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(54) **ASSEMBLY AND METHOD FOR SUBSEA WELL DRILLING AND INTERVENTION**

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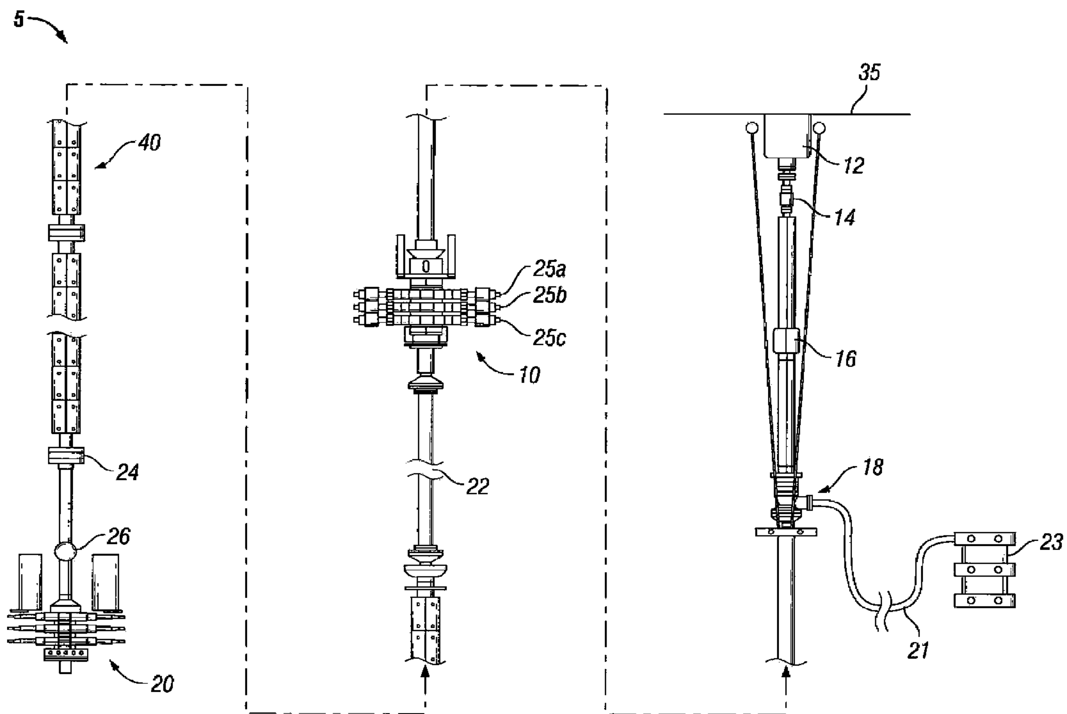
(57) **ABSTRACT**

An assembly suitable for subsea drilling and intervention operations includes a dual blow out preventer system having an upper blow out preventer located between a drill floor and a riser string, and a lower blow out preventer located below the riser string and above a wellhead. The dual BOP system is adapted to enable advanced drilling and intervention operations such as Managed Pressure Drilling ("MPD"), Underbalanced Drilling ("UBD"), or Through Tubing Rotary Drilling ("TTRD") in an offshore deepwater environment.



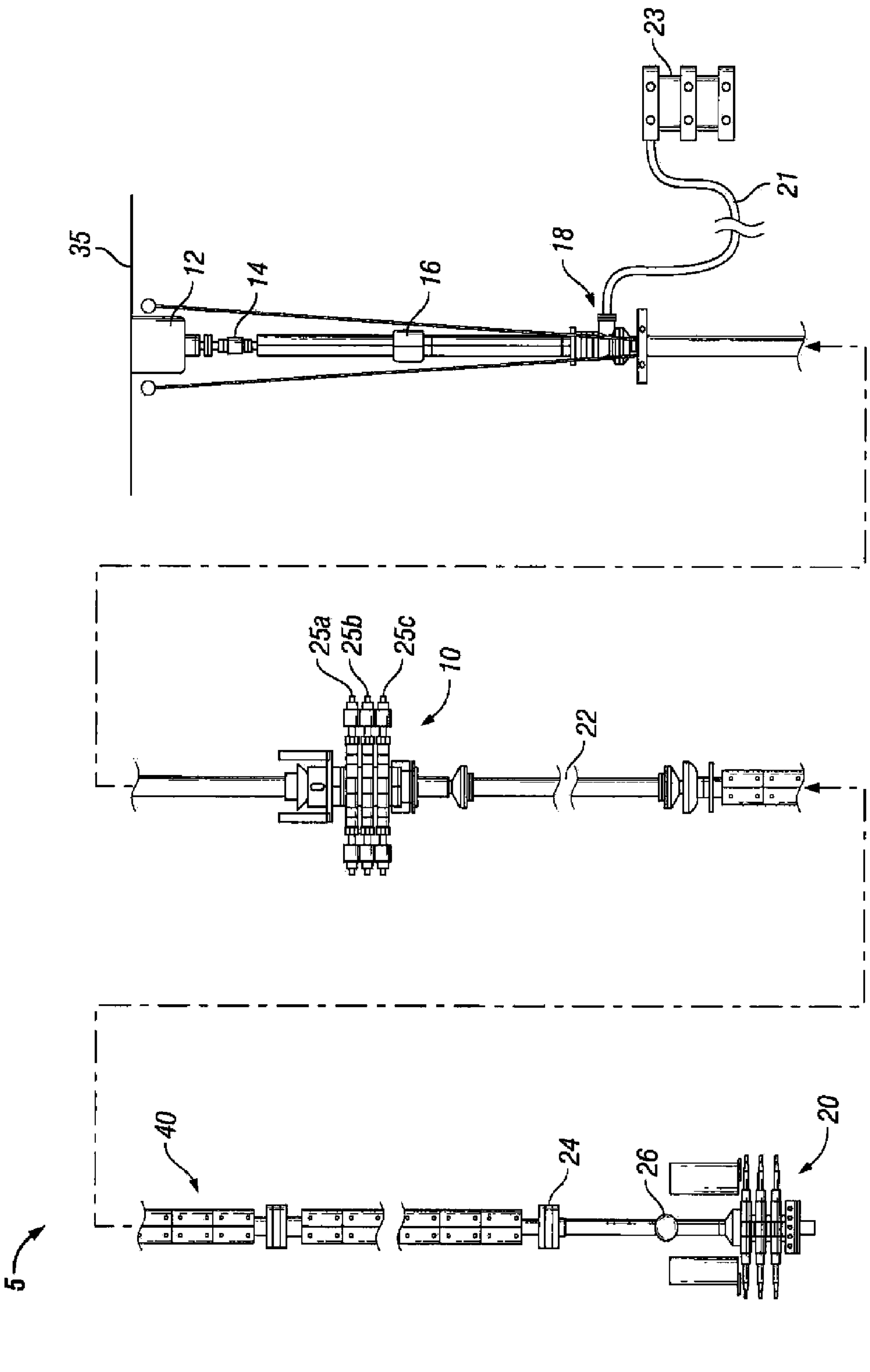


FIG. 1

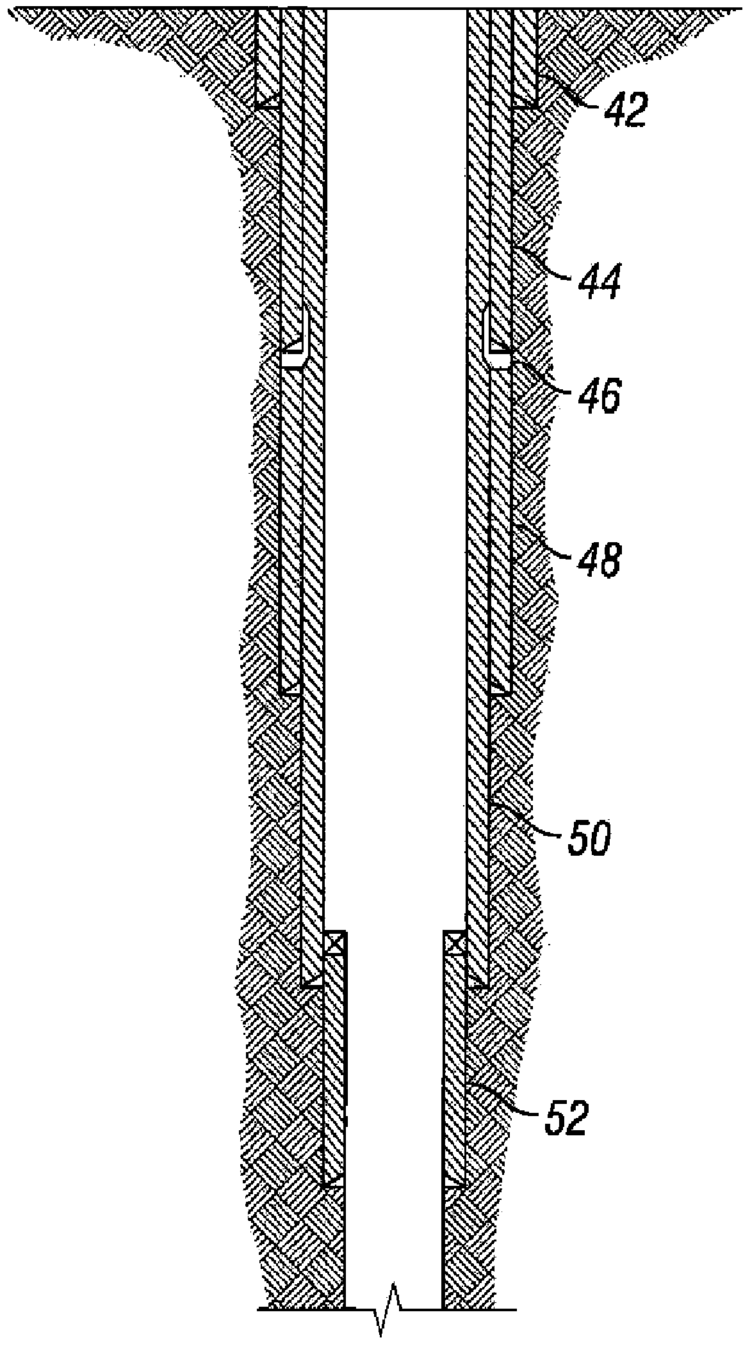


FIG. 2

ASSEMBLY AND METHOD FOR SUBSEA WELL DRILLING AND INTERVENTION

PRIORITY

[0001] The present application claims the benefit of U.S. Provisional Patent Application Ser. No. 61/265,805, entitled "SUBSEA WELL DRILLING AND INTERVENTION METHOD AND APPARATUS," filed on Dec. 2, 2009, naming Gavin Humphreys as inventor, which is hereby incorporated by reference in its entirety.

FIELD OF THE INVENTION

[0002] The invention relates to subsea assemblies used in offshore deepwater operations and the production of hydrocarbons.

DESCRIPTION OF THE RELATED ART

[0003] Hydrocarbon production often requires the placement of drilling equipment in an offshore location. In shallow waters, the rigs and production facilities can be placed on freestanding offshore platforms. As the water becomes deeper, however, use of such platforms becomes impractical. As a result, floating structures, such as drill ships, must be used.

[0004] As the desire to drill at greater water depths increases (e.g., to at least 7,500 ft water depth), floatable support structures have become larger due to the amount of pipe required to drill at such depths. In addition, the physical size and height of the drilling derrick or other type of hoisting tower of the ship also limits the locations in which it can travel. For example, large drillships may not be able to travel through such waterways as the Suez or Panama Canals due to height constraints across the canals, and likewise may not be able to travel under the bridge in the Bosphorous (mouth of the Black sea) due to the height of their drilling derricks or hoisting tower on the drillship. It is often necessary to travel around such waterways, which greatly increases the travel costs and time.

[0005] In addition, conventional deepwater rigs cannot efficiently perform some advanced drilling operations. For example, in recent years, Managed Pressure Drilling ("MPD") and Underbalanced Drilling ("UBD") have become increasingly more relevant to drilling wells that were previously deemed un-drillable or to drill wells where subsurface pore pressures and fracture gradients have converged requiring drilling fluid weights to be tailored to drill through very tight subsurface pressure windows. The conventional deepwater rigs that utilize a single subsea blowout preventer ("BOP") on the seabed which is tied back to the drillship with a relatively low pressure marine riser that is not designed to withstand closed in internal pressure (designed for flow only) lack the pressure integrity in the riser to routinely carry out either MPD nor UBD due to the marine risers' lack of internal pressure integrity (typically a 21¼ inch marine riser has a burst pressure at the time of manufacture of approximately 1,000 psi, which cannot be field tested during the riser's life-time). Limited MPD is also performed where a rotating control head ("RCH") is installed on to a collapsed telescopic joint; however, costly pressurized mud cap drilling technology is required.

[0006] Although some pressurized interventions are being done from rigs, they involve dedicated intervention risers (typically slim completion/production riser for intervention with electric or slick wire-line, Coil Tubing, or Through Tubing Rotary Drilling ("TTRD")) generally with increased costs as they are provided by a third party contractor to compliment the conventional drilling BOP system.

[0007] In view of the foregoing, a need exists for highly mobile floatable structures capable of drilling in deepwater environments. It would be advantageous if the structures were smaller than conventional floatable structures and cost substantially less to build and operate. In addition, there is a need for a floatable structure capable of utilizing drilling technologies such as MPD and UBD in deepwater environments.

SUMMARY OF THE INVENTION

[0008] Floatable structures used in deepwater drilling and intervention are provided as embodiments of the present invention. The systems and methods described herein allow operators to perform MPD, UBD, or TTRD) in deep water applications. In an exemplary embodiment, the floatable structure includes a dual BOP system comprising an upper blow out preventer ("UBOP") and a lower blow out preventer ("LBOP"). The UBOP is located between a drill floor and above a riser string, while the LBOP is located below the riser string and above a wellhead. The riser utilizes a slim design adapted to withstand a high pressure environment. The UBOP, LBOP, and riser combine to form a riser system that has the same high pressure integrity from top to bottom, essentially forming an extension of the wellbore. In addition, an expandable intermediate liner may be tripped down the riser and installed below a slim surface casing, thus saving a casing string size. Also, the present invention allows the well to be designed to effectively reduce the number of casing strings by using MPD or UBD drilling technology.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. **1** is a diagram of a dual BOP system made in accordance with an exemplary embodiment of the present invention; and

[0010] FIG. **2** is a diagram of an expandable casing string as run in accordance with an exemplary methodology of the present invention.

DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

[0011] Illustrative embodiments and methodologies of the invention are described below as they might be employed to allow users to perform advanced drilling and intervention operations in deep water environments. In the interest of clarity, not all features of an actual implementation or methodology are described in this specification. 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' 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 of the invention will become apparent from consideration of the following description and drawings.

[0012] Referring to FIG. **1**, an exemplary embodiment of the present invention is illustrated. As shown in FIG. **1**, a floatable structure includes a vessel (not shown), such as a drill ship, and a dual BOP/riser system **5** coupled beneath the floor of the vessel. Dual BOP/riser system **5** comprises an upper blow out preventer ("UBOP") **10** and a lower blow out preventer ("LBOP") **20**. As will be described in detail later, the drill ship may be a DrillSLIM™ or SLIMDRILL™ drill ship designed by Stena Drilling Ltd. of Scotland, U.K., which is the Assignee of the present invention. The UBOP **10** is located below drill floor **35** and above riser string **40**. LBOP **20** is located below riser string **40** and above a wellhead (not shown). A bag preventer (not shown) may also be located above UBOP **10**. Extending below drill floor **35** is a diverter assembly **12** having a flex joint **14** coupled beneath it. Diverter assembly **12** may include, for example, **16** inch overboard lines to the port and starboard sides of the ship.

[0013] Flex joint **14** connects to slip joint assembly **16**, which can be a triple barrel slip joint assembly having a 50 ft stroke. Assembly **18** is coupled beneath slip joint assembly **16** and includes a high pressure spacer joint with a load ring and blafro flange. This exemplary embodiment also includes a rotating control head ("RCH") in assembly **18**, which is installed above the high pressure spacer joint to enable MPD or UBD. In addition to MPD and UBD, other drilling techniques can be used with the present invention as will be apparent to those of skill in the art having the benefit of this disclosure. A flexible line **21** is tied into an independent choke manifold **23**, which may be located in the substructure of the drill ship, to facilitate the application of MPD or UBD drilling technology and is totally independent from the main rig kill and choke lines.

[0014] Further referring to the exemplary embodiment of FIG. **1**, UBOP **10** is coupled beneath assembly **18** and includes at least three sets of rams, **25***a*, **25***b*, **25***c*, wherein at least two of the three sets of rams comprise variable bore rams ("VBR") rated at 10K psi. In the alternative, rams **25***a*, **25***b*, and **25***c* include one 9⅝ inch casing ram and two 2⅞-5.5 inch VBR. UBOP **10** can also include, for example, a 13⅝ inch annular preventer rated at 5K psi. Upper stress joint **22** is coupled beneath UBOP **10** and connects to riser string **40**, and may be a 13⅝ inch triple barreled telescopic joint with up to a 50 ft stroke. UBOP **10** also includes a choke/kill manifold with inlets from below the rotating elements of the RCH and an independent choke manifold with self-adjusting chokes for MPD and UBD.

[0015] Riser string 40 may be a 13⅝ inch inner diameter ("ID"), high pressure 10K riser, having kill and choke lines from the seabed to the surface. Conventional drilling marine risers (generally utilized with a subsea BOP on the seabed) are designed to control drilling fluid flow and have sufficient burst pressure strength at the seabed to hold the pressure differential between the heaviest drilling mud inside the riser against seawater pressure outside the riser. A high pressure riser can also withstand these physical properties, but it can also be sealed up at the top of the riser and be subjected to up to 10,000 psi additional pressure in the event that an activity may require the riser to be pressured. Riser string **40** may also include a design that includes a 10,000 psi burst rating, and also be able to comply with stringent dimensional requirements for handling and storage on the deck of the drill ship to keep the ship size to a minimum.

[0016] For example, the riser can be approximately 7,500 ft of 13⅝ inch ID×10K (120 joints) with two choke/kill lines which would allow for high pressure pumping outside riser string **40**. The joints can be 65 ft long with high strength connectors, weigh +/−21 T (dry), and have a 45 inch outer diameter ("OD") with buoyancy. Riser string **40** is kept in tension by a substructure mounted tensioner system, rated to 2.4 million lbs with 14.0 ppg (1.68 specific gravity (SG)) fluid inside the riser.

[0017] The riser system also has 10,000 psi kill and choke line (generally associated with subsea BOP control systems) to facilitate conventional seabed well control techniques or to monitor and control pressures below a sealed LBOP if the riser system is used as a lubricator while using MPD or UBD drilling technologies.

[0018] In further reference to the exemplary embodiment of FIG. **1**, lower stress joint **24** is coupled beneath riser string **40** and connects to high pressure ball valve **26** to contain the mud when emergency disconnect is initiated. LBOP **20** includes at least three sets of rams **30***a*, **30***b*, **30***c*, which can include, for example, one pipe ram to hang-off the drill pipe and two blind shear rams with fail safe closed connections to monitor pressure build up in the event the well is closed in on the blind rams. LBOP also includes an emergency disconnect and a wellhead connector. In the alternative, LBOP **20** may be comprised of super shear blind/shear rams in order to shear and seal on the 9.5/8 inch casing and heavier drill pipe. LBOP **20** and the lower riser package enable the well to be closed in at seabed level, and the high pressure riser string **40** to be disconnected.

[0019] In this exemplary embodiment, LBOP **20** and the lower riser package are controlled by a multiplex system with acoustic backup including: duplicate umbilical control reels for approximately 7500 ft water depth and a modular emergency subsea accumulator pack (set on seabed) that is connected using a remotely operated vehicle (ROV). UBOP **10** can be controlled by a pilot hydraulic control system. The controls for both UBOP **10** and LBOP **20** can be adjacent to each other on the same panels. The hydraulic disconnect package or lower riser package can include an inverted connector with acoustic control back up. Those ordinarily skilled in the art having the benefit of this disclosure realize these and a variety of other components may be utilized within the riser package of the present invention.

[0020] Accordingly, through the use of LBOP **20**, high pressure riser string **40**, UBOP **10**, and an RCH designed into the riser system, the present invention provides the ability to utilize MPD and UBD in deep water offshore applications. Riser string **40** and UBOP **10** act as an extension of the wellbore for drilling operations facilitating MPD and UBD operations. As such, the riser system between UBOP **10** and LBOP **20** holds the same pressure as UBOP **10** and LBOP **20**, thereby creating a deepwater drilling BOP and riser system that has the same high pressure integrity from top to bottom. Similarly, riser string **40** can act as a very long lubricator for pressurized well interventions by also using LBOP **20** and UBOP **10** together with an RCH for MPD, UBD, and TTRD well intervention applications.

[0021] Referring to the exemplary embodiment of FIG. **2**, the present invention provides the ability to drill a slimmed down (top hole) well design where an expandable intermediate liner is installed below slim surface casing, thus saving a casing string size. An exemplary method of the present invention will now be described. Expandable liners, as understood in the art, are utilized in this exemplary methodology. The well of FIG. **2** is located at a water depth of approximately 7,500 ft, having a total depth ("TD") of approximately 22,500 ft. Surface casing **42** and intermediate casing **44** are run and cemented prior to running the 13.5/8 inch×10,000 psi dual BOP/riser system **5**. Generally, intermediate casing **44** will be one API size smaller than the typical casing run before the placing of a BOP in a conventional well design. For example, intermediate casing **44** may be a 13⅜ inch casing string, while such casing would typically be a 20 inch casing string in a conventional well design.

[0022] After setting surface casing **42** and intermediate casing **44** (13.3/8 inch), dual BOP/riser system **5** is run. Thereafter, if required, the next hole section is drilled with a bi-centered bit or under-reamed to 16 inches/17½ inches. Then, solid expandable liner **48** is run and expanded to seal at the junction of shoe **46**. In this exemplary embodiment, expandable liner **48** is an 11¾ inch OD solid expandable liner that when expanded has the same drift diameter as the previously set 13⅜ inch casing. This now makes the casing shoe depth of the present invention equivalent to that of a conventional casing design. Those skilled in the art having the benefit of this disclosure realize that in wells that only require four casing/liner strings to get to TD, or have a TD liner smaller than 7 inches, the use of expandable liner may not be necessary. Additionally, those same skilled persons realize other casing/liner types may be utilized with the present invention. Once expandable liner **48** is set, then all further drilling activity will be performed as understood in the art.

[0023] Further referring to the exemplary methodology of FIG. **2**, in order to secure the 12¼ inch drift for expanded casing/liner, the expansion system and method must be taken into account to determine the necessary surface casing size, as would be understood by one skilled in the art having the benefit of this disclosure. The well can then be drilled with a 12¼ inch bit for a 9⅝ inch casing string **50** or a 9⅝ inch liner string (subject to well design criteria) at approximately 17,500 ft, for example, and finished using a 8½ inch hole and 7 inch production liner **52** at approximately 22,500 ft, for example. The sizes and methods used herein are exemplary in nature as would be understood by one skilled in the art having the benefit of this disclosure. For example, the systems and methods described herein can be used in water depths less than or greater than approximately 7,500 ft. Accordingly, the present invention allows the well to be designed to effectively reduce the number of casing strings by using MPD or UBD drilling technology to continually monitor subsurface pore pressures and set casing in the appropriate subsurface pressure regime.

[0024] The drill ship or drilling semi-submersible with identical drilling technology functionality utilized with the present invention will now be described. The drill ship may include various types of equipment useful in deep water drilling. As previously stated, an exemplary drill ship is the 145-8×29-31 m DrillSLIM™. Use of DrillSLIM™, or similar designs, allows efficient movement around the world by the most direct routes (e.g., through the Suez and Panama Canals and under the Bosporus Bridge), which substantially reduces transit times and costs. The ship's hoisting tower arrangement mounted to a deck of the drill ship is specifically designed to telescope inward to ensure when collapsed the top of the hoist sheaves can pass under the bridges on the Panama and Suez canals and under the Bosphorous bridge into the Black Sea while the drill ship is in transit draft. The hoisting tower would include sufficient racking capacity for a full drill string for water depths of at least about approximately 7,500 ft. As an example using approximately 7,500 ft water depth as a basis, the heaviest load of 355 tons (T) occurs when the approximately 7,500 ft of riser, two sets of BOP's, ancillary and travelling equipment are run. A 500 ton hoist rating can be used to allow some margin of safety. The hoisting tower would further include hoisting capacity to hoist double drill pipe joints for use in drilling wells in water depths of at least approximately 7,500 ft; a hoisting capacity to hoist casing for use in drilling wells in water depths of at least approximately 7,500 ft; or combinations thereof.

[0025] In addition, the drill ship can also include active pit tank capacity to fully displace a largest hole volume over to another mud or brine system for use in drilling wells in water depths of at least approximately 7,500 ft; full mud treatment and cuttings containment, with the ability to mix new mud and brine simultaneously, for use in drilling wells in water depths of at least approximately 7,500 ft; liquid and dry bulk storage for use in drilling wells in water depths of at least approximately 7,500 ft; deck space and services for electric and slick line, cementing, well testing, well simulation, coiled tubing, MPD/UBD operations, drill cutting operations, or combinations thereof for use in drilling wells in water depths of at least approximately 7,500 ft; or combinations thereof. The floatable structure may further include various combinations of the types of equipment described herein.

[0026] For example, the active pit system can be 6,460 bbls (1027 m^3) plus five treatment tanks of 60 bbls (9.5 m^3) each. The active pits can be split in half for two independent mud/brine systems with two independent automated mud/brine mixing facilities for concurrent operations. Liquid storage can include 9,749 bbls (1,550 m^3) of drill water, 2,139 bbls (340 m^3) of base oil, and 1,572 bbls (250 m^3) of brine. Three conventional triplex pumps with approximately 7,500 psi fluid ends can provide for all downhole pumping operations. Solids control can be provided by four linear motion shale shakers, a desander, a desilter, a degasser, and space for two contractor supplied centrifuges. Solids disposal can be via one double self cleaning screw conveyor feeding into a big bag turntable station. Dry bulk storage can include six×60 m^3 tanks, (one bentonite, three barite and two cement) with three×6 m^3 surge tanks The cement unit can be contractor supplied and also provide pressure testing and emergency pumping services. Those ordinarily skilled in the art having the benefit of this disclosure realize other types of equipment can be used with the present invention, such as those used in controlling mud and solids, as well as cement systems.

[0027] The exemplary drill ship may further include hoisting and handling equipment. A single hoisting tower with a ram type hoist having a clear working height of 120 ft for drilling, along with a top drive and double joints of range two drill pipe, can be included. Dead line compensation can be included for drill string motion compensation. The hoisting tower can further include a hydraulic racking system with setback for 22,500 ft of 5 inch drill pipe and drill collars. A remote operated iron roughneck can be provided on the drill floor **35** for tubular make-up and break-out. A skidding and trolley system below the substructure can be provided for handling and storing the two×13⅝ BOP stacks and up to two subsea Xmas trees. Additionally, at moon pool level, there can be a retractable dummy riser spider trolley to hang off the BOP while the load ring and telescopic joints are installed.

[0028] The exemplary drill ship described herein can further include three hydraulic knuckle boom cranes: a compensated crane rated to 120 T in port/60 T offshore for handling BOP equipment, Xmas trees, and for construction activities; a 20 T rated crane to serve the aft deck and mud treatment deckhouse; and a 25 T rated crane for loading tubulars from the quay to the riser racks. The systems and methods described herein can also include two horizontal catwalks, one forward for riser transport and one aft for drill pipe/casing both at drill floor **35** elevation. One gantry crane can be installed on the riser storage area and one gantry crane over the aft pipe storage area. A tubular handling overhead crane and a vertical pipe elevator can be installed in the pipe hold in the hull. Other types of hoisting and handling equipment that can be used in the present invention will be apparent to those of skill in the art having the benefit of this disclosure.

[0029] The exemplary drill ship described herein will also include rotating equipment. For example, rotating the drill string can be a 500 tons AC motor driven top drive. A conventional 49½ inch rotary table can be fitted for tubular support and can be driven by a hydraulic motor for limited rotational capability. Other suitable types of rotating equipment will be apparent to those of skill in the art having the benefit of this disclosure.

[0030] The exemplary drill ship described herein further includes drilling tools. In an aspect, for example, approximately 22,500 ft each of 5 inch and 3½ inch high grade drill pipe, and ten each of 8 inch, 6½ inch and 4¾ inch drill collars, all with handling and fishing tools can be included. The types and amounts of drilling tools included will vary depending upon the needs of each system as will be apparent to those of skill in the art having the benefit of this disclosure.

[0031] The exemplary drill ship also includes utility systems. The electrical power system can include variable speed AC drives for the mud pumps and top drive, with a normal drilling load of 3.0 Megawatts (MW). The hoisting system can be hydraulically powered through a central HPU. The types and amounts of utility systems included in embodiments of the present invention will vary depending upon the needs of each system as will be apparent to those of skill in the art having the benefit of this disclosure.

[0032] The exemplary drill ship can be powered by six 4.7 MW main diesel electric alternator sets with propulsion from five fixed pitch, variable speed thrusters with a combined power of 17.3 MW. The thrusters can be configured for independent and integrated operation with the dynamically positioned vessel to IMO class 3. All systems can be designed and installed to ensure that adequate redundancy is maintained and that no single failure will result in loss of positional keeping or operational performance.

[0033] The exemplary drill ship can also have an endurance of sixty days (typically thirty days transit and thirty days dynamically positioned), and operations can be designed to be carried out without assistance from other vessels. The ship's service speed can be around fourteen knots. The helideck can be rated for S61, S92, EC225 & Super Puma helicopters. One 25 m burner boom can be mounted on the port stern for flaring operations.

[0034] Using embodiments of the present invention, smaller riser strings are used and less casing strings are necessary. As a result, smaller drill ships can be used, in less hostile geological and pore pressure regime environments where less casing is required, thereby cutting conventional operating costs in half and reducing well costs by half Conventional dual activity drill ships have four drill crews (two well centers), while the drill ships constructed and used in accordance with embodiments of the present invention are expected to have only two drill crews (one well centre). The crew rate will be +/−70% of that of the larger drill ships. Furthermore, the all up day spread rate (including services and fuel) for the large drill ship are expected to be in the region of $750-$800,000/day, while the expectation for use of the systems and methods described herein is expected to be one-half to two-thirds that spread rate.

[0035] In addition, well intervention workovers into an existing subsea well to move the "drainage point" in the reservoir using TTRD technology to increase reserves base also becomes viable as the dual BOP/riser system **5** will enable an RCH to be installed at surface to facilitate MPD drilling technology, which is relevant when reservoir pore pressures are in decline causing convergences of the pore pressure-fracture gradient window. Without the high pressure riser of the present invention, this cannot be achieved using conventional subsea stack-marine riser systems.

[0036] An exemplary embodiment of the present invention provides a subsea assembly for use in subsea operations, the assembly comprising a slip joint assembly located beneath a vessel floor; a rotating control head located beneath the slip joint assembly; an upper blow out preventer ("UBOP") located beneath the rotating control head; an upper stress joint located beneath the UBOP; a riser string located beneath the upper stress joint; a lower stress joint located beneath the riser string; a lower blow out preventer ("LBOP") located beneath the lower stress joint; and a wellhead located beneath the LBOP. In another embodiment, the riser string has a pressure rating that is the same as a pressure rating of the UBOP and LBOP. In yet another embodiment, the assembly is used in an offshore deepwater environment. In the alternative, the assembly is adapted to perform at least one of a Managed Pressure Drilling, Underbalanced Drilling, or Through Tubing Rotary Drilling operation. In yet another embodiment, the riser string is sized for running casing having an API size less than or equal to 13⅜'. The vessel may also have a length of no more than 148 meters and a width of no more than 28 meters. In yet another embodiment, the vessel is adapted to drill wells in water depths of at least 7,500 ft.

[0037] An exemplary methodology of the present invention provides a method for use in a subsea operation, the method comprising the steps of (a) providing a slip joint assembly located beneath a vessel floor; (b) providing a rotating control head located beneath the slip joint assembly; (c) providing an upper blow out preventer ("UBOP") located beneath the rotating control head; (d) providing an upper stress joint located beneath the UBOP; (e) providing a riser string located beneath the upper stress joint; (f) providing a lower stress joint located beneath the riser string; (g) a lower blow out preventer ("LBOP") located beneath the lower stress joint; and (f) providing a wellhead located beneath the LBOP. In another methodology, step (e) further comprises the step of providing the riser string with a pressure rating that is the same as a pressure rating of the UBOP and LBOP. In yet another methodology, the method further comprises the step of performing the subsea operation in an offshore deepwater environment. In another methodology, the method further comprises the step of performing at least one of a Managed Pressure Drilling, Underbalanced Drilling, or Through Tubing Rotary Drilling operation. In another methodology, the method further comprises the step of tripping a liner having an API size less than or equal to 13⅜" through the riser string. In yet another, the method further comprises the step of providing the vessel with a length of no more than 148 meters and a width of no more than 28 meters.

[0038] Another exemplary embodiment of the present invention provides a subsea assembly for use in subsea operations, the assembly comprising an upper blow out preventer ("UBOP") located beneath a vessel floor; a riser string located beneath the UBOP; and a lower blow out preventer ("LBOP") located beneath the riser string and operatively coupled to a wellhead. In another embodiment, the riser string has a pressure rating that is the same as a pressure rating of the UBOP and LBOP. In yet another embodiment, a pressure rating of the UBOP, riser string, and LBOP is at least 10,000 psi. In another embodiment, the assembly is used in an offshore deepwater environment. In yet another embodiment, the assembly is adapted to perform at least one of a Managed Pressure Drilling, Underbalanced Drilling, or Through Tubing Rotary Drilling operation. In yet another embodiment, the riser string is sized for running casing having an API size less than or equal to 13⅜". An exemplary embodiment may also comprise a rotating control head. In another embodiment, the vessel has a length of no more than 148 meters and a width of no more than 28 meters. In yet another embodiment, the vessel is adapted to drill wells in water depths of at least 7,500 ft.

[0039] Another exemplary methodology of the present invention provides a method for use in subsea operations, the method comprising the steps of (a) providing a vessel having a floor; (b) providing an upper blow out preventer ("UBOP") located beneath the floor; (c) providing a riser string located beneath the UBOP; (d) providing a lower blow out preventer ("LBOP") located beneath the riser assembly; and (e) connecting the LBOP to a wellhead beneath the LBOP. In another methodology, the method further comprises the step of providing the riser string with a pressure rating that is the same as a pressure rating of the UBOP and LBOP. In yet another, the method further comprises the step of providing the UBOP, riser string, and LBOP with a pressure rating of at least 10,000 psi. In another methodology, the method further comprises the step of performing the subsea operations in an offshore deepwater environment. In yet another, the method further comprises the step of performing at least one of a Managed Pressure Drilling, Underbalanced Drilling, or Through Tubing Rotary Drilling operation. In another methodology, the method further comprises the step of tripping liner down the riser string, the liner having an API size less than or equal to 13⅜". In yet another methodology, the method further comprises the step of locating a rotating control head beneath the UBOP. In another exemplary methodology, step (a) further comprises the step of providing the vessel with dimensions of no more than 148 meters in length and no more than 28 meters in width. In yet another, the method further comprises the step of drilling a well at a water depth of at least 7,500 ft.

[0040] Another exemplary embodiment of the present invention provides a subsea assembly for use in subsea operations, the assembly comprising a vessel having a floor; and a riser string located beneath the floor, wherein the assembly is adapted to perform at least one of a Managed Pressure Drilling, Underbalanced Drilling, or Through Tubing Rotary Drilling operation. In another embodiment, the assembly further comprises an upper blow out preventer ("UBOP") located above the riser string; a lower blow out preventer ("LBOP") located below the riser string; and a wellhead located beneath the LBOP. In yet another, the riser string is adapted to withstand at least 10,000 psi.

[0041] Another exemplary methodology of the present invention provides a method for use in subsea operations, the method comprising the steps of (a) providing a vessel having a floor; (b) providing a riser string located beneath the floor; and (c) performing at least one of a Managed Pressure Drilling, Underbalanced Drilling, or Through Tubing Rotary Drilling operation. In another exemplary methodology, the method further comprises the steps of providing an upper blow out preventer ("UBOP") located above the riser string; providing a lower blow out preventer ("LBOP") located beneath the riser string; and providing a wellhead located beneath the LBOP. In yet another, the method further comprises the step of adapting the riser string to withstand at least 10,000 psi.

[0042] All of the embodiments and methodologies of the present invention disclosed and claimed herein can be made and executed without undue experimentation in light of the present disclosure. While the invention is susceptible to various modifications and alternative forms, specific embodiments have been shown by way of example in the drawings and have been described in detail herein. However, it should be understood that the invention is not intended to be limited to the particular forms disclosed. For example, it will be apparent that certain components that are useful in drilling can be substituted for the components described herein, or additional components can be used to drill the deep water wells, while achieving the same or similar results. Accordingly, the intention is to cover all modifications, equivalents and alternatives falling within the spirit and scope of the invention as defined by the appended claims.

What is claimed is:

1. A subsea assembly for use in subsea operations, the assembly comprising:

a slip joint assembly located beneath a vessel floor;

a rotating control head located beneath the slip joint assembly;

an upper blow out preventer ("UBOP") located beneath the rotating control head;

an upper stress joint located beneath the UBOP;

a riser string located beneath the upper stress joint;

a lower stress joint located beneath the riser string;

a lower blow out preventer ("LBOP") located beneath the lower stress joint; and

a wellhead located beneath the LBOP.

2. An assembly as defined in claim **1**, wherein the riser string has a pressure rating that is the same as a pressure rating of the UBOP and LBOP.

3. An assembly as defined in claim **1**, wherein the assembly is used in an offshore deepwater environment.

4. An assembly as defined in claim **1**, wherein the assembly is adapted to perform at least one of a Managed Pressure Drilling, Underbalanced Drilling, or Through Tubing Rotary Drilling operation.

5. An assembly as defined in claim **1**, wherein the riser string is sized for running casing having an API size less than or equal to 13⅜".

6. An assembly as defined in claim **1**, wherein the vessel has a length of no more than 148 meters and a width of no more than 28 meters.

7. An assembly as defined in claim **1**, wherein the vessel is adapted to drill wells in water depths of at least 7,500 ft.

8. A method for use in a subsea operation, the method comprising the steps of:

(a) providing a slip joint assembly located beneath a vessel floor;

(b) providing a rotating control head located beneath the slip joint assembly;

(c) providing an upper blow out preventer ("UBOP") located beneath the rotating control head;

(d) providing an upper stress joint located beneath the UBOP;

(e) providing a riser string located beneath the upper stress joint;

(f) providing a lower stress joint located beneath the riser string;

(g) a lower blow out preventer ("LBOP") located beneath the lower stress joint; and

(f) providing a wellhead located beneath the LBOP.

9. A method as defined in claim **8**, wherein step (e) further comprises the step of providing the riser string with a pressure rating that is the same as a pressure rating of the UBOP and LBOP.

10. A method as defined in claim **8**, further comprising the step of performing the subsea operation in an offshore deepwater environment.

11. A method as defined in claim **8**, further comprising the step of performing at least one of a Managed Pressure Drilling, Underbalanced Drilling, or Through Tubing Rotary Drilling operation.

12. A method as defined in claim **8**, further comprising the step of tripping a liner having an API size less than or equal to 13⅜" through the riser string.

13. A method as defined in claim **8**, further comprising the step of providing the vessel with a length of no more than 148 meters and a width of no more than 28 meters.

14. A subsea assembly for use in subsea operations, the assembly comprising:

an upper blow out preventer ("UBOP") located beneath a vessel floor;

a riser string located beneath the UBOP; and

a lower blow out preventer ("LBOP") located beneath the riser string and operatively coupled to a wellhead.

15. An assembly as defined in claim **14**, wherein the riser string has a pressure rating that is the same as a pressure rating of the UBOP and LBOP.

16. An assembly as defined in claim **14**, wherein a pressure rating of the UBOP, riser string, and LBOP is at least 10,000 psi.

17. An assembly as defined in claim **14**, wherein the assembly is used in an offshore deepwater environment.

18. An assembly as defined in claim **14**, wherein the assembly is adapted to perform at least one of a Managed Pressure Drilling, Underbalanced Drilling, or Through Tubing Rotary Drilling operation.

19. An assembly as defined in claim **14**, wherein the riser string is sized for running casing having an API size less than or equal to 13⅜".

20. An assembly as defined in claim **14**, further comprising a rotating control head.

21. An assembly as defined in claim **14**, wherein the vessel has a length of no more than 148 meters and a width of no more than 28 meters.

22. An assembly as defined in claim **14**, wherein the vessel is adapted to drill wells in water depths of at least 7,500 ft.

23. A method for use in subsea operations, the method comprising the steps of:

(a) providing a vessel having a floor;

(b) providing an upper blow out preventer ("UBOP") located beneath the floor;

(c) providing a riser string located beneath the UBOP;

(d) providing a lower blow out preventer ("LBOP") located beneath the riser assembly; and

(e) connecting the LBOP to a wellhead beneath the LBOP.

24. A method as defined in claim **23**, further comprising the step of providing the riser string with a pressure rating that is the same as a pressure rating of the UBOP and LBOP.

25. A method as defined in claim **23**, further comprising the step of providing the UBOP, riser string, and LBOP with a pressure rating of at least 10,000 psi.

26. A method as defined in claim **23**, further comprising the step of performing the subsea operations in an offshore deepwater environment.

27. A method as defined in claim **23**, further comprising the step of performing at least one of a Managed Pressure Drilling, Underbalanced Drilling, or Through Tubing Rotary Drilling operation.

28. A method as defined in claim **23**, further comprising the step of tripping liner down the riser string, the liner having an API size less than or equal to 13⅜".

29. A method as defined in claim **23**, further comprising the step of locating a rotating control head beneath the UBOP.

30. A method as defined in claim **23**, wherein step (a) further comprises the step of providing the vessel with dimensions of no more than 148 meters in length and no more than 28 meters in width.

31. A method as defined in claim **23**, further comprising the step of drilling a well at a water depth of at least 7,500 ft.

32. A subsea assembly for use in subsea operations, the assembly comprising:

a vessel having a floor; and

a riser string located beneath the floor, wherein the assembly is adapted to perform at least one of a Managed Pressure Drilling, Underbalanced Drilling, or Through Tubing Rotary Drilling operation.

33. An assembly as defined in claim **32**, wherein the assembly further comprises:

an upper blow out preventer ("UBOP") located above the riser string;

a lower blow out preventer ("LBOP") located below the riser string; and

a wellhead located beneath the LBOP.

34. An assembly as defined in claim **32**, wherein the riser string is adapted to withstand at least 10,000 psi.

35. A method for use in subsea operations, the method comprising the steps of:

(a) providing a vessel having a floor;

(b) providing a riser string located beneath the floor; and

(c) performing at least one of a Managed Pressure Drilling, Underbalanced Drilling, or Through Tubing Rotary Drilling operation.

36. A method as defined in claim **35**, further comprising the steps of:

providing an upper blow out preventer ("UBOP") located above the riser string;

providing a lower blow out preventer ("LBOP") located beneath the riser string; and

providing a wellhead located beneath the LBOP.

37. A method as defined in claim **35**, further comprising the step of adapting the riser string to withstand at least 10,000 psi.

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