

Field of the Invention

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at the forward end of the main deck will freely flood thereby reducing the above-deck buoyancy of the integrated heavy lift and logistics vessel. This unique feature is not found in other vessels. A second advantage of embodiments of an integrated heavy lift and logistics vessel in accordance with this invention is that a section of the semi-enclosed forecastle structure may be flooded through the use of a tube that is provided either at the first wing-wall, the second wing-wall or at both the first and second wing-walls. The flooding of this section of the semi-enclosed forecastle structure assists in reducing the above deck buoyancy of the submerging vessel making it easier for the vessel to submerge.

The above and other problems in the art are solved and an advance in the art is made in accordance with this invention. In accordance with a first aspect of the invention, there is provided an integrated heavy lift and logistics vessel having a deck with a first section for receiving a vessel, and a second section that is bordered by a first wing-wall provided on a port side of the deck, a second wing-wall provided on a starboard side of the deck, and a deck box provided at a bow of the deck whereby the deck box abuts the first wing-wall and the second wing-wall. The integrated heavy lift and logistics vessel also has a ballasting system that is configured to lower the deck below a water level and below a hull of a docking vessel, and to raise the deck above the water level, wherein the second section of the deck is configured to flood when the deck is lowered below the water level thereby reducing the above-deck buoyancy of the heavy lift and logistics vessel. Further, an accommodation unit is also provided on the top surface of the deck box.

In accordance with embodiments of the invention, the first wing-wall of the integrated heavy lift and logistics vessel comprises a first tube that extends from a hull of the integrated heavy lift and logistics vessel to the deck. The first tube has a first opening at the hull and a second opening at a surface of the deck. When the ballasting system lowers the deck below the water level, this will cause water to flow through the first tube via the first opening and the second opening to flood the second section of the deck. In accordance with embodiments of the invention, this first tube may be tilted at an angle in relation to a surface of the deck such that the first opening of the tube is positioned lower than the second opening of the first tube.

In accordance with embodiments of the invention, the second wing-wall of the integrated heavy lift and logistics vessel also comprises a second tube that

extends from a hull of the integrated heavy lift and logistics vessel to the deck. The second tube has a first opening at the hull and a second opening at a surface of the deck. When the ballasting system lowers the deck below the water level, this will cause water to flow through the second tube via the first opening and the second opening to flood the second section of the deck.

In accordance with embodiments of the invention, the integrated heavy lift and logistics vessel further includes a helipad that is provided on a top surface of the accommodation unit. Means for handling discharge of cargo from the integrated heavy lift and logistics vessel to an attending vessel may also be provided on the integrated heavy lift and logistics vessel in embodiments of the invention.

In accordance with embodiments of the invention, the integrated heavy lift and logistics vessel includes an emergency shelter. The emergency shelter may include emergency medical facilities as well.

In accordance with embodiments of the invention, storage means are provided in a hull of the integrated heavy lift and logistics vessel for storing liquids, including provision for carry liquids on deck in flexible bladders.

In accordance with embodiments of the invention, the integrated heavy lift and logistics vessel has an anchor winch that is provided on the top surface of the deck box for guiding the other vessel to the deck.

In accordance with embodiments of the invention, pipe racks are provided on the top surface of the deck box of the heavy lift and logistics vessel for storing tubular members.

Brief Description of the Drawings

The above advantages and features of a system in accordance with this invention are described in the following detailed description and are shown in the drawings:

Figure 1 illustrating a side view of an integrated heavy lift and logistics vessel with a docked vessel in accordance with embodiments of this invention;

Figure 2 illustrating a plan view of an integrated heavy lift and logistics vessel in accordance with embodiments of this invention;

Figure 3 illustrating a plan view and a side view of an integrated heavy lift and logistics vessel in accordance with embodiments of this invention;

5 Figure 4a illustrating a plan view of an integrated heavy lift and logistics vessel in accordance with embodiments of this invention;

Figure 4b illustrating a plan view of an integrated heavy lift and logistics vessel having flooding tubes or ports in accordance with embodiments of this invention;

10 Figures 4c and 4d illustrating a cross sectional view of an integrated heavy lift and logistics vessel in accordance with the embodiment illustrated in Figure 4b from the perspective of arrow A;

Figure 5 illustrating side views of the integrated heavy lift and logistics vessel in accordance with embodiments of this invention;

15 Figures 6a-6k illustrating a story board showing the operation of an integrated heavy lift and logistics vessel in accordance with embodiments of this invention;

Figure 7 illustrating a side view of an integrated heavy lift and logistics vessel in accordance with embodiments of this invention; and

20 Figure 8 illustrating a flow chart depicting a method of dry docking a vessel in accordance with embodiments of this invention.

Detailed Description

25 This invention relates to an integrated heavy lift and logistics vessel for dry docking, deploying or logistically supporting another vessel in remote locations. More particularly, this invention relates to an integrated heavy lift and logistics vessel that is designed to carry out heavy lifting and transporting functions. The integrated heavy lift and logistics vessel is also equipped with an accommodation
30 unit and various forms of storage. The integrated heavy lift and logistics vessel may also be used to transport heavy, large and bulky cargo or vessels from one port to another or from one location to another. Cargo or vessels that may be transported by the integrated heavy lift and logistics vessel may include, but are not

limited to, drilling units, drilling platforms, jack-up units. Although the subsequent description only describes the loading and transportation of vessels, one skilled in the art will recognize that the integrated heavy lift and logistics vessel may also be used to transport other types of floatable bulky cargo without departing from this invention.

The integrated heavy lift and logistics vessel in accordance with embodiments of the invention provides means of combining transportation and logistical support which allows for efficient operations as opposed to existing methodologies where these functions are carried out separately and are conducted in an ad hoc manner rather than in an integrated fashion as made possible by this invention. This invention has primary application in waters suitable for drilling using a self-elevation drilling unit (jack-up), offshore Alaska, Canada, and Russia in its Arctic embodiment and in areas such as Central America, West Africa and South East Asia.

An integrated heavy lift and logistics vessel in accordance with embodiments of the invention is able to dry dock another vessel by controlling a ballasting system of the integrated heavy lift and logistics vessel. As the ballasting system lowers the integrated heavy lift and logistics vessel below a water level, an accommodation unit provided on a top surface of a deck box remains dry throughout the ballasting operations. Further, as the integrated heavy lift and logistics vessel is submerging, a forward section of the semi-enclosed deck will freely flood thereby reducing the above-deck buoyancy of the integrated heavy lift and logistics vessel.

In accordance with embodiments of the invention, a wing-wall on the integrated heavy lift and logistics vessel may be provided with a flooding tube or a freeing port that is there to allow ingress and egress of water from the interior floodable forward section. As the ballasting system lowers the deck of the integrated heavy lift and logistics vessel below a water level, the forward section of the deck may be initially flooded through the use of this tube or port that may be provided either at the first wing-wall, the second wing-wall or at both the first and second wing-walls. The flooding of this semi-enclosed section assists in reducing the above deck buoyancy of the submerging vessel making it easier for the vessel to submerge. As the ballasting system raises the deck of the integrated heavy lift and logistics vessel above the water level, water pooled within the section of the

deck may be released to sea through the use of these tubes thereby lightening the load on the integrated heavy lift and logistics vessel allowing this vessel to rise faster.

5 Figure 1 illustrates a side view of a heavy lift and logistics vessel with a docked vessel in accordance with embodiments of the invention. Heavy lift and logistics vessel 100 comprises cranes 110, deck 115, deck box 116, pipe racks 120, storage areas 125, 130, 135, 140, winch 155, containers 145 and accommodation unit 150. Heavy lift and logistics vessel 100 also has a ballasting
10 system comprising one or more ballast tanks installed (not shown) across a hull of heavy lift and logistics vessel 100. The structure of deck box 116 is such that an entire top surface of deck box 116 will remain above a water level throughout ballasting operations. In other words, the height or elevation of the top surface of deck box 116 is configured such, so that the top surface of deck box 116 will remain
15 dry as heavy lift and logistics vessel 100 submerges and rises during ballasting operations. As accommodation unit 150 is provided on the top surface of deck box 116, this means that accommodation unit 150 will also remain dry throughout ballasting operations. As illustrated in Figure 1, deck 115 is used for receiving a vessel that is to be dry-docked. In Figure 1, it is illustrated that the dry docked
20 vessel is vessel 105. Further, the width of deck 115 is designed to be wider than the width of vessel 105 so that vessel 105 may be floated above deck 115 safely without colliding into the hull of heavy lift and logistics vessel 100 or the sides of deck box 116.

25 In embodiments of the invention, an emergency shelter is provided within accommodation unit 150. In further embodiments, the emergency shelter is provided with emergency medical facilities. Accommodation unit 150 may also be used to house all the workers on heavy lift and logistics vessel 100. In extreme situations or in emergencies, accommodation unit 150 may also be used as a safe
30 refuge quarters that can be set up to accommodate the operations unit that is being logistically supported. Such a setup would be useful in situations whereby workers/ personnel from a nearby vessel/ platform/ dock would have to be evacuated and may seek temporary refuge while awaiting assistance or evacuation from other sources. Accommodation unit 150 will also be capable of handling the personnel
35 from vessel 105 in temporary quarters located within accommodation unit 150 until further assistance can arrive to provide assistance. In addition to emergency medical facilities, the emergency shelter may include a galley/ mess for personnel

that it may accommodate. The heavy lift and logistics vessel may also be provided with additional small living quarters for personnel working on the heavy lift and logistics vessel in its normal operating mode.

5 Storage areas 125, 130, 135, and 140 may be used to store various items such as fluids, pipes and any other types of bulky items. One skilled in the art will recognize that the size and positioning of these storage areas may vary according to their requirements. Cranes 110 may be used to handle the discharge of cargo to and from heavy lift and logistics vessel 100 onto a nearby attending vessel or onto
10 the docks. One skilled in the art will recognize that the positioning and number of cranes 110 may be altered or varied accordingly without departing from this invention.

When vessel 105 is to be docked onto heavy lift and logistics vessel 100,
15 the ballast tanks on heavy lift and logistics vessel 100 will be flooded. As the ballast tanks are flooded, heavy lift and logistics vessel 100 will slowly submerge further below the water level. Under conventional operating conditions, as the ballast tanks are typically positioned at various parts across heavy lift and logistics vessel 100, the ballast tanks will be gradually filled in order to minimize the yaw and
20 roll of heavy lift and logistics vessel 100 as heavy lift and logistics vessel 100 is being submerged. Once deck 115 has submerged sufficiently below the water level to receive vessel 105, vessel 105 will then be guided over deck 115 of heavy lift and logistics vessel 100. Once vessel 105 is in position over deck 115, the water within the ballast tanks will be gradually pumped out, until the tanks have been
25 sufficiently emptied. As the tanks are being emptied, heavy lift and logistics vessel 100 will gradually rise from the water. The rising of heavy lift and logistics vessel 100 together with deck 115 will cause deck 115 to lift vessel 105 along, effectively dry docking vessel 105 onto heavy lift and logistics vessel 100. When this happens, a normally submerged section of vessel 105 will be raised above the
30 water level. The entire process is reversed when vessel 105 is to be unloaded off heavy lift and logistics vessel 100. This float-on/ float-off method allows for extremely heavy and vessels and/or bulky cargo to be easily manipulated on and off vessel 100. In addition to the float-on/ float-off method described above, cargo may also be loaded on and unloaded off heavy lift and logistics vessel 100 using a
35 roll-on/ roll-off method by raising either the starboard side or port side of heavy lift and logistics vessel 100, allowing vessel 105 to be lowered off deck 115 onto a quayside.

A plan view of heavy lift and logistics vessel 100 is illustrated in Figure 2. One skilled in the art will recognize that accommodation unit 150 may be placed at any position on deck box 116 without departing from the invention. Similarly, pipe racks 120 and cranes 110 may be placed at various positions on deck box 116
5 without departing from the invention. The width of deck 115 may vary according to the width of vessel 105 that is to be docked on deck 115.

Figure 3 illustrates a plan view and a side view of heavy lift and logistics
10 vessel 100 in accordance with embodiments of the invention. In this embodiment, helipads 305 are provided on a top surface of accommodation hub 150. Helipads 305 allow for helicopters from nearby vessels and/or docks to land on vessel 100 in case of emergencies. For example, if personnel aboard heavy lift and logistics vessel 100 or docked vessel 105 need to be evacuated, such personnel may do so
15 via these helicopters.

In embodiments of the invention, as illustrated in Figure 4a, integrated heavy lift and logistics vessel 100 has a deck that may be divided into two decking sections, which is decking section 419 and decking section 420. Decking section
20 419 is used for receiving and/or docking vessel 105 while decking section 420, which is bordered on a first side by wing-wall 410, on a second side by deck box 412 and on a third side by wing-wall 411, freely floods when integrated heavy lift and logistics vessel 100 submerges. As integrated heavy lift and logistics vessel 100 begins to submerge, water will flow onto the deck of integrated heavy lift and
25 logistics vessel 100 through the sides of decking section 419. The flowing water will then collect and pool at decking section 420. The collecting of water or the flooding of section 420 causes the above-deck buoyancy of vessel 100 to reduce thereby allowing vessel 100 to submerge easily. Wing-walls 410, 411 and deck box 412 further assists in stabilizing integrated heavy lift and logistics vessel 100 when
30 vessel 100 is submerged.

The long forecastle area within wing-walls 410, 411 provide a covered area that may be used as storage space for bulk materials. Further, this covered area may be utilized as a work area, protected from severe weather, for assembling
35 parts or conducting on ship maintenance and repairs.

In embodiments of the invention, a flooding tube may be provided within wing-walls 410 and/or 411 to accelerate the flooding of decking section 420. As illustrated in Figure 4b, tube 405 may be provided within each of wing-walls 410 and 411 to allow water from the sea to flow to decking section 420 as vessel 100 begins submerging. Although Figure 4b illustrates that tube 405 is provided within each of wing-walls 410 and 411, one skilled in the art will recognize that any number of tubes 405 may be used without departing from this invention. In other words, in an embodiment of the invention, only wing-wall 410 of vessel 100 may be provided with one of tube 405 while in another embodiment of the invention, it may be only wing-wall 411 of vessel 100 that is provided with one of tube 405.

As illustrated in Figure 4b, tube 405 has an opening at the hull of vessel 100 or at the exterior walls of wing-walls 410, 411 that faces the sea, and another opening at the interior walls of wing-walls 410, 411 facing decking section 420. As the ballasting system of vessel 100 begins to submerge vessel 100, water from the sea will flow through tube 405 via the opening of tube 405 that faces the sea, which is the opening at the hull of vessel 100 or at the exterior walls of wing-walls 410, 411. The water will then flow out from tube 405 through the other opening located at the interior walls of wing-walls 410, 411 onto decking section 420. As water floods and ponds at decking section 420, this causes the above deck buoyancy of vessel 100 to greatly reduce thereby making it easier for vessel 100 to submerge.

After vessel 105 has been loaded and docked onto vessel 100, the ballasting system of vessel 100 will begin to raise the deck of vessel 100 above the water level. As vessel 100 rises, water contained within decking section 420 will flow out to sea via tube 405. The rapid emptying of water contained within decking section 420 allows for vessel 100 to rise faster and to achieve a stable floating state quicker.

Figure 4c illustrates a cross-sectional view of wing-wall 411 as seen from the angle of arrow A. As illustrated in Figure 4c, tube 405 extends from a hull of integrated heavy lift and logistics vessel 100, through wing-wall 411, to section 420 of the deck. In other words, tube 405 has opening 426 that is located at the hull and opening 425 that is adjacent the surface of section 420 of the deck. When the ballasting system lowers the deck below the water level, this causes water to flow from opening 425, through tube 405, and out to section 420 of the deck via opening 425 thereby flooding this section of the deck. In contrast, as the ballasting system

raises the deck above the water level, water pooled within section 420 will flow in the opposite direction through tube 405 that is the pooled water will flow through opening 426, through tube 405 and out to sea via opening 425.

5 In accordance with embodiments of the invention, tube 405 may be tilted at an angle in relation to a surface of the deck such that the first opening of the tube is positioned lower than the second opening of the first tube. This will allow water pooled within section 420 to empty faster when the ballasting system raises the deck of vessel 100 above the water level. Such an embodiment is illustrated in
10 Figure 4d.

In embodiments of the invention, deck 115 or decking section 419 may be provided either at the stern of heavy lift and logistics vessel 100, the aft of heavy lift and logistics vessel 100 or at the middle of heavy lift and logistics vessel 100.
15 These embodiments are illustrated in Figure 5. Embodiment 505 illustrates deck 115 or decking section 419 being positioned at the stern of heavy lift and logistics vessel 100 while embodiment 510 illustrates deck 115 or decking section 419 being positioned at the aft of heavy lift and logistics vessel 100 and embodiment 515 illustrates deck 115 or decking section 419 being positioned at the middle of heavy
20 lift and logistics vessel 100.

Figures 6a-6k illustrates the loading and docking of vessel 105 onto heavy lift and logistics vessel 100. For brevity, in Figures 5a-6k, although reference is only made to deck 115, one skilled in the art will recognize that decking section 419
25 may be used interchangeably with deck 115 without departing from the invention. Figure 6a illustrates vessel 105 when vessel 105 is vertically moored to seabed 609 via tension leg moorings 605. When vessel 105 is moored, the upper portion of vessel 105 will remain above water level 610. After vessel 105 has completed its drilling operations, vessel 105 will jack up from seabed 609 and float freely as
30 illustrated in Figure 6b. When this happens, vessel 100 will move closer to vessel 105 in preparation for dry docking procedures. Figure 6c illustrates heavy lift and logistics vessel 100 after the ballast tanks in heavy lift and logistics vessel 100 has been flooded causing vessel 100 to submerge below water level 610. The flooding of the ballasts in vessel 100 are controlled carefully to ensure that heavy lift and
35 logistics vessel 100 does not submerge too deep, specifically to ensure that accommodation unit 150 does not submerge below water level 610. However, heavy lift and logistics vessel 100 must be sufficiently submerged so that deck 115

is lower than the hull of vessel 105. Vessel 105 is then guided over deck 115 either through self-propulsion, through the use of tug boats, or through the use of anchor winches 155 provided on heavy lift and logistics vessel 100. Once vessel 105 is positioned directly above deck 115 as illustrated in Figure 6d, heavy lift and logistics vessel 100 will empty its ballast tanks causing heavy lift and logistics vessel 100 to rise above water level 610. As heavy lift and logistics vessel 100 rises, this causes deck 115 together with docked vessel 105 to rise as well. The transit of heavy lift and logistics vessel 100 to a new location is illustrated in Figures 6e, 6f, 6g and 6h. Once deck 115 and the normally submerged section of docked vessel 105 has been raised above water level 610; tug boat 615 will approach to assist in the transporting of heavy lift and logistics vessel 100 with docked vessel 105 to a new location. In embodiments of the invention, if heavy lift and logistics vessel 100 is provided with self-propulsion systems, it will not be necessary for tug boat 615 to assist heavy lift and logistics vessel 100 in moving to a new location as heavy lift and logistics vessel 100 will be able to do so by its own accord. The propulsion system may comprise of a self-propulsion system or a propulsion-assist system. One skilled in the art will recognize that other types of propulsion systems may be used without departing from this invention.

Figure 6i illustrates that once heavy lift and logistics vessel 100 has reached its new location, the ballast tanks of heavy lift and logistics vessel 100 will be flooded causing deck 115 together with docked vessel 105 to submerge below water level 610. As tugboat 615 would have tied guide ropes around vessel 105 in anticipation of the float-off procedures, tugboat 615 may then guide vessel 105 away from heavy lift and logistics vessel 100 towards the new location. After heavy lift and logistics vessel 100 has safely undocked vessel 105 at its new location and after vessel 105 has been floated off deck 115, heavy lift and logistics vessel 100 may then moor nearby using various mooring arrangements such as spread mooring, bow anchor mooring or spud moorings. As heavy lift and logistics vessel 100 is provided with accommodation unit 150 and various storage arrangements, heavy lift and logistics vessel 100 may assist in the drilling procedures going on at vessel 105. Once vessel 105 arrives at the new location, vessel 105 will moor itself at its new location. In the embodiment shown in Figure 6j, vessel 105 is vertically moored on seabed 609 using tension leg moorings thereby securing itself at its new location.

In embodiments of the invention, inflatable liquid storage bags or bladders 705 may be inflated, filled with fluid and placed on top of deck 115 as illustrated in Figure 7. This provides additional fluid storage to support well drilling operations. Further, inflatable liquid storage bags 705 when deflated may be stored in any of storage areas 125, 130, 135 or 140.

Heavy lift and logistics vessel 100 combines the transport and logistics support functions along with duties such as emergency stand-by, helicopter operations support etc. Such features of heavy lift and logistics vessel 100 provide an effective solution to drilling in remote areas with seasonal requirements whereby drilling units are moved on a regular basis. An example of such remote areas is in the Arctic whereby rigs need to be removed in the heavy ice winter months.

Figure 8 illustrates process 800 that is performed by a heavy lift and logistics vessel to dry dock a vessel in accordance with embodiments of this invention. Process 800 begins in step 805 by submerging a deck of the heavy lift and logistics vessel below a water level. The vessel which is to be docked on the heavy lift and logistics vessel is then positioned over the submerged docked deck of the heavy lift and logistics vessel in step 810. At step 815, the deck of the heavy lift and logistics vessel is raised above the water level. This causes the hull of the docked vessel to rise as well above the water level. The heavy lift and logistics vessel together with the docked vessel are then transported to a new location or a new site at step 820. Once the heavy lift and logistics vessel arrives at the new site, the deck of the heavy lift and logistics vessel is then submerged below the water level. This occurs at step 825. As the hull of the vessel submerges below the water level, the vessel will float on its accord. At step 830, the floating vessel will then be guided away from the deck of the heavy lift and logistics vessel towards the new site. Process 800 then ends.

An example of a heavy lift and logistics vessel in accordance with embodiments of the invention is set out below.

Dimensions	
Length	205 m
Beam	50 m
Depth	15 m
Draft	10 m
Average Depth	22.5 m
Displacement	82769 mt
CUNO	153750 m3
tons/m3	0.085
Steel Wt	19603 mt
LightShip (1.25*St Wt)	24504 mt
Payload	
Rig	25408 mt
Cargo Dwt	32856 mt
Fuel	20000 mt
Well Consumables	12856 mt

Table 1

Table 1 above illustrates the approximate dimensions of a heavy lift and
5 logistics vessel in accordance with an embodiment of this invention.

The above is a description of a heavy lift and logistics vessel for loading,
transporting and unloading a vessel. It is foreseen that those skilled in the art can
and will design alternative embodiments of this invention as set forth in the following
10 claims.

CLAIMS:

1. An integrated heavy lift and logistics vessel for docking a vessel comprising:

5 a deck having a first section for receiving a vessel, and a second section bordered by a first wing-wall provided on a port side of the deck, a second wing-wall provided on a starboard side of the deck, and a deck box provided at a bow of the deck, the deck box abutting the first wing-wall and the second wing-wall wherein the first wing-wall comprises a first tube extending from a hull of the integrated heavy lift
10 and logistics vessel to the deck, the first tube having a first opening at the hull and a second opening at a surface of the first wing-wall facing the deck, wherein in response to the ballasting system lowering the deck below the water level, water flows through the first tube via the first opening and the second opening to flood the second section of the deck and further wherein the first tube is tilted at an angle in
15 relation to a surface of the deck such that the first opening of the tube is positioned lower than the second opening of the first tube;

a ballasting system configured to lower the deck below a water level and below a hull of a docking vessel, and to raise the deck above the water level, wherein the second section of the deck is configured to flood when the deck is lowered below
20 the water level; and

an accommodation unit provided on a top surface of the deck box.

2. The integrated heavy lift and logistics vessel of claim 1 wherein the second wing-wall comprises:

25 a second tube extending from a hull of the integrated heavy lift and logistics vessel to the deck, the second tube having a first opening at the hull and a second opening at a surface of the second wing-wall facing the deck, wherein in response to the ballasting system lowering the deck below the water level, water flows through the first opening and the second opening to flood the second section of the deck.

3. The integrated heavy lift and logistics vessel of claim 1 further comprising:
a helipad provided on a top surface of the accommodation unit.

4. The integrated heavy lift and logistics vessel of claim 1 further comprising:

35 means for handling discharge of cargo from the integrated heavy lift and logistics vessel to an attending vessel.

5. The integrated heavy lift and logistics vessel of claim 1 further comprising:
an emergency shelter.

6. The integrated heavy lift and logistics vessel of claim 5 wherein the
5 emergency shelter further comprises emergency medical facilities.

7. The integrated heavy lift and logistics vessel of claim 1 further comprising:
storage means provided in a hull of the integrated heavy lift and logistics
vessel for storing liquids.

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8. The integrated heavy lift and logistics vessel of claim 1 further comprising:
pipe racks provided on the deck box for storing tubular members.