EFFICIENT OPEN WATER RISER DEPLOYMENT

BACKGROUND OF THE INVENTION

1. Field of the Invention.

This invention relates in general to production of oil and gas wells, and in particular to a device and method for deploying a riser subsea. More particularly, the present invention relates to parking a riser subsea and moving the riser to an adjacent wellhead for wellhead operations.

2. Description of Related Art.

Subsea risers are tubular members extending from the sea surface to seafloor. One option when encasing a drill string during drilling a well subsea, a riser typically spans between a drilling rig to a subsea wellhead mounted on the seafloor. The riser usually remains coupled to the subsea wellhead until after the well is completed. Fluids produced from the well generally flow from the wellhead into a flow line that discharges into a manifold connected to flow lines from other wellheads. Fluids converging in the manifold are delivered to above the sea surface via a main flow line. Over time, a producing well typically undergoes maintenance or workover procedures that require a riser be reconnected to the wellhead, this is usually a smaller diameter that can act as a conduit for wellbore fluids during well testing or a conduit for tools and gauges etc during well workover operations, so that the well can be accessed from above the sea surface. During such maintenance procedures the riser can be connected to drilling rig or a surface vessel on its upper end. In either instance, the riser is redeployed from a storage site or manufacturing facility and transported to the wellhead being maintained, which is a time consuming and costly step.

SUMMARY OF THE INVENTION

Disclosed herein is an apparatus for and method of subsea operations. In an example a method of deploying a riser is disclosed that includes initially running the riser from a conventional vessel, mobile drilling rig, or other site. In an example embodiment, the

riser incorporates buoyancy such it can be moved from a given location or well site to another well site or location. Also, the riser can be parked subsea for a period of time then moving and mounting the riser onto a wellhead. An upper end of the riser can then be coupled to a facility above sea surface and the wellhead can be accessed from above the sea surface through the riser. The method may optionally include providing a riser mount on the seafloor on which the riser is parked. In an alternative example, a riser section can be attached to the upper end of the riser. In another alternative embodiment, a beacon can be emitted from the parked riser so that the riser can be located subsea. Alternatively, the riser can be parked onto a subsea wellhead. An optional buoyancy module can be added on the riser for maintaining the riser in a substantially vertical orientation. The steps of moving the riser from a parking location to a wellhead can be repeated.

Yet further disclosed is a riser assembly that includes a riser mount set in the seafloor and spaced apart from a proximate wellbore. The riser assembly includes a riser section having a lower end selectively parked on the riser mount and selectively engagable with a subsea wellhead positioned on the wellbore. A riser extension can selectively connect between an upper end of the riser section and a vessel at sea level, so that when the riser section is engaged with the wellhead and the riser extension is connected to the riser section, the wellhead is accessible through the riser section and riser extension from the vessel. A beacon can be included on the riser section. Optionally, a buoyancy module can be provided on the riser section that has a chamber selectively containing a gas.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a side schematic view of an embodiment of a subsea exploration/production riser in accordance with the present disclosure.

Figure 2 is a side schematic view of the riser of Figure 1 being moved from a parked to a deployed position.

Figure 3 is a side schematic view of an example embodiment of the riser of Figure 2 in a deployed position.

DETAILED DESCRIPTION OF THE INVENTION

The apparatus and method of the present disclosure will now be described more fully hereinafter with reference to the accompanying drawings in which embodiments are shown. This subject of the present disclosure may, however, be embodied in many different forms and should not be construed as limited to the illustrated embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout. For the convenience in referring to the accompanying figures, directional terms are used for reference and illustration only. For example, the directional terms such as "upper", "lower", "above", "below", and the like are being used to illustrate a relational location.

It is to be understood that the subject of the present disclosure is not limited to the exact details of construction, operation, exact materials, or embodiments shown and described, as modifications and equivalents will be apparent to one skilled in the art. In the drawings and specification, there have been disclosed illustrative embodiments of the subject disclosure and, although specific terms are employed, they are used in a generic and descriptive sense only and not for the purpose of limitation. Accordingly, the subject disclosure is therefore to be limited only by the scope of the appended claims.

Referring now to Figure 1 an example embodiment of a portion of a riser assembly 10 is shown in a side view. The riser assembly 10 is shown parked on a riser mount 12 that anchors into the sea floor 14. In the embodiment of Figure 1, the riser mount 12 is shown made up of a planar base 16 resting on the sea floor 14 and a substantially cylindrical pedestal 18 projecting upward from the base 16. In an optional embodiment, the pedestal 18 is profiled substantially similar to a mandrel typically found on an upper end of a wellhead assembly. An anchor pin 20 is shown in dashed outline that extends into the sea floor 14 for affixing the riser mount 12 in place and providing a stable support on which the riser assembly 10 may be parked. The sea floor 14 will dictate the design of the base 16 and anchor pin 20, and when the sea floor 14 is considered "soft", skirts (not shown) may be added for added support that extend from the base 16 and into the sea floor 14. In

the example of Figure 1, riser assembly 10 is made up primarily of a tubular assembly and is shown having a lower riser package 22 on its lower most end. Shown coaxially to and adjacent to the lower riser package 22 is an emergency disconnect package 24. An elongated tubular riser body 26 is shown mounted on an upper end of the emergency disconnect package (EDP) 24. Connectors may be included within the EDP 24 that secure the riser assembly 10 to the pedestal 18. Thus in one example use of the riser assembly 10, the riser mount 12 is set within the sea floor 14 specifically to provide a fixture on which the riser assembly 10 may be parked for a period of time before being deployed for use with wellbore operations. The riser assembly 10 can be configured so that its upper end is safely below the draft of ships and out of the way of seagoing vessels. In an example embodiment, the uppermost two or three riser joints of a typically sized riser could be removed to avoid ship traffic. In an alternate embodiment of the riser assembly 10 though, at least some of the riser assembly 10 can be above the sea surface.

A buoyancy module 28 is further shown provided with the riser assembly 10 on a portion of the riser body 26. The buoyancy module 28 is for maintaining the riser assembly 10 in a substantially vertical orientation while in the parked position, and may include substances having a density lower than sea water. In the example of Figure 1, a chamber 30, shown in dashed outline, is provided within the buoyancy module 28. Alternatively, the buoyancy module 28 may contain multiple chambers 30 or be completely or partially filled with substances such as foam or constituents having densities less than sea water. While parked, care should be taken while "tuning" the buoyancy module 28 so that the upward force exerted by the buoyancy module 28 onto the riser assembly 10 is enough to maintain the riser assembly 10 vertical, while not pulling the riser mount 12 from the sea floor 14. So that the riser assembly 10 may be located while subsea and after having been parked for a period of time, a beacon 32 is shown that emits a signal or signals. The signals, in one example embodiment, may be a single continuous signal, or discreet signals that are used for locating the riser assembly 10.

Illustrated in Figure 1 are wellhead assemblies 34 on the sea floor 14 and at a location proximate to the riser mount 12. Flow lines 36 attached to the wellhead assemblies 34

and are piped along the sea floor 14 to a manifold 38. Production fluid from wellbores 40 beneath the wellhead assemblies 34 is directed to production facilities through the flow lines 36 and manifold 38. Initial deployment of the riser assembly 10 may be from a drilling rig or other suitable vessel. Alternatively, initial deployment may be towed out by a lesser vessel of opportunity, in sections of nominally 150 to 300m or more (with a suitable deployment frame and buoyant supports) and fully assembled in situ with ROV support from the same vessel that is also then used to effect intervention operations, without the need for instance a derrick, or handling tower.

Shown in Figure 2, is an example of the work boat 44 at the sea surface 46 transporting riser assembly 10A from the riser mount 12 and towards one of the wellhead assemblies 34. In this example, a tubular riser section or extension 48 is attached to the upper end of the riser body 26 wherein, the riser extension 48 is suspended from a line 49 depending from the workboat 44. Optionally, the line 49 may depend from a vessel other than a workboat 44. In an alternative, the line 49 can attach directly to the upper end of the riser body 26. In the example of Figure 2, a connection joint 50 provides connection between the riser body 26 and riser extension 48. In one example embodiment, the connection joint 50 is a riser tensioner joint. An example of a tensioner joint is described in Fraser, Jr., et al., U.S. Patent No. 6,017,168, which is assigned to the assignee of the present application.

Referring now to Figure 3, the riser assembly 10A is shown having been attached to and deployed onto a wellhead assembly 34. The riser assembly 10A extends upward from the wellhead assembly 34 through the sea and attaches on its upper end to a platform 52 shown above the sea surface 46. The platform 52 can be any craft or vessel for conducting subsea operation such as a mobile drilling unit (MODU), intervention vessel, floating production facility, ship, and the like. As discussed above, the riser assembly 10 can be configured so it is a set distance beneath the sea surface and below the draft of passing ships. For such embodiments, the riser extension 48 would make up the difference in distance between the riser assembly 10 of Figure 1 and the riser assembly 10A of Figure 3. Also as discussed above, the distance from the upper end of the riser

assembly 10 and sea surface can be roughly 100 feet, meaning the riser extension 48 can include about two to three riser joints.

A valve 54 is shown in a pipe extending from the wellhead assembly 34 into the flow line 36. When accessing the wellhead 34 and wellbore 40, the valve 54 may be closed, thereby isolating the flow line 36 and manifold 38 from wellbore operations. Also illustrated in Figure 3 is a charging connection 56 for selectively providing gas or other substances to within the buoyancy module 28. In one example of use, a remotely operated vehicle (ROV) 58 is shown subsea that may be used to charge the buoyancy module 28 while it is beneath the sea surface 46. Charging the buoyancy module 28 may be required to tension the riser assembly 10A when it is mounted on the wellhead assembly 34. The recharging gas can be provided with the ROV 58, from a line (not shown) deployed from above the sea surface, or from a vessel (not shown) sent subsea with the ROV 58.

After completing operations through the riser assembly 10A between the platform 52 and wellhead assembly 34 and/or wellbore 40, the riser assembly 10A may be removed from the wellhead assembly 34. The riser assembly 10A can then be moved to another wellhead assembly or returned to the riser mount 12 as illustrated in Figure 2. Upon or prior to being returned to the riser mount 12, the tubular riser extension 48 can optionally be removed from the riser assembly 10A. Either embodiment of the riser assembly 10, 10A may be parked for an indefinite period of time for retransportation and later use.

While the invention has been shown or described in only some of its forms, it should be apparent to those skilled in the art that it is not so limited, but is susceptible to various changes without departing from the scope of the invention.

PARTS LIST

10 riser system
12 riser mount
14 sea floor
16 base
18 pedestal
20 anchor pin
22 lrp
24 edp
26 riser body
28 buoyancy module
30 container
32 beacon
34 wellhead assemblies
36 flow line jumpers
38 manifold
40 wellbore
44 workboat
46 sea surface
48 riser section
49 line
50 connection joint (riser tensioner joint)
52 platform
54 valve
56 charging connection
58 ROV

WHAT IS CLAIMED IS:

1. A method of deploying a riser 10 comprising:

characterized by parking a riser lower portion 26 subsea for a period of time on a riser mount 12 set in the seafloor 14 and spaced proximate to a wellhead 38;

moving the riser lower portion 26 from the parked position to the wellhead 38;

mounting a lower end 22 of the riser lower portion 26 onto the wellhead 38;

completing a full length of the riser 10A;

coupling an upper end of the riser 10A to a facility 52 above sea surface 46; and

accessing the wellhead 38 from above the sea surface 46 through the full length of the riser 10A.

2. The method of claim 1, characterized in that in step (a), the upper end of the riser lower portion 26 is below the draft of a vessel sailing on the sea surface 46.

3. The method of claims 1 or 2, characterized by the riser 10 being parked in step (a) has a length less than a depth of the sea where the riser 10 is parked.

4. The method of claim 3, characterized in that in step (d) comprises further connecting a riser section 48 to the upper end of the riser lower portion 26, the riser section 48 having a length less than a length of the riser lower portion 26.

5. The method of any of claims 1-4, further characterized by emitting a beacon 32 from the riser lower portion 26 of step (a) so that the riser lower portion 26 can be located subsea.

6. The method of any of claims 1-5, characterized in that the riser lower portion 26 is parked on a wellhead 38 located subsea.

7. The method of any of claims 1-6, further characterized by providing a buoyancy module 28 on the riser lower portion 26 for maintaining the riser lower portion 26 in a substantially vertical orientation.

8. The method of any of claims 1-7, further characterized by removing the riser lower portion 26 from the wellhead 38 and repeating steps (a) – (f).

9. The method of any of claims 1-8, characterized in that the riser lower portion 26 is parked at a location proximate to the wellhead 38 and a plurality of additional wellheads 34.

10. A riser assembly 10 comprising:

a riser mount 12 set in the seafloor 14 and spaced apart from a proximate wellbore 40;

characterized by a riser lower section 26 having a lower end 22 selectively parked on the riser mount 12 and selectively engagable with a subsea wellhead 38 positioned on the wellbore 40; and

a riser extension 48 selectively connected between an upper end of the riser lower section 26 and a vessel 52 at sea level 46, so that when the riser lower section 26 is engaged with the wellhead 38 and the riser extension 48 is connected to the riser lower section 26, the wellhead 38 is accessible through the riser lower section 26 and the riser extension 48 from the vessel 52.

11. The riser assembly of claim 10, further characterized by a beacon 32 mounted on the riser lower section 26.

12. The riser assembly of claims 10 or 11, further characterized by a buoyancy module 28 provided on the riser lower section 26 that has a chamber 30 selectively containing a gas.

13. The riser assembly of any of claims 10-12, further characterized by a charging connection on the chamber 30 for conveying gas into the chamber 30.

14. The riser assembly of any of claims 10-13, further characterized by a riser tensioner joint 50 on the upper end of the riser section 48 that is where the riser extension 48 connects to the riser section.

15. The riser assembly of any of claims 10-14, further characterized by an emergency disconnect package 24 and lower riser package 22 provided on the riser lower section 26.

16. A method of deploying a riser 10 comprising:

characterized by providing a riser 10 having a lower end 26 with an emergency disconnect package 24 and a lower riser package 22;

parking the riser 10 subsea for a period of time on a riser mount 12 set in the seafloor 14 and spaced proximate to a wellhead 38;

emitting a beacon 32 from the parked riser 10;

providing a buoyancy module 28 on the riser 10;

moving the riser 10 from the parked position to the wellhead 38;

mounting a lower end of the riser 10 onto the wellhead 38;

completing a full length of the riser 10A by adding an extension 48 to an upper end of the riser 10;

coupling an upper end of the riser section to a facility 52 above sea surface 46; and

accessing the wellhead 38 from above the sea surface 46 through the full length of the riser 10A.

17. The method of claim 16, characterized in that the buoyancy module 28 further comprises a chamber 30 with a charging connection for conveying gas into the chamber 30, the method further characterized by charging the buoyancy module 28 with gas.

18. The method of claim 17, characterized in that the buoyancy module 28 is charged after step (e).

19. The method of any of claims 16-18, characterized in that the extension 48 is coupled above the buoyancy module 28.

20. The method of any of claims 16-19, further characterized by hydraulically clamping the lower end of the riser 10 to the riser mount 12.

21. The method of any of claims 16-20, characterized in that step (a) is characterized by towing sections of the riser 10 along the sea surface 46 and assembling the sections in situ with a remotely operated vehicle 58.