

Offshore System with Subsea Riser

Background

[0001] Drilling and producing offshore oil and gas wells includes the use of offshore platforms for the exploitation of undersea petroleum and natural gas deposits. In deep water applications, floating platforms (such as spars, tension leg platforms, extended draft platforms, and semi-submersible platforms) are typically used. One type of offshore platform, a tension leg platform (“TLP”), is a vertically moored floating structure used for offshore oil and gas production. The TLP is permanently moored by groups of tethers, called a tension legs or tendons, that eliminate virtually all vertical motion of the TLP due to wind, waves, and currents. The tendons are maintained in tension at all times by ensuring net positive TLP buoyancy under all environmental conditions. The tendons stiffly restrain the TLP against vertical offset, essentially preventing heave, pitch, and roll, yet they compliantly restrain the TLP against lateral offset, allowing limited surge, sway, and yaw. Another type of platform is a spar, which typically consists of a large-diameter, single vertical cylinder extending into the water and supporting a deck. Spars are moored to the seabed like TLPs, but whereas a TLP has vertical tension tethers, a spar has more conventional mooring lines.

[0002] The offshore platforms typically support risers that extend from one or more wellheads or structures on the seabed to the platform on the sea surface. The risers connect the subsea well with the platform to protect the fluid integrity of the well and to provide a fluid conduit to and from the wellbore. During drilling operations, a drilling riser is used to maintain fluid integrity of the well. After drilling is completed, a production riser is installed.

[0003] The risers that connect the surface wellhead to the subsea wellhead can be thousands of feet long and extremely heavy. To keep the risers as light as possible, they are designed so as to not be able to withstand their own weight, even when in water. In fact, the connectors used to connect sections of some

risers, e.g. production risers, are designed to be weaker than the riser sections themselves. An example of such connectors is a thread and couple connector where the ends of two adjacent riser sections are both threaded into the connector. When the riser is placed under conditions exceeding operating limits, the connectors will actually be the first components to fail.

[0004] To prevent the risers from buckling under their own weight or placing too much stress on the subsea wellhead, upward tension is applied, or the riser is lifted, to relieve a portion of the weight of the riser. Since offshore platforms are subject to motion due to wind, waves, and currents, the risers must be tensioned so as to permit the platform to move relative to the risers. Accordingly, the tensioning mechanism must exert a substantially continuous tension force to the riser within a well-defined range so as to compensate for the movement of the platform.

[0005] Hydro-pneumatic tensioner systems are an example of a riser tensioning mechanism used to support risers. A plurality of active hydraulic cylinders with pneumatic accumulators is connected between the platform and the riser to provide and maintain the necessary riser tension. Platform responses to environmental conditions that cause changes in riser length relative to the platform are compensated by the tensioning cylinders adjusting for the movement.

[0006] Regardless of the tensioning system used, the system must be designed to accommodate with weight and movement characteristics of each riser. However, some risers may require so much tensioning that the loads transferred to the platform exceed the lower allowable load requirements of the platform. A way to accommodate risers when the load requirements exceed the limits of the platform is needed.

Brief Description of the Drawings

[0007] For a detailed description of the preferred embodiments of the invention, reference will now be made to the accompanying drawings in which:

[0008] FIG. 1 shows an off-shore drilling or production system in accordance with various embodiments;

[0009] FIG. 2 shows views of different sections of the riser system of FIG. 1;

[0010] FIG. 3 shows a first example connector in accordance with various embodiments; and

[0011] FIG. 4 shows another example connector in accordance with various embodiments.

Detailed Description

[0012] The following discussion is directed to various embodiments of the invention. The drawing figures are not necessarily to scale. Certain features of the embodiments may be shown exaggerated in scale or in somewhat schematic form and some details of conventional elements may not be shown in the interest of clarity and conciseness. Although one or more of these embodiments may be preferred, the embodiments disclosed should not be interpreted, or otherwise used, as limiting the scope of the disclosure, including the claims. It is to be fully recognized that the different teachings of the embodiments discussed below may be employed separately or in any suitable combination to produce desired results. In addition, one skilled in the art will understand that the following description has broad application, and the discussion of any embodiment is meant only to be exemplary of that embodiment, and not intended to intimate that the scope of the disclosure, including the claims, is limited to that embodiment.

[0013] Certain terms are used throughout the following description and claims to refer to particular features or components. As one skilled in the art will appreciate, different persons may refer to the same feature or component by different names. This document does not intend to distinguish between components or features that differ in name but not function. The drawing figures are not necessarily to scale. Certain features and components herein may be shown exaggerated in scale or in somewhat schematic form and some

details of conventional elements may not be shown in interest of clarity and conciseness.

[0014] In the following discussion and in the claims, the terms “including” and “comprising” are used in an open-ended fashion, and thus should be interpreted to mean “including, but not limited to... .” Also, the term “couple” or “couples” is intended to mean either an indirect or direct connection. Thus, if a first device couples to a second device, that connection may be through a direct connection, or through an indirect connection via other devices, components, and connections. In addition, as used herein, the terms “axial” and “axially” generally mean along or parallel to a central axis (e.g., central axis of a body or a port), while the terms “radial” and “radially” generally mean perpendicular to the central axis. For instance, an axial distance refers to a distance measured along or parallel to the central axis, and a radial distance means a distance measured perpendicular to the central axis.

[0015] Referring now to FIG. 1, a schematic view of an offshore system 10 is shown. In this example, the system 10 is an offshore production system and includes a riser 14 between a floating platform or vessel 16 and a subsea wellhead 12 on the sea floor 13. Because the example shown is a production system, the riser is designed as a production riser. However, it should be appreciated that the offshore system 10 and the riser 14 may also be designed and configured for drilling operations in accordance with different embodiments as well. As shown in FIG. 1, mooring lines or tendons 15 may be provided to attach the floating platform 16 to the sea floor.

[0016] In the example shown in FIG. 1, the riser 14 connects with the platform 16 (in this example, a SPAR-type platform). Other types of floating structures 16 that can be used with the invention include floating production storage and offloading (FPSO) systems, semi-submersible platforms, tension leg platforms (TLPs), and others known to those of ordinary skill in the art. The connection between the subsea wellhead 12 and the platform 16 provided by the riser 14 allows fluid communication there between.

[0017] As shown in FIG. 2, the riser 14 is shown broken up to be able to include detail on specific sections but it should be appreciated that the riser 14 maintains fluid integrity from the subsea wellhead 12 to the production equipment on the platform 16.

[0018] The platform 16 includes a mezzanine deck 20, the tensioner deck 22, and a production deck 24 located above the sea level 21. As shown, the riser 14 includes a tension joint 34 and a transition joint 36. The riser 14 is attached at its lower end to the subsea wellhead 12 using an appropriate connection. For example, the riser 14 may include a wellhead connector 40 with an integral stress joint as shown. As an example, the wellhead connector 40 may be a tie back connector. Alternatively, the stress joint may be separate from the wellhead connector 40. The riser 14 may or may not include other specific riser joints, such as riser joints 42 with strakes or fairings and splash zone joints 44. The upper end of the riser 14 terminates in a surface wellhead and production tree 50 on the mezzanine deck 20.

[0019] A riser tension system 60 is attached to the riser 14 at the tension joint 34 by using a tensioner ring 62 on the riser 14. The riser tension system 60 is supported on the tensioner deck 22 and dynamically tensions the riser 14. This allows the tension system 60 to adjust for the movement of the platform 16 while maintaining at least a portion of the riser 14 under tension. The riser tension system 60 may be any appropriate system, such as a hydro-pneumatic tensioner system with tensioning cylinders 64 as shown. The number of tensioning cylinders used may vary depending on the design of the system 10.

[0020] Although the tension system 60 is able to compensate for the motion of the platform 16, the tension system 60 is not designed to provide all of the required tension to the riser 14 to prevent buckling. To prevent the riser from otherwise buckling, the riser 14 includes compression connectors 80 that are designed to be strong enough such that at least a portion of the riser 14 is able to withstand a compressive load. The amount and location of the compression connectors will depend on the designed loads and configuration of the system

10 and the riser 14. It should be appreciated that the compression connectors 80 need not be used on the entire length of the riser 14. Instead, the riser 14 need only include at least one compression connector 80 such that a portion of the riser 14 may withstand being placed in compression. In this manner, the tension system 60 does not need to provide the full tensioning requirements that the riser 14 would otherwise need to prevent buckling. Thus, the full load needed to support the riser 14 does not need to be transferred to the platform 16 and the platform 16 may be used to support a riser 14 heavier than it would otherwise be able to.

[0021] FIG. 3 shows an example of a compression connector. In this example, the compression connector 80a is a pin and box connector including a pin 82 and a box 84. The compression connector 80a may be designed to be even stronger than the riser section itself.

[0022] FIG. 4 shows another example of a compression connector. In this example, the compression connector 80b is a flange connector, which is typically designed to be stronger than other types of connectors. The flange connector 80b includes a body with a flange 88 and a neck 86 for each riser section end. The riser section end connects to the neck 86 either through welding, shrink-fit, or some other suitable connection method. Once attached, the riser sections are connected by tightening bolts that run through the adjacent flanges of the connector 80b.

[0023] Although the present invention has been described with respect to specific details, it is not intended that such details should be regarded as limitations on the scope of the invention, except to the extent that they are included in the accompanying claims.

Claims

1. An offshore system for a subsea well, including:
 - a subsea riser including sections of pipe, for connecting a platform to the subsea well;
 - a riser tension system attached to the riser and including a dynamic riser tensioner to dynamically compensate for movement of the platform while providing tension to the riser when the riser is connected to the platform;
 - at least two of the riser sections being connected with a compression connector for withstanding a compressive load when the riser is in compression.
2. The system of claim 1, further including multiple compression connectors.
3. The system of claim 1, wherein each compression connector includes a pin and a box.
4. The system of claim 1, wherein each compression connector includes a body including a flange and a neck extending from the flange.

5. The system of claim 1, wherein the tension system may be designed only to support a weight less than needed to place the subsea riser in tension.
6. The system of claim 1, wherein the tension system may support a riser heavier than the tension system is designed to support.
7. The system of claim 1, wherein the riser is one of a production riser or a drilling riser.