Abstract: A semi-submersible platform that is suitable to serve as a logistic hub at a remote offshore location. The semi-submersible platform is configured in a V-shape to reduce motion of the semi-submersible platform caused by rough sea conditions. The semi-submersible platform has a vessel docking area within the platform and a balancing unit to balance the unsymmetrical load of the platform that protects a vessel in the docking area from rough sea conditions.
SEMI-SUBMERSIBLE INTEGRATED PORT

FIELD OF THE INVENTION

The present invention relates a semi-submersible platform suitable to serve as a logistic hub at a remote offshore location. More particularly, this invention relates to a semi-submersible platform configured in a V-shape to reduce motion of the semi-submersible platform caused by rough sea conditions. Still more particularly, this invention relates to a semi-submersible platform having a vessel docking area within the platform and a balancing unit to balance the unsymmetrical load of the platform that protects a vessel from rough sea conditions.

BACKGROUND OF THE INVENTION

Semi-submersible platforms have been widely used in oil and gas exploration/production as these mobile platforms may be moved easily from one field site to another. However, as offshore exploration and operation move further away from the shore, various logistical problems arise. Particularly, offshore companies face logistical issues in transporting personnel and supplies to and from platforms at remote field sites further away from the shore. Typically, helicopters are used to transport personnel and supplies when field sites are located less than 150 km from the shore. However, such a transportation method becomes costly, risky and inefficient when the field sites are located more than 300 km from the shore. Some typical problems with the use of helicopters for transportation to these remote field sites include longer flights; no nearby emergency response in the event of helicopter/vessel disasters; no in-field servicing/refuelling facilities; no in-field storage/warehouse for storing foods and equipment; and no accommodation facilities for personnel.

A solution to the above issues is to have a platform built halfway between the field site and the shore so that helicopters/vessels may be deployed to transport personnel from the shore to the platform, and subsequently to the intended field site. However, this method is still inefficient as embarkation/disembarkation of personnel and loading/unloading of materials between a vessel/helicopter and the platform are extremely difficult and dangerous under rough sea conditions. Therefore, under rough sea conditions, it is a challenge to ensure that the platform remains stable with minimum motion.
A semi-submersible vessel is described in US Patent Publication No. 2003/0205189 A1 published on 6 November 2003 in the name of Joe Wayne Key et al. This publication discloses a semi-submersible floating production vessel having a ring pontoon with several columns extending upwardly from the pontoon to support a deck on which production modules are positioned. The columns are surrounded with fenders for protecting the columns from impact with floating bodies. It is an object of this publication to provide a semi-submersible vessel with sufficiently large water plane inertia to ensure adequate stability while minimizing the vessel motion response. It is not an object of this publication to provide a platform that serves as a logistic hub at a remote offshore location. Further, the design does not provide a docking area for ships that protects the ships from rough sea conditions.

SUMMARY OF THE INVENTION

The above and other problems are solved and an advance in the art is made by a semi-submersible platform in accordance with the present invention. A first advantage of a semi-submersible platform in accordance with an embodiment of the present invention is that the platform serves as a logistic hub at a remote offshore location and is equipped with various facilities for offshore exploration and operation, including accommodation facilities, medical facilities, helicopter parking/servicing/refuelling facilities, and warehouse facilities. A second advantage of a semi-submersible platform in accordance with an embodiment of the present invention is that the platform is configured to have a V-shape to take the advantage of the directionality of external environments (e.g. strong winds) to reduce motion of the platform and hence increase the stability of the platform in adverse environmental conditions. A third advantage of a semi-submersible platform in accordance with an embodiment of the present invention is that the platform has a wide opening at rear end that provides access to a docking area for a vessel within the platform. A vessel berthed in the docking area is protected from rough sea conditions. A fourth advantage of a semi-submersible platform in accordance with an embodiment of the present invention is that the platform has a balancing unit formed by one or more upwardly extending columns adjacent to the apex of the V-shaped semi-submersible platform for balancing the unsymmetrical load of the platform.

According to an embodiment of the present invention, there is provided a semi-submersible platform having a first end and a second end. The semi-submersible
platform comprises a first pontoon on a first side of the semi-submersible platform, and a second pontoon on a second side of the semi-submersible platform. The second pontoon is aligned with the first pontoon at an angle of no more than 180°. An opening is defined between the first and second pontoons proximate the second end of the semi-submersible platform to provide a docking area within the semi-submersible platform accessible by a vessel through the opening so that the vessel is protected from rough sea conditions by the semi-submersible platform. A balancing unit proximate the first end of the semi-submersible platform and connected to a first end of each of the first and second pontoons forming a V-shaped semi-submersible platform. The balancing unit comprises at least one upwardly extending main column for balancing the load of the V-shaped semi-submersible platform.

According to an embodiment of the present invention, the semi-submersible comprises a first set of secondary columns extending upwardly from the first pontoon, and a second set of secondary columns extending upwardly from the second pontoon. The first set of secondary columns is aligned substantially parallel and spaced apart from one another. The second set of secondary columns is also aligned substantially parallel and spaced apart from one another.

According to an embodiment of the present invention, the diameter of the main column is larger than the diameter of each secondary column of the first and second sets of secondary columns for balancing the semi-submersible platform. In another embodiment, the main column has an opening extending through the entire length of the main column to allow drilling operations to be performed through the opening.

According to embodiments of the present invention, the balancing unit comprises a set of main columns. In accordance with some of these embodiments, the columns in the set of main columns may be arranged in one of the following configurations: a triangular configuration, a rectangular configuration, or a circular configuration.

According to an embodiment of the present invention, the semi-submersible platform may further comprise a first main deck arranged substantially parallel to and above the first pontoon and connected to the first set of secondary columns. A second main deck arranged substantially parallel to and above the second pontoon and connected to the second set of secondary columns.
According to embodiments of the present invention, the semi-submersible platform further comprises a first extended pontoon extending laterally from a second end of the first pontoon proximate the second end of the semi-submersible platform. A second extended pontoon extending laterally from a second end of the second pontoon proximate the second end of the semi-submersible platform. The first and second extended pontoons are substantially parallel and spaced apart from each other. In accordance with some of these embodiments, the first and second extended pontoons are removable.

According to embodiments of the present invention, the semi-submersible platform further comprises a support pontoon connecting the first and second extended pontoons. In accordance with some of these embodiments, a set of support pontoons connect the first and second extended pontoons.

According to an embodiment of the present invention, the semi-submersible platform further comprises a retractable wall interconnecting columns of the first and second sets of secondary columns and the balancing unit.

According to some embodiments of the present invention, the semi-submersible platform further comprises an extendable deck connecting the first main deck and the second main deck. In accordance with some of these embodiments, the extendable deck is removable.

According to an embodiment of the present invention, the semi-submersible platform further comprises ballasting means housed in each of the first and second pontoons.

According to some embodiments of the present invention, the semi-submersible platform further comprises crew quarters on the semi-submersible platform. In some embodiments of the present invention, the semi-submersible platform further comprises a helicopter deck on the semi-submersible platform.

According to some embodiments of the present invention, the semi-submersible platform further comprises a securing mechanism having a first end affixed to the semi-submersible platform and a second end attached to the sides of the vessel that berthed in the docking area.
According to some embodiments of the present invention, the semi-submersible platform further comprises a guiding mechanism for pulling the vessel into the docking area through the opening of the semi-submersible platform. In accordance with some of these embodiments, the guiding mechanism comprises a yoke structure.

**BRIEF DESCRIPTION OF THE DRAWINGS**

The present invention will now be described, by way of examples only, with reference to the accompanying drawings, in which:

Figure 1 illustrating a perspective view of a semi-submersible platform in accordance with an embodiment of the present invention;

Figure 2 illustrating a schematic top view of various configurations of a balancing unit in accordance with embodiments of the present invention;

Figure 3 illustrating a top view of a semi-submersible platform in accordance with an embodiment of the present invention;

Figure 4 illustrating a perspective view of a semi-submersible platform with a retractable wall in accordance with an embodiment of the present invention.

Figure 5 illustrating a top view of a semi-submersible platform with extended portions in accordance with an embodiment of the present invention; and

Figure 6 illustrating a top view of a semi-submersible platform with an extendable deck in accordance with an embodiment of the present invention.

**DETAILED DESCRIPTION OF THE INVENTION**

The present invention relates a semi-submersible platform suitable to serve as a logistic hub at a remote offshore location of more than 300 km from the shore. More particularly, the present invention relates to a semi-submersible platform configured to have a V-shape to reduce motion response of the platform during rough sea conditions. Still more particularly, the present invention relates to a semi-submersible platform having
a vessel docking area within the platform and a balancing unit to balance the unsymmetrical load of the platform that protects a vessel from rough sea conditions.

Semi-submersible platform 100, shown in Figures 1-6, is a semi-submersible integrated port or logistic hub with a docking area in accordance with an embodiment of the present invention. Semi-submersible platform 100 comprises two semi-submersible pontoons 101 and 102 that are each preferably in a longitudinally elongated form. In some embodiments, the length of each of the pontoons 101 and 102 is in the range of 50m to 100m. First pontoon 101 is on the first side of semi-submersible platform 100 and second pontoon 102 is on the second side of semi-submersible platform 100. Pontoons 101 and 102 are arranged that they diverge from one another by an angle, Θ, of no more than 180° forming a substantially V-shaped configuration. In operation, pontoons 101 and 102 are submersed underwater. One skilled in the art will recognize that the size and shape of pontoons 101 and 102 may be varied without departing from the present invention.

Semi-submersible platform 100 further comprises two main decks 105 and 106 that are each preferably in a longitudinally elongated form. First main deck 105 is aligned substantially parallel to and above first pontoon 101. Similarly, second main deck 106 is aligned substantially parallel to and above second pontoon 102. In a preferred embodiment, main decks 105 and 106 are above sea level. However, main decks 105 and 106 may be underwater for other uses. A first set of secondary columns 109 extends upwardly from first pontoon 101 to first main deck 105, and a second set of secondary columns 110 extends upwardly from second pontoon 102 to second main deck 106. Each of secondary columns 109 and 110 is semi-submersible and is preferably cylindrical shape to support the load of semi-submersible platform 100. In some embodiments, the diameter and height of each of secondary columns 109 and 110 are in the range of 10m to 20m and 15m to 30m respectively. The columns in each set of secondary columns 109 and 110 are aligned substantially parallel to and spaced apart from one another, as shown in Figure 1, so as to achieve a stable and even weight distribution of semi-submersible platform 100. In operation, the lower part of secondary columns 109 and 110 are submersed underwater. One skilled in the art will recognize that the size and shape of main decks 105 and 106 and secondary columns 109 and 110 may be varied without departing from the present invention.
Semi-submersible platform 100 further comprises a semi-submersible balancing unit 113 to balance the unsymmetrical load of semi-submersible platform 100. Balancing unit 113 is located proximate the front end of semi-submersible platform 100 and connected (or integrated) to the front end of pontoons 101 and 102 and the associated front end of main decks 105 and 106, forming a V-shaped semi-submersible platform 100. In other words, balancing unit 113 is adjacent to the apex (i.e. front end) of the V-shaped semi-submersible platform 100. Balancing unit 113 is semi-submersible and in operation, the lower part of balancing unit 113 is submersed underwater. Balancing unit 113 comprises at least one upwardly extending main column 115, as shown in Figure 1 and Figure 2 (a). Main column 115 is preferably cylindrical shape. In some embodiments, balancing unit 113 may comprise a set of main columns 115 arranged in various configurations, such as a triangular (Figure 2 (b)), a rectangular (Figure 2 (c)) and a circular (Figure 2 (d)). In some embodiments, the diameter and height of main column 115 are in the range of 25m to 50m and 15m to 30m respectively. One skilled in the art will recognise that the size and shape of balancing unit 113 and main column 115 may be varied without departing from the present invention. Pontoons 101 and 102, first and second sets of secondary columns 109 and 110, and main column 115 of balancing unit 113 may house a ballasting means, e.g. a ballast tank, for facilitating the movement of these parts relative to the sea level.

As the load near the apex of the V-shaped semi-submersible platform 100 is generally heavier than other parts of platform 100, this creates an uneven weight distribution that needs to be counter-balanced. For example, main machineries, crew quarters 117 and helicopter deck 119 may be located near the apex of the V-shaped semi-submersible platform 100. Therefore, the diameter and size of main column 115 proximate the apex region of platform 100 should be larger than the diameter and size of secondary columns 109 and 110 in order to balance the unsymmetrical load of platform 100. In some embodiments, main column 115 has an opening (not shown) extending through the entire length of main column 115 to allow drilling operations (or other suitable offshore operations) to be performed through the opening and to allow connection to the sea bed through the bottom opening of main column 115 that is submersed underwater.

An opening 121 is defined between pontoons 101 and 102 and the associated main decks 105 and 106. Opening 121 is located proximate the rear end (opposite the apex) of the V-shaped semi-submersible platform 100. A docking area 123 is provided within semi-submersible platform 100 between pontoons 101 and 102 and the associated
main decks 105 and 106. Docking area 123 is accessible by a vessel through opening 121 so that a vessel berthed in docking area 123 is protected from rough sea conditions, e.g. strong winds and/or waves. The size of docking area 123 is determined by opening 121 which in turn is determined by angle $\Theta$ between pontoons 101 and 102. A larger angle $\Theta$ has a larger opening 121 which then provides a larger docking area 123 for receiving a larger vessel. In some embodiments, docking area 123 provides a berth for a vessel approximately 50m in length and 13m in width.

The V-shaped semi-submersible platform 100 takes the advantage of directionality of external environments (e.g. swell and current direction) by deflecting the environment loads away from platform 100. For example, when strong winds approach the apex of the V-shaped semi-submersible platform 100, the winds split and pass along both sides of semi-submersible platform 100 towards the rear end, as shown by arrows X in Figure 3. This results in a reduction of motion response in semi-submersible platform 100 to rough sea conditions and protects a vessel berthed in docking area 123 from the rough sea conditions. Furthermore, in some embodiments, semi-submersible platform 100 may include a retractable wall 401 that interconnects secondary columns (109 and 110) and balancing unit 113, as shown in Figure 4. Therefore, retractable wall 401 effectively acts as an additional protective barrier for the vessel berthed in docking area 123. This allows a vessel to dock safely even during rough sea conditions. Once the vessel is berthed in docking area 123, embarkation/disembarkation of passengers and loading/unloading of materials may safely take place on main decks 105 and 106.

Figure 5 shows that semi-submersible platform 100 may include two extended portions 501 and 502 proximate the rear end of semi-submersible platform 100 to create a longer docking area 123 for receiving a longer vessel 505. Each of extended portions 501 and 502 is preferably in a longitudinally elongated form. In some embodiments, the length of each of the extended portions 501 and 502 is in the range of 50m to 100m. First extended portion 501 is on the first side of semi-submersible platform 100, and second extended portion 502 is on the second side of semi-submersible platform 100. First extended portion 501 comprises a first extended pontoon and the associated first extended main deck connected by a first set of upwardly extending columns. Second extended portion 502 comprises a second extended pontoon and the associated second extended main deck connected by a second set of upwardly extending columns. The first extended pontoon extends laterally from the rear end of first pontoon 101, and the second extended pontoon extends laterally from the rear end of second pontoon 102. The first
and second extended pontoons are substantially parallel and sufficiently spaced apart from each other to receive vessel 505. The extended portions 501 and 502, and hence the first and second extended pontoons, are removable from semi-submersible platform 100. In some embodiments, there is a support pontoon 507 connects the first and second extended pontoons to strengthen the structure of extended portions 501 and 502. More than one support pontoon 507 may be used without departing from this embodiment of this invention.

Semi-submersible platform 100 may include crew quarters 117 for personnel and parking area 119 for helicopters. Typically, crew quarters 117 is disposed above main decks 105 and 106 proximate the apex of semi-submersible platform 100, and parking area 119 for helicopters is disposed above crew quarters 117. In some embodiments, as shown in Figure 6, semi-submersible platform 100 may include an extendable deck 601 that connects first main deck 105 and second main deck 106. Extendable deck 601 is useful if additional space is required, such as for additional crew quarters, production facilities, and warehouses for foods and/or equipment. This allows a large number of personnel to remain on semi-submersible 100 for extended periods of time and/or allows more production activities to be performed on semi-submersible platform 100. Extendable deck 601 is extendable to cover the entire area (or any desired area size) between main decks 105 and 106. Extendable deck 601 is also retractable and removable so as to create a space for docking a vessel.

In some embodiments, in order to stabilize a vessel in docking area 123 and to prevent the vessel from bumping into sides of docking area 123, a securing mechanism (not shown) may be employed to hold a vessel steady as the vessel is berthed in docking area 123. The securing mechanism includes a first end affixed to semi-submersible platform 100 and a second end attached to the both sides of the vessel. In some other embodiments, semi-submersible platform 100 may include a guiding mechanism (not shown) for pulling the vessel into docking area 123. The guiding mechanism may comprise a yoke structure (not shown) which has a general V-shape or U-shape with two arms extending towards the vessel and the end of the arms are securely fastened to both sides of the vessel. Therefore, when the yoke structure moves towards the apex of semi-submersible platform 100, the vessel will be pulled into docking area 123.

The above embodiments provide a description of features and advantages of a V-shaped semi-submersible platform with a docking area that reduces motion of the
platform under rough sea conditions in accordance with the present invention. It is envisioned that those skilled in the art can and will design alternative embodiments that infringe on the present invention as set forth in the following claims.
CLAIMS

1. A semi-submersible platform having a first end and a second end, the semi-
submersible platform comprising:
   a first pontoon on a first side of the semi-submersible platform;
   a second pontoon on a second side of the semi-submersible platform, the second
pontoon is aligned with the first pontoon at an angle of no more than 180° wherein an
opening is defined between the first and second pontoons proximate the second end of
the semi-submersible platform to provide a docking area within the semi-submersible
platform accessible by a vessel through the opening so that the vessel is protected from
rough sea conditions by the semi-submersible platform; and
   a balancing unit proximate the first end of the semi-submersible platform and
connected to a first end of each of the first and second pontoons forming a V-shaped
semi-submersible platform wherein the balancing unit comprises at least one upwardly
extending main column for balancing the load of the V-shaped semi-submersible
platform.

2. The semi-submersible platform of claim 1 further comprising:
   a first set of secondary columns extending upwardly from the first pontoon
wherein the first set of secondary columns are aligned substantially parallel and spaced
apart from one another; and
   a second set of secondary columns extending upwardly from the second pontoon
wherein the second set of secondary columns are aligned substantially parallel and
spaced apart from one another.

3. The semi-submersible platform of claim 2, the diameter of the main column is
larger than the diameter of each secondary column of the first and second sets of
secondary columns for balancing the semi-submersible platform.

4. The semi-submersible platform of claim 1 wherein the main column has an
opening extending through the entire length of the main column to allow drilling
operations to be performed through the opening.

5. The semi-submersible platform of claim 1 wherein the balancing unit comprises a
set of main columns arranged in a substantially triangular configuration.
6. The semi-submersible platform of claim 1 wherein the balancing unit comprises a set of main columns arranged in a substantially rectangular configuration.

7. The semi-submersible platform of claim 1 wherein the balancing unit comprises a set of main columns arranged in a substantially circular configuration.

8. The semi-submersible platform of claim 2 further comprising:
   a first main deck arranged substantially parallel to and above the first pontoon and connected to the first set of secondary columns; and
   a second main deck arranged substantially parallel to and above the second pontoon and connected to the second set of secondary columns.

9. The semi-submersible platform of claim 1 further comprising:
   a first extended pontoon extending laterally from a second end of the first pontoon proximate the second end of the semi-submersible platform; and
   a second extended pontoon extending laterally from a second end of the second pontoon proximate the second end of the semi-submersible platform,
   wherein the first and second extended pontoons are substantially parallel and spaced apart from each other.

10. The semi-submersible platform of claim 9 wherein the first and second extended pontoons are removable.

11. The semi-submersible platform of claim 9 further comprising:
    a support pontoon connecting the first and second extended pontoons.

12. The semi-submersible platform of claim 9 further comprising:
    a set of support pontoons connecting the first and second extended pontoons.

13. The semi-submersible platform of claim 2 further comprising:
    a retractable wall interconnecting columns of the first and second sets of secondary columns and the balancing unit.

14. The semi-submersible platform of claim 8 further comprising:
    an extendable deck connecting the first main deck and the second main deck.
15. The semi-submersible platform of claim 14 wherein the extendable deck is removable.

16. The semi-submersible platform of claim 1 further comprising: ballasting means housed in each of the first and second pontoons.

17. The semi-submersible platform of claim 1 further comprising: crew quarters on the semi-submersible platform.

18. The semi-submersible platform of claim 1 further comprising: a helicopter deck on the semi-submersible platform.

19. The semi-submersible platform of claim 1 further comprising: a securing mechanism having a first end affixed to the semi-submersible platform and a second end for attaching to the sides of the vessel that berthed in the docking area.

20. The semi-submersible platform of claim 1 further comprising: a guiding mechanism for pulling the vessel into the docking area through the opening.

21. The semi-submersible platform of claim 20 wherein the guiding mechanism comprises a yoke structure.
Figure 4
INTERNATIONAL SEARCH REPORT

International application No.
PCT/SG2012/000299

A. CLASSIFICATION OF SUBJECT MATTER

B63B 35/44 (2006.01) B63B 35/00 (2006.01) B63B 35/34 (2006.01) E02B 3/06 (2006.01) B63B 22/02 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC, WPI: IPC - B63B 35/00, B63B 35/34, B63B 35/38, B63B 35/44, B63B 35/50, B63B 35/58, E02B 3/06, B63B 22/02; UC - 264/LOW; keywords (deck, dock, pontoon, semi-submerged, vessel, v-shape and like terms)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Date of the actual completion of the international search: 15 November 2012
Date of mailing of the international search report: 15 November 2012

Name and mailing address of the ISA/AU

AUSTRALIAN PATENT OFFICE
PO BOX 200, WODEN ACT 2606, AUSTRALIA
Email address: pct@ipaaustralia.gov.au
Facsimile No.: +61 2 6283 7999

Authorised officer

Darcy Corbett
AUSTRALIAN PATENT OFFICE
(ISO 9001 Quality Certified Service)
Telephone No. 0262832212

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<td>GB 1582468 A (SLOTNAES) 07 January 1981 page 2 line 121 - page 3 line 10, page 3 lines 16-21; Figures 3, 4</td>
<td>1, 4, 17</td>
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<td>Y</td>
<td>GB 1065216 A (LABORDE et al.) 12 April 1967 page 3 lines 66-70; Figures</td>
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