subsea production well as defined in Claim 1, wherein the tubing hanger includes a fluid production

port extending laterally from the central tubing hanger bore for producing fluids from production tubing extending from the tubing hanger into the well.

9. A method of drilling and completing a subsea production well as defined in Claim 1, further comprising:

positioning an internal tree cap above the tubing hanger and secured to the tree.

10. A method of drilling and completing a subsea production well as defined in Claim 9, further comprising:

positioning at least one plug within the central tubing hanger bore, and positioning another plug within a central bore of the tree cap.

11. A method of drilling and completing a subsea production well as defined in Claim 1, wherein the casing hangar is landed on a shoulder within the wellhead housing.

12. A method of drilling and completing a subsea production well as defined in Claim 1, wherein the orientation sleeve extends from within the wellhead housing into the spool bore of the spool with an upper end below the spool side port.

13. A method of drilling and completing a subsea production well as defined in Claim 1, wherein the tubing hanger is positioned within the spool bore of the tree and is supported on the orientation sleeve.

14. A system for drilling and completing a subsea production well with a casing installed in the well bore and a wellhead housing having a wellhead housing bore installed on the upper end of the casing, the drilling operation including drilling a hole with a drill bit having a cutting diameter, the system comprising:

a horizontal spool tree connected with an upper end of the wellhead housing, the spool tree having a spool with a spool bore and at least one spool side port extending radially from the spool bore;

a BOP connected with the upper end of the spool tree and having BOP bore aligned with the spool bore and the wellhead housing bore;

a casing string supported on a casing hanger within the bore of the wellhead housing;

an orientation sleeve between the wellhead housing and the spool, the orientation sleeve having a predetermined rotational orientation with the spool and an internal diameter less than the cutting diameter of the drill bit; and

a tubing hanger having a side port extending radially from a tubing hanger central bore for landing on the orientation sleeve and rotationally oriented by the orientation sleeve to align the tubing hanger side port with the spool side port.

15. A system for drilling and completing a subsea production well as defined in Claim 14, further comprising:

a sleeve-shaped subsea tree bore protector within the bore of the tree for protecting the spool tree while drilling the hole.

16. A system for drilling and completing a subsea production well as defined in Claim 14, further comprising:

a lower seal for sealing between the orientation sleeve and the casing hanger; and

an upper seal for sealing between the orientation sleeve and the spool.

17. A system for drilling and completing a subsea production well as defined in Claim 14, where the orientation sleeve includes an upper guide surface for engagement with the tubing hanger to orient the tubing hanger with respect to the tree.

18. A system for drilling and completing a subsea production well as defined in Claim 14, further comprising:

a connector for fixing the position of the orientation sleeve to the tree to resist vertical and rotational forces applied to the orientation sleeve.

19. A system for drilling and completing a subsea production well as defined in Claim 14, wherein the tubing hanger includes a fluid production port extending laterally from the central tubing hanger bore for production fluids from production tubing extending from the tubing hanger into the production well.

20. A system for drilling and completing a subsea production well as defined in Claim 14, further comprising:

an internal tree cap positioned above the tubing hanger and secured to the tree.

21. A system for drilling and completing a subsea production well as defined in Claim 20, further comprising:

at least one plug within the central tubing hanger bore; and

another plug within a central bore of the tree cap.

22. A method of drilling and completing wells with a casing installed in the wellbore and a wellhead housing having a wellhead housing bore installed on the upper end of the casing, the method comprising:

lowering a spool of a horizontal tree into connection with an upper end of the wellhead housing, the spool having a spool bore and at least one spool side port extending radially from the spool bore;

installing a BOP at the upper end of the spool, the BOP having a BOP bore aligned with the spool bore and the wellhead housing bore;

drilling a first hole with a first bit having a first cutting diameter by passing the first bit through the BOP and the spool on the wellhead;

lowering a casing string carrying a casing hanger through the bores of the BOP, the spool and the wellhead housing into the first hole;

landing the casing hanger on a shoulder within the wellhead housing;

drilling a second hole with a second bit having a second cutting diameter less than the first cutting diameter by passing the second bit through the BOP and the spool on the wellhead, through the casing hanger and at least a portion of the casing string;

thereafter installing an orientation sleeve between housing bore and the tree bore, the orientation sleeve having in a predetermined rotational orientation with the spool of the tree; and

lowering a tubing hanger having a side port extending radially from a tubing hanger central bore for landing on the orientation sleeve and rotationally oriented by the orientation sleeve to align the tubing hanger side port with the spool side port.

23. A method of drilling and completing the subsea production well as defined in Claim 22, further comprising:

positioning a sleeve-shaped subsea tree bore protector within the bore of the tree when drilling the second hole.

24. A method of drilling and completing a production well as defined in Claim 23, further comprising:

removing the subsea tree bore protector before installing the orientation sleeve.

25. A method of drilling and completing a subsea production well as defined in Claim 22, further comprising:

sealing the orientation sleeve at its lower end to the casing hanger and its upper end to the tree.

26. A method of drilling and completing a subsea production well as defined in Claim 22, wherein the orientation sleeve includes an upper guide surface for engagement with the tubing hanger to orient the tubing hanger with respect to the tree.

27. A method of drilling and completing a subsea production well as defined in Claim 22, further comprising:

fixing the orientation sleeve to the tree to resist vertical and rotational forces applied to the orientation sleeve.

28. A method of drilling and completing a subsea production well as defined in Claim 22, further comprising:

positioning an internal tree cap above the tubing hanger and secured to the tree.

29. A method of drilling and completing a subsea production well with a casing installed in the wellbore and a wellhead housing having wellhead housing bore installed on the upper end of the casing, the method comprising:

lowering a spool of a tree into connection with an upper end the wellhead housing, the spool having a spool bore along subetantially its axial length greater than the wellhead housing bore below the spool;

installing a BOP at the upper end of the spool, the BOP having a BOP bore aligned with the spool bore and the wellhead housing bore;

drilling a first hole with a first bit having first cutting diameter by passing the first bit through the BOP and the spool;

lowering a casing string carrying a casing hanger through the bores of the BOP and the spool tree and landing the casing hanger in the bore of the wellhead housing;

drilling a second hole with a second bit having a second cutting diameter less than the first cutting diameter by passing the second bit through the BOP, the tree spool, and at least a portion of the casing string; and

lowering a tubing string carrying a tubing hanger through the bore of the BOP, and landing the tubing hanger in the bore of the spool.

30. The method of drilling and completing a subsea production well as defined in Claim 29, further comprising:

lowering a second casing string carrying a second casing hanger through the bores of the BOP and the spool tree, and landing the second casing hanger on the casing hanger.

31. The method of drilling and completing a subsea production well as defined in Claim 29, further comprising:

installing a sleeve between the wellhead housing and the spool; and

landing the tubing hanger at an upper end of the sleeve.

32. The method of drilling and completing a subsea production well as defined in Claim 29, further comprising:

positioning a sleeve-shaped subsea tree bore protector within the bore of the spool when drilling one of the first hole and the second hole.

33. A method of drilling and completing a subsea production well as defined in Claim 29, wherein the casing hanger is landed on a shoulder within the wellhead housing.

34. A system for drilling and completing a subsea production well with a casing installed in the well bore and a wellhead housing having a wellhead housing bore installed on the upper end of the casing, the system comprising:

a spool of a tree connected with an upper end of the wellhead housing, the spool having a spool bore along substantially its axial length greater than the wellhead housing bore below the spool;

a BOP connected with the upper end of the spool and having BOP bore aligned with the spool bore and the wellhead housing bore;

a first casing string supported on a first casing hanger landed on a shoulder within the bore of the wellhead housing;

a second casing string supported on a second casing hanger landed on the first casing hanger within the bore of the wellhead housing; and

a tubing string supported on a tubing hanger landed within the spool bore.

35. A system for drilling and completing a subsea production well as defined in Claim 34, further comprising:

a sleeve extending upward from the second casing hanger, the tubing hanger landed within the spool bore at an upper end of the sleeve.

36. A system for drilling and completing a subsea production well as defined in Claim 34, further comprising:

a sleeve-shaped subsea bore protector within the bore of the spool prior to positioning the tubing hanger within the spool bore.

37. A system for drilling and completing a subsea production well as defined in Claim 34, further comprising:

an internal tree cap positioned above the tubing hanger and secured to the spool.

38. A system for drilling and completing a subsea production well as defined in claim 37, further comprising:

at least one plug within the central tubing hanger bore; and

another plug within a central bore of the tree cap.

39. A system for drilling and completing a subsea production well as defined in claim 34, further comprising:

an orientation sleeve between the wellhead housing and the spool, the orientation sleeve having a predetermined rotational orientation with the spool and an internal diameter less than the cutting diameter of the drill bit; and

a tubing hanger having a side port extending radially from a tubing hanger central bore for landing on the orientation sleeve and rotationally oriented by the orientation sleeve to align the tubing hanger side port with the spool side port.

40. A system for drilling and completing a subsea production well as defined in claim 34, wherein the orientation sleeve includes an upper guide surface for engagement with the tubing hanger to orient the tubing hanger with respect to the tree.