

AUTONOMOUS PAINTED JOINT SIMULATOR AND METHOD TO REDUCE THE TIME REQUIRED TO CONDUCT A SUBSEA DUMMY RUN

FIELD OF THE INVENTION

The present invention relates generally to subsea operations and, more specifically, to assemblies and methods utilizing a painted joint simulator to reduce the time required to conduct a dummy run in order to space out subsea test equipment within a blow-out preventer (“BOP”).

BACKGROUND

During conventional drilling procedures, it is often desirable to conduct various tests of the wellbore and drill string while the drill string is still in the wellbore. These tests are commonly referred to as drill stem tests (“DST”). To facilitate DST, a subsea test tree (“SSTT”) carried by the drill string is positioned within the BOP stack. The SSTT is provided with one or more valves that permit the wellbore to be isolated as desired, for the performance of DST. The SSTT also permits the drill string below the SSTT to be disconnected at the seabed, without interfering with the function of the BOP. In this regard, the SSTT serves as a contingency in the event of an emergency that requires disconnection of the drillstring in the wellbore from the surface, such as in the event of severe weather or malfunction of a dynamic positioning system. As such, the SSTT includes a decoupling mechanism to unlatch the portion of the drill string in the wellbore from the drill string above the wellbore. Thereafter, the surface vessel and riser can decouple from the BOP and move to safety. Finally, the SSTT typically is deployed in conjunction with a fluted hanger disposed to land at the top of the wellbore to at least partially support the lower portion of the drillstring during DST.

Before DST, however, proper positioning of the SSTT within the BOP is important so as to prevent the SSTT from interfering with operation of the BOP. In particular, if the SSTT is not correctly spaced apart from the hanger, proper functioning of the BOP rams may be inhibited. Moreover, the SSTT may be destroyed by the rams to the extent the rams are activated for a particular reason. Accordingly, a “dummy run” is conducted before DST to determine positioning of the SSTT within the BOP, and in particular the spacing of the fluted hanger from the SSTT so that the SSTT components are positioned between the BOP rams.

During conventional dummy runs, a temporary hanger with a painted pipe above it is run into the BOP, typically on jointed tubing. Once the temporary hanger lands within the BOP, the rams are closed on the painted pipe with sufficient pressure to leave marks that indicate their position relative to the landed hanger. The rams are then retracted, and the dummy string is retrieved uphole. Based upon the markings on the painted pipe, proper positioning of the SSTT within the BOP is determined and the spacing of the fluted hanger from the SSTT is accordingly adjusted at the surface to achieve the desired positioning when the SSTT is deployed in the BOP.

Although simplistic, there is at least one severe drawback to conventional dummy run operations. Making up the jointed tubing used in the dummy assembly is very time consuming. Given this, and the fact that some wells are drilled at ocean depths of up to 10,000 feet or deeper, it can take days to complete a single dummy run. At the present time, it is estimated that some floating rigs have a daily cost of upwards of 400,000 USD. Therefore, conventional dummy run operations are very expensive.

In view of the foregoing, there is a need in the art for cost-effective approaches to proper positioning of the subsea test equipment within the BOP.

SUMMARY OF INVENTION

According to a first aspect of the present invention, there is provided a method to determine placement of a subsea test tree ("SSTT") within a blow out preventer ("BOP"), the method comprising: deploying a sensing joint down through a tubular and into a BOP, the sensing joint comprising: a heavy weight fluid contained therein; and a hanger positioned along the sensing joint; landing the sensing joint adjacent the BOP using the hanger; closing at least one BOP ram upon the sensing joint, thereby providing an indication of a position of the at least one BOP ram; retracting the at least one BOP ram from the sensing joint; forcing the heavy weight fluid out of the sensing joint; allowing the sensing joint to move back up through the tubular; and determining a desired placement of an SSTT within the BOP based upon the indication of the position of the at least one BOP ram, wherein closing the at least one BOP ram upon the sensing joint further comprises utilizing a sensor along the sensing joint to detect that the hanger has seated within a landing mechanism.

According to a second aspect of the present invention, there is provided a assembly to determine placement of a subsea test tree (“SSTT”) within a blow out preventer (“BOP”), the assembly comprising: a sensing joint comprising: a first chamber housing a heavy weight fluid; and a piston configured to force the heavy weight fluid out of the sensing joint; and a hanger positioned along the sensing joint, wherein the hanger further comprises a sensor to detect when the hanger has seated in a landing mechanism.

According to a third aspect of the present invention, there is provided a method to determine placement of a subsea test tree (“SSTT”) within a blow out preventer (“BOP”), the method comprising: landing a joint within a tubular adjacent a BOP, the joint comprising a heavy weight fluid; closing at least one BOP ram upon the joint; retracting the at least one BOP ram from the joint; forcing the heavy weight fluid out of the joint; moving the joint back up through the tubular; and utilizing the joint to determine a desired placement of an SSTT within the BOP, wherein closing the at least one BOP ram upon the joint further comprises utilizing a sensor along the joint to detect that the joint has landed.

According to a fourth aspect of the present invention, there is provided a method to determine placement of a subsea test tree (“SSTT”) within a blow out preventer (“BOP”), the method comprising: deploying a joint down through a tubular and into a BOP, the joint comprising: a first umbrella assembly positioned at an upper end of the joint; and a hanger positioned along the joint; landing the joint adjacent the BOP using the hanger; closing at least one BOP ram upon the joint, thereby providing an indication of a position of the at least one BOP ram; activating the first umbrella assembly; retracting the at least one BOP ram from the joint; causing fluid to flow up the tubular and into the activated first umbrella assembly; moving the joint back up through the tubular; and determining a desired placement of an SSTT within the BOP based upon the indication of the position of the at least one BOP ram.

According to a fifth aspect of the present invention, there is provided a assembly to determine placement of a subsea test tree (“SSTT”) within a blow out preventer (“BOP”), the assembly comprising: a joint comprising: a first umbrella assembly positioned at an upper end of the joint; and a fluid communication port providing fluid communication between the first umbrella assembly and a location outside the joint; and a hanger positioned along the joint.

According to a sixth aspect of the present invention, there is provided a method to determine placement of a subsea test tree (“SSTT”) within a blow out preventer (“BOP”), the method comprising: landing a joint within a tubular adjacent a BOP, the joint comprising a first umbrella assembly; closing at least one BOP ram upon the joint; activating the first umbrella assembly; retracting the at least one BOP ram from the joint; moving the joint back up through the tubular; and utilizing the joint to determine a desired placement of an SSTT within the BOP.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1A is a cross-sectional view of an assembly to reduce the time associated with performing a dummy run according to certain exemplary embodiments of the present invention;

FIG. 1B illustrates the assembly of FIG. 1A landed within a BOP with the lowermost ram closed;

FIG. 1C illustrates the assembly of FIG. 1A during its ascent back to the surface in accordance to certain exemplary methodologies of the present invention;

FIG. 2A is a cross-sectional view of an alternate assembly to reduce the time associated with performing a dummy run according to certain exemplary embodiments of the present invention;

FIG. 2B illustrates a three-dimensional view of a cement basket utilized as the umbrella assembly according to certain exemplary embodiments of the present invention;

FIG. 2C illustrates the assembly of FIG. 2A and how the umbrella assembly is opened while the assembly is landed within a BOP with the lowermost ram closed; FIG. 2D illustrates the assembly of FIG. 2A during its ascent back to the surface in accordance to certain exemplary methodologies of the present invention; and

FIG. 3 illustrates a three-dimensional view of an assembly having a first and second umbrella assembly according to certain exemplary embodiments of the present invention.

SUMMARY OF INVENTION

~~— A first aspect of the present invention provides a method to determine placement of a subsea test tree (“SSTT”) within a blow out preventer (“BOP”), the method comprising, deploying a sensing joint down through a tubular and into a BOP, the sensing~~

~~joint comprising, a heavy weight fluid contained therein; and a hanger positioned along the sensing joint. The method also comprises landing the sensing joint adjacent the BOP using the hanger, closing at least one BOP ram upon the sensing joint, thereby providing an indication of a position of the at least one BOP ram, retracting the at least one BOP ram from the sensing joint, forcing the heavy weight fluid out of the sensing joint, allowing the sensing joint to move back up through the tubular, and determining a desired placement of an SSTT within the BOP based upon the indication of the position of the at least one BOP ram.~~

~~——— A second aspect of the present invention provides an assembly to determine placement of a subsea test tree (“SSTT”) within a blow out preventer (“BOP”), the assembly comprising, a sensing joint comprising a first chamber housing a heavy weight fluid; and a piston configured to force the heavy weight fluid out of the sensing joint. The assembly also comprises a hanger positioned along the sensing joint.~~

~~——— A third aspect of the present invention provides a method to determine placement of a subsea test tree (“SSTT”) within a blow out preventer (“BOP”), the method comprising landing a joint within a tubular adjacent a BOP, the joint comprising a heavy weight fluid, closing at least one BOP ram upon the joint, retracting the at least one BOP ram from the joint, forcing the heavy weight fluid out of the joint, moving the joint back up through the tubular, and utilizing the joint to determine a desired placement of an SSTT within the BOP.~~

~~——— A fourth aspect of the present invention provides a method to determine placement of a subsea test tree (“SSTT”) within a blow out preventer (“BOP”), the method comprising, deploying a joint down through a tubular and into a BOP, the joint comprising, a first umbrella assembly positioned at an upper end of the joint; and a hanger positioned along the joint. The method also comprises landing the joint adjacent the BOP using the hanger, closing at least one BOP ram upon the joint, thereby providing an indication of a position of the at least one BOP ram, activating the first umbrella assembly, retracting the at least one BOP ram from the joint, causing fluid to flow up the tubular and into the activated first umbrella assembly, moving the joint back up through the tubular; and determining a desired placement of an SSTT within the BOP based upon the indication of the position of the at least one BOP ram.~~

~~— A fifth aspect of the present invention provides an assembly to determine placement of a subsea test tree (“SSTT”) within a blow out preventer (“BOP”), the assembly comprising, a joint comprising a first umbrella assembly positioned at an upper end of the joint; and a fluid communication port providing fluid communication between the first umbrella assembly and a location outside the joint. The assembly also comprises a hanger positioned along the joint.~~

~~— A sixth aspect of the present invention provides a method to determine placement of a subsea test tree (“SSTT”) within a blow out preventer (“BOP”), the method comprising, landing a joint within a tubular adjacent a BOP, the joint comprising a first umbrella assembly. The method also comprises closing at least one BOP ram upon the joint, activating the first umbrella assembly, retracting the at least one BOP ram from the joint, moving the joint back up through the tubular, and utilizing the joint to determine a desired placement of an SSTT within the BOP.~~

DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

Illustrative embodiments and related methodologies of the present invention are described below as they might be employed in assemblies and methods for reducing the time required to conduct dummy runs through utilization of an autonomous painted joint simulator. In the interest of clarity, not all features of an actual implementation or methodology are described in this specification. Also, the “exemplary” embodiments described herein refer to examples of the present invention. It will of course be appreciated that in the development of any such actual embodiment, numerous implementation-specific decisions must be made to achieve the developers’ specific goals, such as compliance with system-related and business-related constraints, which will vary from one implementation to another. Moreover, it will be appreciated that such a development effort might be complex and time-consuming, but would nevertheless be a routine undertaking for those of ordinary skill in the art having the benefit of this disclosure. Further aspects and advantages of the various embodiments and related methodologies of the invention will become apparent from consideration of the following description and drawings.

FIG. 1A illustrates an exemplary embodiment of assembly 10 utilized to reduce the time associated with conducting a dummy run according to exemplary embodiments

of the present invention. Although not shown in FIG. 1A, assembly 10 is deployed down through a tubular (a riser, for example) that extends down through a body of water from a surface vessel, and is connected to a BOP (now shown). Assembly 10 includes a sensing joint 12 having a hanger 14 positioned along its body. Sensing joint 12 may be comprised of a buoyant material, aluminum or some other material suitable for downhole use. The outer diameter of sensing joint 12 matches the diameter of the real pipe that will be utilized during DST. In certain exemplary embodiments, hanger 14 may be a separate fluted hanger attached to the body of sensing joint 12. However, in other embodiments,

CLAIMS

~~WHAT IS CLAIMED IS:~~

1. A method to determine placement of a subsea test tree ("SSTT") within a blow out preventer ("BOP"), the method comprising:

deploying a sensing joint down through a tubular and into a BOP, the sensing joint comprising:

a heavy weight fluid contained therein; and

a hanger positioned along the sensing joint;

landing the sensing joint adjacent the BOP using the hanger;

closing at least one BOP ram upon the sensing joint, thereby providing an indication of a position of the at least one BOP ram;

retracting the at least one BOP ram from the sensing joint;

forcing the heavy weight fluid out of the sensing joint;

allowing the sensing joint to move back up through the tubular; and

determining a desired placement of an SSTT within the BOP based upon the indication of the position of the at least one BOP ram,

wherein closing the at least one BOP ram upon the sensing joint further comprises utilizing a sensor along the sensing joint to detect that the hanger has seated within a landing mechanism.

2. A method as defined in claim 1, wherein providing the indication of the position of the at least one BOP ram comprises placing a mark on the sensing joint using the at least one BOP ram, and wherein determining the desired placement of the SSTT comprises conducting a visual inspection of the mark.

~~3. A method as defined in claim 1, wherein closing the at least one BOP ram upon the sensing joint further comprises utilizing a sensor along the sensing joint to detect that the hanger has seated within a landing mechanism.~~

43. A method as defined in claim 1, wherein forcing the heavy weight fluid out of the sensing joint further comprises utilizing a high pressure fluid contained within the sensing joint to force the heavy weight fluid out of the sensing joint.

54. A method as defined in claim 1, wherein forcing the heavy weight fluid out of the sensing joint further comprises:

detecting retraction of the at least one BOP ram from the sensing joint; and
in response to the detecting, actuating a piston positioned within the sensing joint to force the heavy weight fluid out of the sensing joint.

65. A method as defined in claim 54, wherein actuating the piston further comprises actuating a valve contained within the sensing joint to an open position to allow a high pressure fluid contained within the sensing joint to force the piston to expel the heavy weight fluid out of the sensing joint.

76. A method as defined in claim 1, wherein allowing the sensing joint to move back up through the tubular further comprises:

opening an umbrella assembly positioned at an upper end of the sensing joint; and
forcing fluid up the tubular and into the umbrella assembly.

87. A method as defined in claim 76, wherein opening the umbrella assembly further comprises activating a packer element.

98. An assembly to determine placement of a subsea test tree ("SSTT") within a blow out preventer ("BOP"), the assembly comprising:

a sensing joint comprising:

a first chamber housing a heavy weight fluid; and

a piston configured to force the heavy weight fluid out of the sensing joint;

and

a hanger positioned along the sensing joint,

wherein the hanger further comprises a sensor to detect when the hanger has seated in a landing mechanism.

~~10. An assembly as defined in claim 9, wherein the hanger further comprises a sensor to detect when the hanger has seated in a landing mechanism.~~

~~11~~9. An assembly as defined in claim ~~9~~8, wherein the sensing joint further comprises a sensor to detect when a BOP ram has contacted the sensing joint.

~~12~~10. An assembly as defined in claim ~~9~~8, wherein the sensing joint further comprises a second chamber housing a high pressure fluid configured to actuate the piston.

~~13~~11. An assembly as defined in claim ~~12~~10, wherein the sensing joint further comprises a valve positioned between the second chamber and the piston.

~~14~~12. An assembly as defined in claim ~~9~~8, further comprising an umbrella assembly positioned at an upper end of the sensing joint.

~~15~~13. An assembly as defined in claim ~~14~~12, wherein the umbrella assembly is a cement basket or a packer assembly.

~~16~~14. A method to determine placement of a subsea test tree ("SSTT") within a blow out preventer ("BOP"), the method comprising:

landing a joint within a tubular adjacent a BOP, the joint comprising a heavy weight fluid;

closing at least one BOP ram upon the joint;

retracting the at least one BOP ram from the joint;

forcing the heavy weight fluid out of the joint;

moving the joint back up through the tubular; and

utilizing the joint to determine a desired placement of an SSTT within the BOP,

wherein closing the at least one BOP ram upon the joint further comprises utilizing a sensor along the joint to detect that the joint has landed.

~~17~~15. A method as defined in claim ~~16~~14, wherein utilizing the joint to determine the desired placement of the SSTT further comprises inspecting a mark placed on the joint by the at least one BOP ram.

~~18. A method as defined in claim 16, wherein closing the at least one BOP ram upon the joint further comprises utilizing a sensor along the joint to detect that the joint has landed.~~

~~19~~16. A method as defined in claim ~~16~~14, wherein forcing the heavy weight fluid out of the joint further comprises utilizing a high pressure fluid to force the heavy weight fluid out of the joint.

~~20~~17. A method as defined in claim ~~16~~14, wherein moving the joint back up through the tubular further comprises:

- activating an umbrella assembly positioned along the joint; and
- forcing fluid up the tubular and into the umbrella assembly.

~~21~~18. A method as defined in claim ~~20~~17, wherein activating the umbrella assembly further comprises activating a packer element or opening a cement basket.

~~22~~19. A method to determine placement of a subsea test tree (“SSTT”) within a blow out preventer (“BOP”), the method comprising:

- deploying a joint down through a tubular and into a BOP, the joint comprising:
 - a first umbrella assembly positioned at an upper end of the joint; and
 - a hanger positioned along the joint;
- landing the joint adjacent the BOP using the hanger;
- closing at least one BOP ram upon the joint, thereby providing an indication of a position of the at least one BOP ram;
- activating the first umbrella assembly;
- retracting the at least one BOP ram from the joint;
- causing fluid to flow up the tubular and into the activated first umbrella assembly;
- moving the joint back up through the tubular; and
- determining a desired placement of an SSTT within the BOP based upon the indication of the position of the at least one BOP ram.

2320. A method as defined in claim 2219, wherein providing the indication of the position of the at least one BOP ram comprises placing a mark on the joint using the at least one BOP ram, and wherein determining the desired placement of the SSTT comprises conducting a visual inspection of the mark.

2421. A method as defined in claim 2219, wherein activating the first umbrella assembly further comprises:

forcing fluid through a fluid communication port positioned within the joint, the fluid communication port providing fluid communication between a piston forming part of the first umbrella assembly and a location outside the joint, the piston configured to restrain the first umbrella assembly in a closed position; and

utilizing the forced fluid to actuate the piston such that the piston releases the first umbrella assembly to an open position.

2522. A method as defined in claim 2421, wherein forcing fluid through the fluid communication port further comprises receiving the forced fluid from a location outside the joint that is beneath the closed at least one BOP ram.

2623. A method as defined in claim 2219, wherein the first umbrella assembly is activated while the at least one BOP ram is closed upon the joint.

2724. A method as defined in claim 2219, wherein activating the first umbrella assembly further comprises activating a packer element or opening a cement basket.

2825. A method as defined in claim 2219, wherein deploying the joint down through the tubular further comprises utilizing a second umbrella assembly to assist in deploying the joint down through the tubular.

2926. An assembly to determine placement of a subsea test tree (“SSTT”) within a blow out preventer (“BOP”), the assembly comprising:

a joint comprising:

a first umbrella assembly positioned at an upper end of the joint; and

a fluid communication port providing fluid communication between the first umbrella assembly and a location outside the joint; and
a hanger positioned along the joint.

~~30~~27. An assembly as defined in claim ~~29~~26, wherein the first umbrella assembly further comprises:

an expandable basket portion extending from the upper end of the joint; and
a piston positioned to hold the basket portion in a closed position.

~~31~~28. An assembly as defined in claim ~~30~~27, wherein the fluid communication port is positioned to provide communication between the piston and the location outside the tool joint.

~~32~~29. An assembly as defined in claim ~~29~~26, wherein the location outside the tool joint is located beneath at least one BOP ram.

~~33~~30. An assembly as defined in claim ~~29~~26, wherein the first umbrella assembly is a cement basket or a packer assembly.

~~34~~31. An assembly as defined in claim ~~29~~26, further comprising a second umbrella assembly positioned above the first umbrella assembly.

~~35~~32. A method to determine placement of a subsea test tree ("SSTT") within a blow out preventer ("BOP"), the method comprising:

landing a joint within a tubular adjacent a BOP, the joint comprising a first umbrella assembly;

closing at least one BOP ram upon the joint;

activating the first umbrella assembly;

retracting the at least one BOP ram from the joint;

moving the joint back up through the tubular; and

utilizing the joint to determine a desired placement of an SSTT within the BOP.

~~36~~33. A method as defined in claim ~~35~~32, wherein utilizing the joint to determine the desired placement of the SSTT further comprises inspecting a mark placed on the joint by the at least one BOP ram.

~~37~~34. A method as defined in claim ~~35~~32, wherein activating the first umbrella assembly further comprises actuating a piston of the first umbrella assembly to release the first umbrella assembly into an open position.

~~38~~35. A method as defined in claim ~~35~~32, wherein the first umbrella assembly is activated while the at least one BOP ram is closed upon the joint.

~~39~~36. A method as defined in claim ~~35~~32, wherein activating the first umbrella assembly further comprises activating a packer element or opening a cement basket.

~~40~~37. A method as defined in claim ~~35~~32, wherein landing the joint within a tubular further comprises utilizing a second umbrella assembly to assist in deploying the joint down through the tubular.