Summary of the invention

Hereto, according to an aspect of the invention, there is provided a vessel hull for use as a hull for a floating hydrocarbon storage and/or processing plant. The vessel hull comprises:

- a stern portion, a bow portion and a central portion in between the bow and stern portions, the vessel hull provided with longitudinal hull sides comprising the longitudinal hull sides of the stern portion, the bow portion and the central portion, wherein the bow portion comprises a vertical plane of symmetry extending in a longitudinal direction of the hull,
- a deck, arranged on the hull, suitable for supporting hydrocarbon processing modules,
- hydrocarbon storage tanks, arranged inside the hull, for storing hydrocarbons to be obtained from seabed-based wellheads,
- an anchoring connection arrangement for connection with anchor lines suitable for mooring the vessel hull to a seabed,
- wherein either:
    - both longitudinal hull sides comprise mooring line connection reinforcements near or in the bow portion and stern portion for connecting mooring lines to be used with a spread-moored anchor line arrangement and one or both longitudinal hull sides comprise riser balcony connection reinforcements arranged in between the mooring line connection reinforcements in longitudinal direction, suitable for supporting a riser balcony for connecting risers; or
    - the bow portion comprises a turret reinforcement suitable for receiving an internal turret; or
    - the bow portion comprises a turret reinforcement suitable for receiving an external turret, wherein the turret is provided with anchor line connection points and riser connection points;

characterized in that

- the deck comprises process module reinforcements suitable for supporting hydrocarbon process modules;

- the vessel hull is provided with a transverse bulkhead arranged between the bow portion and the central portion, the central portion comprising two longitudinal central portion bulkheads extending in the longitudinal direction from the stern portion to the transverse bulkhead, the central portion bulkheads being spaced-apart at a transverse distance D1; and
- the bow portion comprises two longitudinal bow portion bulkheads, wherein, when seen in top view, the longitudinal portion bulkheads are each arranged on one side of the vertical plane of symmetry, each longitudinal bow portion bulkhead extending from the transverse bulkhead towards the bow and comprising a first section which diverges in a direction from the transverse bulkhead away from the vertical plane of symmetry.

According to an embodiment of the invention, a method for producing a vessel hull for use as a hull for a floating hydrocarbon storage and/or processing plant is provided, comprising the steps of:

- producing a vessel hull stern portion, a bow portion and a central portion in between the bow and stern portions, the vessel hull provided with longitudinal hull sides comprising the longitudinal hull sides of the stern portion, the bow portion and the central portion,
- arranging a deck on the hull suitable for supporting hydrocarbon processing modules,
- arranging hydrocarbon storage tanks inside the hull, for storing hydrocarbons to be obtained from a seabed-based wellhead,
- providing the hull with an anchoring connection arrangement for connection with anchor lines suitable for mooring the vessel hull to a seabed, characterized by
- arranging process module reinforcements in the deck, suitable for supporting hydrocarbon process modules,

and at least two of the following steps:

- providing both longitudinal hull sides with mooring line connection reinforcements near or in the bow portion and stern portion for connecting mooring lines to be used in a spread-moored anchor line arrangement, and arranging in between the mooring line connection reinforcements in longitudinal direction, riser balcony connection reinforcements on one or both longitudinal hull sides suitable for supporting a riser balcony for connecting risers,

- providing the bow portion with turret reinforcements suitable for receiving an internal turret,
- providing the bow portion with turret reinforcements suitable for receiving an external turret, wherein the turret is provided with anchor line connection points and riser connection points.

Thus, a sort of ‘multi-purpose hull’ is provided, based on a ‘design one, build several’ philosophy, having reinforcements pre-installed in those hull locations where further FSO or FPSO equipment, in particular relating to anchor line connection points (i.e. the mooring system) and riser connection points, is to be installed. The

reinforcements are to be integrated in the hull at the dry dock and subsequently the hull having the aforementioned reinforcements is transported to an quay side that can receive an FPSO or FSO for the actual conversion into an FPSO or FSO having the desired mooring and riser system arrangement. The conversion can be carried out using local equipment. In a particular scenario, the dry dock is for example situated in South Korea, whereas the quay side for the top sides integration for the FPSO is located in Brazil. If, for instance, an FPSO having an external turret system is to be constructed at the FPSO quay side, the 'non-used' reinforcements (i.e. the ones specifically arranged for use with a spread-moored arrangement and/or an internal turret arrangement) can remain in place, then serving only as general structural reinforcements for the vessel hull but not for a mooring arrangement.

It is found in practice that the total time needed for conversion to an FSO or FPSO can be reduced with about 6-12 months, compared to the classic method of converting and refurbishing the hull of an existing second-hand oil tanker.

The size and flexibility of the hull design enables the FSO or FPSO to be moored in various configurations, i.e. to be compatible with any type of environment, water depth, riser type or storage requirement, with no rework needed within the hull.

In the context of this patent application, 'reinforcements' are to be understood as structural reinforcements for providing additional structural strength/stiffness at the respective hull location, to allow the hull to deal with the relatively larger forces occurring at that hull location due to the presence of riser systems, mooring systems, process modules, crane support, flare stack, etcetera.

Another ~~aspect~~ embodiment of the invention relates to a vessel hull for use as a hull of a floating hydrocarbon storage and/or processing plant, comprising:

- a stern portion, a bow portion and a central portion in between the bow and stern portions, the vessel hull provided with longitudinal hull sides comprising the longitudinal hull sides of the stern portion, the bow portion and the central portion,
- a deck, arranged on the hull, suitable for supporting hydrocarbon processing modules,
- hydrocarbon storage tanks, arranged inside the hull, for storing hydrocarbons to be obtained from seabed-based wellheads,
- an anchoring connection arrangement for connection with anchor lines suitable for mooring the vessel hull to a seabed, characterized in that

resemble an arc having a centre of curvature coinciding with a centre point of the internal turret receivable in the reception space.

Yet another embodiment relates to an aforementioned vessel hull, comprising one or more removable propulsion units. Each propulsion unit can be connected to or associated with a (power) generator unit that is removable as well.

Thus, the vessel hull can be transported from a first location (in particular the dry dock) to a second location (most notably the FPSO or FSO quay side) by using the propulsion provided by the removable propulsion units. After the selective work is performed at the quayside (integration of the selected mooring system with riser connection points, meaning adding a (upper and lower) riser balcony, integration of an internal or external turret, adding the process modules, adding flare stack, the cranes, etc) the completed FSO or FSO can be transported by its own propulsion system to the offshore production site were risers and mooring lines are connected to the respective riser and mooring lines connection points. After transportation and hook-up of risers and mooring lines, the temporary and removable propulsion units and the associated generators are disconnected from the hull and removed so that they can be used for another FPSO or FSO hull according the invention. Thus, installing permanent propulsion in the vessel hull is not required anymore, which will reduce the initial CAPEX costs of the FPSO or FSO.

In an embodiment the deck comprises reinforcement suitable for supporting a flare stack and reinforcements for supporting one or more pedestrial cranes.

Another ~~aspect~~ embodiment of the invention relates to a method for producing a vessel for use as a floating hydrocarbon storage and/or processing plant using an aforementioned vessel hull comprising the steps of:

- arranging the hydrocarbon process modules on the deck, at the location of the process module reinforcements,
- selecting a desired riser and anchor line arrangement, such as a spread moored arrangement, an internal turret arrangement or an external turret arrangement, and
- configuring the vessel hull for use with the desired anchor line and riser arrangement, in particular by configuring anchor line connection points and riser connection points.

The above method can be carried out conveniently at the second location, away from the dry dock, to obtain the finalized or close-to-being-finalized FPSO or FSO.