METHOD FOR INSTALLING AN EXTERNAL LINE ON A DEPLOYED DRILLING RISER

A method for assembling a marine drilling riser includes assembling a predetermined number of sections of the marine drilling riser and extending them into a body of water from a drilling platform. The assembling including affixing a selected number of external line guides to the riser at selected longitudinal positions. The line guides are initially closed to be substantially at most equal a diameter of buoyancy devices on the riser. The line guides are subsequently opened to extend beyond the buoyancy device diameter. A predetermined length of fluid external line is moved to adjacent the assembled riser and the fluid conduit is coupled to the external line guides. The external line guides are locked and assembly of the riser is completed and tension is applied thereto.
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Background

[0001] This disclosure is related to the field of subsea drilling. More particularly, the disclosure relates to methods for installing an external fluid line on a deployed marine drilling riser.

[0002] The present disclosure is described in terms of attaching a mud return line (MRL) pipe to an at least partially deployed marine drilling riser for use in subsea mudlift pump (SMP) marine drilling operations. It should be clearly understood that the scope of the present disclosure is not limited to such SMP applications, but extends to all possible uses for an additional external line used with a marine drilling riser. Such lines may include, without limitation, both fluid carrying lines (conduits or pipes) and electrical and/or optical cables.

[0003] Marine drilling risers known in the art comprise a relatively large diameter conduit that couples to a wellhead disposed proximate the bottom of a body of water. The large diameter conduit extends from the wellhead and extends to a drilling platform on the water surface. The drilling platform may be floating or bottom supported. The large diameter conduit provides a path closed to the seawater external thereto for passage of drilling tools used to drill a wellbore below the wellhead in the formations below the water bottom and may provide at least part of a fluid return path to the drilling platform for drilling fluid being discharged from the wellbore. The large diameter conduit may include a plurality of smaller diameter fluid lines disposed externally thereto. The smaller diameter fluid lines may be used for purposes, including but not limited to choke and kill functions and providing hydraulic fluid pressure to operate devices on the wellhead. The smaller diameter fluid lines are typically affixed to the larger diameter conduit by attachment rings coupled to the exterior of the large diameter conduit and/or through openings in flanges that are affixed to the longitudinal ends of each segment ("joint") of the larger diameter conduit to assemble them end to end to form the
completed marine riser. Marine risers known in the art also typically include buoyancy
device affixed to an exterior of the large diameter conduit to support the weight of the
riser so that the riser will not collapse under its own weight when deployed.

subsea mudlift pump (SMP) module that may be attached to a marine drilling riser. The
SMP module may be attached to the riser using a modified riser joint (MRJ) coupled
within the riser, wherein the MRJ includes docking and hydraulic couplings to secure the
SMP module to the MRJ. If necessary, the SMP module may be detached from the riser
(at the MRJ) during wellbore construction operations without the need to ("recover")
disassemble the riser, wherein the marine drilling riser extends from a wellhead
proximate the water bottom to a drilling platform on the water surface. The MRJ
includes at least one hydraulic connection to the interior of the marine drilling riser. The
hydraulic connection is coupled to an inlet of at least one pump on the SMP module. An
outlet of the at least one pump on the SMP module may be coupled to a mud return line
(MRL), wherein drilling mud that is pumped from the interior of the riser is lifted to the
drilling platform on the water surface. The at least one pump on the SMP module may be
controlled to maintain a selected fluid pressure at any selected depth in the marine
drilling riser and/or in a wellbore drilled through formations below the water bottom.

[0005] In assembling a marine drilling riser using an SMP module as described in the
above cited publication, it is desirable to provide a separate mud return line from the
outlet of the at least one pump to the surface. There are other applications in which
marine riser is used in which an additional external, rigid fluid line or an external line
such as an umbilical cable may be desirable to be used after the riser is deployed. Known
structures for marine drilling risers make such post-deployment attachment of an
additional external line impractical.

**Brief Description of the Drawings**

[0006] FIG. 1 shows an example SMP module.

[0007] FIG. 2 shows an example mud return line (MRL) clamp.
FIG. 3 shows an example bottom end MRL clamp.

FIG. 4 shows a plan view of a drilling deck on a drilling platform indicating relative positions of the well center and a make up hole for the MRL.

FIG. 5 shows a side view of the drilling platform wherein the MRL is being assembled in the make up hole.

FIG. 6 shows the example MRL clamp of FIG. 2 in the deployment position.

FIG. 7 shows the bottom end MRL clamp in the deployment position.

FIG. 7A shows details of a lower external end connector in side view for clarification of an internal flow conduit.

FIG. 8 shows the SMP module affixed to the riser as it is being lowered into the water during riser assembly.

FIG. 9 shows the MRL being moved to adjacent the riser and being coupled to the riser using the MRL clamps.

FIG. 10 shows final assembly of a gooseneck and API specification mud return hose to an upper end of the MRL to complete the assembly of the MRL to the SMP module and the riser.

FIGS. 11A-11C show an example guide wire anchor and various release mechanisms therefor.

**Detailed Description**

FIG. 1 shows one example of a subsea mudlift pump (SMP) module 40 that may be used with a marine drilling system wherein a marine drilling riser (hereinafter simply "riser") extends between a wellhead (not shown) deployed on the water bottom and a drilling platform (FIG. 5) on the water surface. The SMP module 40 may be assembled to the riser 12 below the drilling platform, either in the body of water or in the "moon pool" of a floating drilling platform to a specific riser segment that has features for mating the SMP module 40 both hydraulically and mechanically thereto. An example of
such riser segment, called a modified riser joint (MRJ, shown at 13 in FIG. 8) and the mechanical and hydraulic connections between it and the SMP module 40 are described more fully in International Patent Application Publication No. WO 2013/024354 as set forth in the Background section herein. The SMP module 40 may have one or more (three shown in FIG. 1) pumps 42 that are in fluid communication on an inlet side thereof with a fluid outlet disposed in or forming part of the MRJ (13 in FIG. 8). An outlet of the pumps 42, as explained more fully below, may lift fluid from within the riser through a mud return line (MRL, shown at 24 in FIG. 5) to the drilling unit.

[0019] The pumps 42 may be mounted on a platform, frame or plate structure 41 that may include a semi-circular opening on one side to enable engagement with a mating feature (not shown) on the MRJ. Features such as an externally mounted ring (not shown) may be provided on the MRJ to hold the structure 41 in a selected axial position along the MRJ. A possible advantage of the configuration of the pump module 40 shown in FIG. 1 is that its weight may be more evenly circumferentially distributed around the riser 12 thus reducing lateral stresses on the riser 12. The foregoing example SMP module 40 is shown in and described with reference to FIGS. 2 and 3 in the above cited International Application Publication. Another example structure for a SMP module is described with reference to FIGS. 4 and 5 in the same Publication.

[0020] FIG. 2 shows an example external line guide 11, which in the present example includes a clamp 10, a line retainer 14 pivotally coupled to the clamp 10 and a line retaining line clamp 16, which may be opened and closed, e.g., by a remotely operated vehicle (ROV) or during movement of the riser below a drilling deck (FIG. 5) of a drilling platform. The pipe retainer 14 is shown in its folded/secured position. The external pipe guide 11 may be clamped to the riser 12 during a riser assembly procedure in the folded position shown in FIG. 2, for example, one to each riser joint. In applications such as subsea mudlift drilling where a riser mounted SMP module is used, such external line guides may be coupled to the riser joints above the position of the SMP module (40 in FIG. 1) on the riser (12 in FIG. 8). As used in the present context, the term "line" may mean any longitudinally extensive element that transports a medium,
energy or signals, including, without limitation, fluid carrying conduits or pipes, electrical cable and optical cable such as armored cable (e.g., umbilical cables).

[0021] In the folded or closed position, the external line guides 11 may fit entirely inside a (e.g., 55 inch) buoyancy device ("can") outer diameter, shown in outline at 18. The external line guides 11 may be clamped to the riser 12 at any suitable location above or below buoyancy cans (not shown separately) affixed to respective riser joints. The external line guide 11 may be affixed to the riser 12 in the folded/secured position for running on the riser through a well center opening on the drilling deck of the drilling platform (see FIGS. 4 and 5) as the riser is assembled and run to a wellhead (not shown) on the water bottom.

[0022] FIG. 3 shows a lower external line end connector 11A. A split clamp 10A may be clamped on the riser (12 in FIG. 8) in the folded/secured position as shown in FIG. 3. When so deployed the lower external line end connector 11A may also fit entirely inside buoyancy can outer diameter 18 and may therefore be affixed to the riser (12 in FIG. 8) while assembling and running the riser through the main well center opening (see FIG. 4). The lower external line end connector 11A may include a clamp 10A similar in structure to the clamp shown at 10 in FIG. 2 for affixing the lower end connector 11A to the riser, a pivoting arm 14A and a remotely operated vehicle (ROV) operated locking mechanism 16A. In some embodiments, an outlet pipe from SMP module (40 in FIG. 1) may have a six inch internal diameter, and a MRL pipe, to be explained further below, may have a similar internal diameter. In some embodiments, a swivel and connector may have 100 bar working pressure rating based on pre-qualified riser pin-box connector design principles.

[0023] FIG. 4 shows a plan view of the drill floor 21 of the drilling platform. A main well center 20 is where well construction devices are moved through the drill floor 21. Such devices in the present example may include the riser as it is assembled and extended into the water below the drilling platform to the wellhead (not shown) on the water bottom. An auxiliary well center 22 may include devices (FIG. 5) for assembling and
holding predetermined lengths of drilling tools, conduit and other devices for eventual movement and placement over the main well center 20.

[0024] FIG. 5 shows a side view of the drilling platform, including an upper deck 28, where an opening for the main drill center (20 in FIG. 4) is disposed, and a lower deck 26 disposed below the upper deck 28. The lower deck 26 may include a pipe cart or subsea tree carrier 22A for holding assembled lengths of drilling tools, for example tubular items, for example, riser, MRL, drill pipe, drilling tools, casing, or an umbilical cable, etc. The pipe cart or subsea tree carrier 22A may be used to assemble such lengths of tubular items. In the present example, an external line to be affixed to the riser after at least partial deployment thereof may include a MRL 24. The pipe cart or subsea tree carrier 22A may hold an assembled length thereof for lateral movement toward the main drill center (20 in FIG. 4). The pipe cart or subsea tree carrier 22A may make such movement by being transported along rails 27 on the lower deck 26.

[0025] In the present example method, an external pipe to be secured in the external line guides (11 in FIG. 2) and the lower external line connector (11A in FIG. 3) may be a mud return line (MRL) pipe. A selected length, for example 300 meters, of the MRL pipe 24 may be assembled over the auxiliary well center (22 in FIG. 4) and hung off in the pipe cart or subsea tree carrier 22A. The MRL pipe 24 may be made from substantially rigid conduit segments such as may be made from steel or alloys known in the art for use in conducting fluid under pressure, and connected end to end by, e.g., threaded connections at the longitudinal ends of each conduit segment or by flange couplings. It will be appreciated that threaded connections may reduce the required lateral space for the MRL pipe 24 and enable affixing the MRL pipe 24 closer to the exterior of the riser 12. A guide wire 23 may be deployed through the MRL pipe 24. A standard type ROV operated guide wire anchor (See 60 in FIG. 11A) may be disposed at a lower end of the guide wire 23. In other embodiments, the MRL pipe 24 may be assembled over or proximate the main well center (20 in FIG. 4). MRL pipe assembly may take place prior to, contemporaneously with or after assembly and running of the riser, one example of which will be described further below.
The riser 12 may be assembled over the main drill center (20 in FIG. 4) and extended toward the subsea wellhead (not shown) in accordance with marine drilling riser deployment techniques known in the art. In the present example embodiment, where a SMP module is to be used, at a selected position along the riser 12, the MRJ (13 in FIG. 8) and the SMP module (40 in FIG. 1) may be coupled to the riser 12. It is within the scope of the present disclosure that the SMP module (40 in FIG. 1) will be affixed to the MRJ (13 in FIG. 8) with the riser 12 suspended such that the SMP module (40 in FIG. 1) may be moved along the rails 27 on the lower deck 26 to enable affixing to the drilling riser 12. After the SMP module (40 in FIG. 1) is affixed to the MRJ (13 in FIG. 8), assembly of the riser 12 may continue according to riser assembly and running procedures known in the art. In other embodiments, the SMP module (40 in FIG. 1) may be affixed to the MRJ (13 in FIG. 8) after the riser 12 is substantially completely assembled and is extended to proximate (e.g., within 25 meters) of the wellhead (not shown) on the water bottom.

Referring to FIG. 6, as the riser 12 is assembled, one or more external line guides 11 may be coupled to each riser segment ("joint") and subsequently opened. Opening may be performed, for example, above the water line and below the upper deck (28 in FIG. 5) in the moon pool of the drilling platform as will be explained below with reference to FIG. 7, or may be performed in the water by a ROV. In the present embodiment, such attachment of the external line guides (11 in FIG. 6) may be to the riser joints above the MRJ (13 in FIG. 8), but the scope of the present disclosure is not so limited. When the external line guides 11 are subsequently opened to the position shown in FIG. 6 either by a suitable device disposed below the upper deck (28 in FIG. 5) or after the riser is substantially completely assembled, e.g., such as by using an ROV (not shown), the line retaining line clamp 16 will be positioned outside the external diameter of the buoyancy cans, shown in outline at 18.

In the present example, and referring to FIG. 7, the external line end connector 11A may be moved to the deployment position (open) in the moon pool by the use of a "cherry picker" or utility transporter on the upper deck (28 in FIG. 5) after the SMP module (40 in FIG. 8) is docked on the MRJ (13 in FIG. 8). In another embodiment, the
external line end connector 11A may be moved to the open position shown in FIG. 7 in the water, for example, using an ROV. FIG. 7A shows details of the lower end connector 11A in side view for clarification of an internal flow conduit. The internal flow conduit is shown at 16A and may be coupled hydraulically to the MRL pipe (24 in FIG. 8) when the riser is fully assembled and tensioned.

[0029] Referring to FIG. 8, the SMP module 40 may be observed coupled to the riser 12 on the MRJ 13. A mud outlet conduit 43 may extend from a discharge of the at least one pump on the SMP module 40 to the lower external line end connector 11A affixed to the MRJ 13. Assembly of the riser 12 may then continue, as previously explained, until the bottom of the riser 12 is deployed to a selected distance, for example, approximately 25 meters (80ft) above the subsea wellhead. At such time, an ROV may be operated to connect the guide wire anchor (60A in FIG. 11A) to an anchor base (60B in FIG. 11A) on the lower external line end connector 11A on the MRJ 13.

[0030] Referring to FIG. 9, the pipe cart or subsea tree carrier 22A may then move the previously assembled MRL pipe 24 into a position adjacent to the riser 12 (i.e., in each of the MRL line guides (11 in FIG. 6) while the guide wire 23 is tensioned.

[0031] At this time, the lower end of MRL pipe 24 may be located about 3 meters above a lower external line end connector (16A in FIG. 7A). In the present example embodiment, the ROV may then be used to move the MRL pipe 24 into each retaining line clamp and to close the retaining line clamp (16 in FIG. 6) on each of the external line guides (11 in FIG. 6) Thus, the MRL pipe 24 is locked to the exterior of the riser 12, but may be moved to some extent longitudinally with respect to the riser 12. The guide wire 23 may be removed from the MRL pipe 24 by releasing the guide wire anchor (60A in FIG. 11A) from the anchor base (60B in FIG. 11A) Releasing the guide wire anchor may be performed, for example by using the ROV to lift a release collar (60C in FIG. 11B) or by applying sufficient tension on the guide wire 23 to break a shear pin in a lower release collar (60D in FIG. 11C), either of which will retract anchor tabs (60E in FIG. 11A) that otherwise retain the anchor in the anchor base.
The riser 12 may then be lifted to dock the MRL pipe 24 in the lower external line end connector (11A in FIG. 7) while the ROV makes an optical survey for observation by the system operator. The ROV may fix the MRL pipe 24 by closing the line clamp 16A on the lower external end connector (11A in FIG 7) The MRL pipe 24 may then be removed from the pipe cart or subsea tree carrier 22A, for example, by tensioning the upper end of the MRL pipe 24 toward the riser and removing retaining slips. The riser 12 may then be lowered and hung off using tensioning devices known in the art. Referring to FIG. 10, an upper guide and gooseneck 46 with an American Petroleum Institute (API) qualified hose storm loop 48 may be coupled to the upper end of the MRL pipe 24. A hang-off bracket and tensioner chain/wire with a turnbuckle may be assembled to a lug on the gooseneck 46.

The riser 12 may then then be lowered to the wellhead and locked thereto, for example, using the ROV. The riser may then be tensioned to a pre-defined tension value by lifting on a riser tensioning ring (not shown) of any type known in the art. A gas handler and telescopic riser joint may be deployed and hung off in the riser tensioner ring to complete assembly of the riser 12. In the present example, the gooseneck 46 may be suspended at a depth of about 15 meters in the water upon final assembly of the riser 12.

During operation of the present example embodiment, fluid may be withdrawn from the interior of the riser 12 through the MRJ 13 into an intake port of the at least one pump on the SMP module 40. Discharge from the at least one pump may then be directed through the MRL pipe 24, the API hose storm loop 48 and back to drilling fluid processing equipment (not shown) on the drilling platform.

Disassembly of the riser and MRL pipe may be performed by reversing the above described procedure.

If the external line is, for example an umbilical cable, the pipe cart or subsea handling system may be substituted by a winch. The winch may be used to extend a selected length of umbilical cable for eventual coupling to the line guides as explained above with reference to the MRL pipe. The winch may be fixed position or may move laterally, e.g., along the rail on the lower deck of the drilling platform.
A riser and external line assembly method according to the present disclosure may enable relatively rapid assembly of an additional external rigid fluid line to a deployed riser, e.g., for use with a docked subsea mudlift pump and associated mud return line. The line guides and lower external line end connector are retractable and do not influence deployment of the riser significantly as the line guides can pass through the drill floor main well center opening unrestricted when in the folded position. Deploying and attaching the additional external line, such as a MRL pipe, after the riser has been deployed may have several advantages. First, existing types of marine riser would not need significant modification, which may have high cost and long construction time. Second, such procedure may allow a mudlift system to have wider application as only one special joint of riser is needed as opposed to modifying many joints with an extra return line. Any impact on health, safety and the environment may be reduced because the line guides may be affixed to the riser above the drilling deck and/or prior to mobilizing the riser from land shore base to the rig, and not over open water in the moon pool. Such operation may reduce the risks for operators working in the crowded moonpool or from falling while working with heavy objects over open water, or from dropping line guides into the water. The number of ROV operations may be reduced, again because the line guides may be affixed to the riser before each riser joint is lowered into the water. Reducing the number of ROV operations may assist in reducing operating time and expense when running or retrieving the drilling riser. Finally, because most of the mud return line or other external line may be made from rigid conduit material and is fixed in place with respect to the riser, it may be less susceptible to damage than other forms of mud return line used in connection with subsea mudlift drilling known in the art. Methods according to the present disclosure may provide similar benefits when used to assemble other types of external line to a partially or substantially fully deployed marine riser.

While the invention has been described with respect to a limited number of embodiments, those skilled in the art, having benefit of this disclosure, will appreciate that other embodiments can be devised which do not depart from the scope of the
invention as disclosed herein. Accordingly, the scope of the invention should be limited only by the attached claims.
Claims

What is claimed is:

1. A method for assembling a marine drilling riser, comprising:
   assembling a predetermined number of sections of the marine drilling riser and extending
   the assembled sections into a body of water from a drilling platform, the
   assembling including affixing a selected number of external line guides to the
   riser at selected longitudinal positions along the riser, the external line guides
   initially in a folded position traversing a dimension at most substantially equal to
   a diameter of buoyancy devices affixable to the riser;
   moving the external line guides to an open position such that a line clamp on each line
   guide extends beyond the diameter of the buoyancy devices;
   moving a predetermined length of external line to adjacent the assembled riser and
   coupling the external to a line clamp on each of the external line guides;
   closing the line clamp on each of the external line guides; and
   completing assembly of the riser and applying tension thereto.

2. The method of claim 1 wherein the external line comprises a mud return line in fluid
   communication at one end to an outlet of a subsea mudlift pump.

3. The method of claim 2 wherein the one end of the mud return line is coupled to a
   connector affixed to an exterior of the riser proximate the subsea mudlift pump, and
   wherein the subsea mudlift pump is coupled to an exterior of the riser on a modified riser
   joint.

4. The method of claim 2 wherein the coupling the mud return line to the connector
   comprises lifting the riser to engage the mud return line with the connector.

5. The method of claim 1 wherein the assembling the predetermined length of external line
   is performed at a selected lateral distance from a main well center on the drilling
   platform.
6. The method of claim 5 wherein the moving the predetermined length of external line comprises moving a pipe cart or subsea tree carrier laterally toward the predetermined number of sections of riser.

7. The method of claim 1 wherein the external line guides are affixed to the riser in a closed position such that the external line guides extend laterally from the riser at most to an outer diameter defined by buoyancy cans.

8. The method of claim 7 wherein the external line guides are operated to an open position after being lowered through a drilling deck on the drilling platform, the open position extending a pipe retaining line clamp on each external line guide to beyond the outer diameter defined by the buoyancy cans.

9. The method of claim 8 wherein the operating the external line guides is performed either above a water surface in a moon pool of the drilling platform or below a water surface by a remotely operated vehicle.