DESCRIPTION

FLOATING FACILITY

Technical Field

[0001]

The present invention relates to a floating facility including a liquefied natural gas plant.

Background Art

[0002]

As a facility that liquefies natural gas (NG) produced from gas fields, a floating facility called floating LNG (FLNG) is known in which a floating body such as a hull is disposed on the sea, and a plant (liquefied natural gas plant, hereinafter also referred to as "LNG plant") that liquefies NG is disposed on the floating body.

[0003]

Since various utilities such as water (seawater or fresh water), nitrogen, and air are used to operate the floating body and the LNG plant, the FLNG is equipped with a large number of utility facilities that supply these utilities, for example.

The FLNG is a huge structure that has a total length of several hundred meters and is built over a period of one year or more. For this reason, a layout of facilities including not only the LNG plant and facilities on the

floating body side but also the utility facilities is one of factors that determine difficulty in design and construction of the FLNG.

[0004]

For example, Patent Literature 1 describes a technique for constructing a tank area in which LNG is stored and a factory area including a natural gas liquefaction plant as separate floating structures, and then connecting these floating structures to each other in a length direction. In Patent Literature 1, a gas boiler, which is one of utility facilities, is disposed in a hull, which is a floating body.

Meanwhile, Patent Literature 1 describes nothing about disposition of utility facilities in a floating facility in which an LNG plant is disposed on an upper surface side of a floating body having a tank formed therein.

Citation List

Patent Literature

[0005]

Patent Literature 1: JP 2015-13494 A

Summary of Invention

Technical Problem

[0006]

The present invention has been achieved under such a background, and provides a technique for simplifying design and construction of a floating facility including a liquefied natural gas plant.

Solution to Problem

[0007]

A floating facility of the present invention includes:

a floating body disposed on the sea;

a liquefied natural gas plant disposed on the floating body;

a plant utility facility that supplies utilities to the liquefied natural gas plant; and

a first utility facility that supplies utilities to the floating body and a second utility facility that supplies utilities to the liquefied natural gas plant, the first utility facility and the second utility facility being utility facilities having a mutually common function, in which

the plant utility facility and the second utility facility are disposed on the floating body, and the first utility facility is disposed in the floating body.

[0008]

The floating facility may have the following characteristics.

(a) The plant utility facility includes at least one facility selected from a cooling water supply facility group consisting of a seawater pump, a heat exchanger, and a cooling water pump, and the utility facilities having the common function each include at least one facility selected from a facility group consisting of a fresh water manufacturing apparatus, a nitrogen manufacturing apparatus, an air compressor, a fuel oil supply apparatus, a hydraulic supply apparatus, a fire extinguishing water supply facility, a fire extinguishing medium supply facility, and an inert gas generator.

(b) The liquefied natural gas plant includes a plurality of modules in each of which a device group constituting the liquefied natural gas plant is installed in a frame or on a base.

(c) A plurality of liquefied natural gas tanks is disposed in the floating body, and at least some of these liquefied natural gas tanks are arranged in one row in a ship length direction of the floating body, and in the central area of the floating body in a ship width direction, pull-out positions where pipes connected to the tanks are pulled out to an upper surface side of the floating body are formed, and the modules are separately

disposed in areas on both right and left sides in the ship width direction with respect to these pull-out positions.

Advantageous Effects of Invention

[0009]

In the present invention, the utility facilities are installed inside or outside the floating body according to a utility supply destination, and therefore a burden associated with design and manufacture of the utility facilities and the FLNG can be shared and reduced.

Brief Description of Drawings

[0010]

Fig. 1 is a schematic diagram of an FLNG in prior art.

Fig. 2 is a schematic diagram of an FLNG according to an embodiment.

Fig. 3 is an explanatory diagram relating to a construction process of the FLNG.

Description of Embodiments

[0011]

First, the configuration of an FLNG 1a in prior art will be described with reference to Fig. 1.

In the FLNG 1a, a turret 12, which is a mooring

facility, is disposed on a bow side of a hull 10, which is a floating body disposed on the sea. The turret 12 is connected to a mooring line to moor the hull 10, and is connected to a riser that transports mined natural gas (NG) underwater (the mooring line and the riser are not illustrated). Hereinafter, description will be made by defining the direction in which the turret 12 is disposed as a front of the hull 10.

For example, at a position closer to the left side on the bow side on a main body of the hull 10, a flare stack 14 for combustion of excess gas generated in an LNG plant 2 or an LNG tank 11 is disposed.

[0012]

As illustrated in Fig. 1(b), when the hull 10 is viewed from an upper surface side, a pipe rack 22 is disposed in a central area in a ship width direction so as to extend in a length direction of the hull 10. The pipe rack 22 is a frame structure holding a pipe group through which various fluids handled in the LNG plant 2 flow.

[0013]

A plurality of modules 21 constituting the LNG plant 2 is arranged in a front-rear direction on each of left and right sides of the pipe rack 22. For example, the module 21 is a division unit in which a device group constituting a process unit that performs various processes for NG is

incorporated in a common frame. In each of the modules 21, a large number of device groups, for example, a static device such as a tower tank or a heat exchanger, a dynamic device such as a pump, a connection pipe connecting a static device to a dynamic device, and a connection pipe used for connection to pipes on the pipe rack 22 side are disposed.

Note that it is not an essential requirement to dispose various device groups in the frame to constitute the module 21. For example, the module 21 may be constituted by disposing these device groups on a pallet-shaped base.

[0014]

Examples of the process unit constituting the LNG plant 2 include a gas-liquid separation unit that separates liquid contained in NG received from the riser, a pretreatment unit that removes acidic gas (carbon dioxide, hydrogen sulfide, or the like), moisture, and mercury, a distillation separation unit that performs distillation separation of NG from which impurities have been removed to obtain methane, and a liquefaction unit that liquefies methane.

Furthermore, a living unit 13 is disposed at a position rearward from the area where the modules 21 and the pipe rack 22 are disposed.

[0015]

A plurality of LNG tanks 11 is formed in the main body of the hull 10. The LNG tanks 11 are formed of membrane type tanks, and in the FLNG 1a of this example, the LNG tanks 11 are arranged in two rows in a ship length direction of the hull 10 (Fig. 1 (c)).

[0016]

In the FLNG 1a having the above configuration, when the LNG plant 2 is operated, various utilities such as electric power, cooling water (seawater, fresh water cooled by seawater, and the like), a heat medium (steam, hot water, hot oil, and the like), air, and nitrogen are used.

Utilities such as electric power, fresh water (for drinking water or cooling water), air, and nitrogen are consumed also in an engine unit on the hull 10 side, the LNG tank 11, the living unit 13, and the like.

[0017]

Regarding the disposition of utility facilities that supply the above-described various utilities, in prior art, when there is an extra space in the hull 10, it has been generally considered that these utility facilities are disposed in the hull 10 from a viewpoint of suppressing an increase in size of the FLNG 1a.

That is, as illustrated in Fig. 1(a), many of plant utility facilities 31 that supply utilities to the LNG

plant 2 and common utility facilities 32 that supply utilities to both the hull 10 and the LNG plant 2 are disposed in the hull 10.

[0018]

Note that in prior art as well, a power generation facility including a large power generator or the like may be disposed on a deck of the hull 10 together with the LNG plant 2, while a small power generator that generates electric power used at the time of starting operation of the LNG plant 2 or in an emergency may be disposed in the hull 10. In addition, in prior art, a boiler for heating steam, hot water, or hot oil may be disposed on the hull 10 or in the hull 10. Therefore, in an embodiment described below, a power generation facility, a substation facility, a boiler, and the like are not included in the following plant utility facilities 31 and common utility facilities 32.

[0019]

To summarize again the characteristics of the FLNG 1a having a configuration in prior art, many of the plant utility facilities 31 and common utility facilities 32 are disposed in the hull 10.

However, the LNG plant 2 and the hull 10 are often designed by separate specialized companies. For this reason, it is a factor that complicates a design process of

the FLNG 1a for a shipbuilding company that designs the hull 10 to design a facility for utilities supplied to the LNG plant 2 side.

[0020]

As will be described later, the modules 21 constituting the LNG plant 2 and the hull 10 may be constructed in yards (fabrication yard and shipbuilding dock) separated from each other. For this reason, for example, it is not easy to reflect a request for a change in specifications of a utility facility generated during construction of the LNG plant 2 (modules 21) on the common utility facilities 32 on the hull 10 side constructed in a remote location.

[0021]

In order to solve the problems described above, an FLNG 1 according to the following embodiment has a configuration in which positions where various utility facilities are disposed are optimized according to a utility supply destination.

Hereinafter, the configuration of the FLNG 1 according to a first embodiment will be described with reference to Figs. 2 and 3. Note that in these drawings, components common to the FLNG 1a described above are designated by the same reference numerals as those used in Fig. 1, and repeated description thereof will be omitted.

[0022]

As illustrated in Fig. 2, in the FLNG 1 according to the first embodiment, plant utility facilities 31 disposed in a hull 10 in the FLNG 1a in prior art are disposed on a deck of the hull 10. The plant utility facilities 31 include at least one facility selected from a cooling water supply facility group consisting of a seawater pump, a heat exchanger, and a cooling water pump constituting a cooling water supply facility.

[0023]

In particular, in an LNG plant 2, a large amount of cooling water is used mainly for the purpose of removing heat generated during liquefaction of NG. As the cooling water, for example, fresh water cooled by seawater is used. Examples of the cooling water supply facility that supplies this cooling water include those including a seawater pump that pumps seawater from the sea, a heat exchanger that cools cooling water using the pumped seawater, and a cooling water pump that feeds the cooling water to the LNG plant 2. Note that the configuration of the cooling water supply facility is not limited to the above-described example, and for example, the cooling water supply facility may directly use seawater pumped by a seawater pump as cooling water. In this case, the seawater pump constitutes the cooling water supply facility.

[0024]

Cooling water and seawater that cools the cooling water are utilities that are used in a relatively large amount, and a device (a seawater pump, a heat exchanger, a cooling water pump, or the like) disposed in the cooling water supply facility is large as compared to other utility facilities. Not only the number of these devices installed is large, but also pipes connecting the devices to each other have large diameters. Therefore, when there is an extra space in the hull 10, it has been commonly considered to use the space to suppress an increase in size of the entire FLNG 1a (Fig. 1(a)).

[0025]

Meanwhile, the cooling water supply facility including a relatively large number of large devices and having a complicated structure is one of major factors that complicate a design process and reduce flexibility in a process of manufacturing modules 21 and the hull 10 (for example, a change in specifications of the modules 21 and the hull 10 is reflected quickly).

Therefore, as will be described later, first, the FLNG 1 of the present embodiment is characterized in giving priority to disposing the plant utility facilities 31 on the hull 10 even at the expense of suppressing an increase in size.

[0026]

Here, it is not completely prohibited to use utilities supplied from the plant utility facilities 31 on the hull 10 side. For example, disposition of a pipe that extracts a part (for example, an amount of 30% or less) from utilities supplied from the plant utility facilities 31 and supplies the extracted part to the hull 10 does not largely affect design of the hull 10 and the modules 21 and a construction process thereof.

In addition, it is not an essential requirement to dispose all types of facilities included in the above-described cooling water facility group as the plant utility facilities 31 on the hull 10. Disposition of some types of facilities in the hull is not prohibited while a burden associated with design and construction is taken into account.

[0027]

Furthermore, as schematically illustrated in Figs. 2(a) and 2(b), second, the FLNG 1 of this example is characterized in that a hull-side utility facility (first utility facility) 32b that supplies utilities to the hull 10, and a plant-side utility facility (second utility facility) 32a that supplies utilities to the LNG plant 2 are disposed separately instead of the common utility facility 32 disposed in the hull 10 in prior art.

[0028]

In each of the hull-side utility facility 32b and the plant-side utility facility 32a, a utility facility having a common function is disposed. Specifically, for example, at least one utility facility selected from a facility group consisting of a fresh water manufacturing apparatus that manufactures fresh water from seawater, a nitrogen manufacturing apparatus that manufactures nitrogen from air, an air compressor that supplies instrument air, a fuel oil supply apparatus that supplies fuel oil to a power generator or a boiler, a hydraulic supply apparatus that supplies operation oil to a hydraulic drive device, a fire extinguishing water supply facility that supplies digested water, a fire extinguishing medium supply facility that supplies a digestive medium such as digestive liquid, and an inert gas generator that obtains an inert gas from fuel combustion exhaust gas is disposed in each of the hull-side utility facility 32b and the plant-side utility facility 32a.

[0029]

The plant-side utility facility 32a is disposed on a deck of the hull 10, and the hull-side utility facility 32b is disposed in the hull 10.

By adopting the above-described configuration, it is not necessary to design the facilities 31 and 32a related

to utilities used on the LNG plant 2 side when the hull 10 is designed. In addition, the hull 10 and the modules 21 can be constructed independently without being affected by a change in specifications of the utility facilities 31, 32a, and 32b.

[0030]

Fig. 3 is a schematic diagram illustrating an example of a process of manufacturing the FLNG 1. The LNG plant 2 is manufactured in a state of being divided into a plurality of modules 21 on a fabrication yard side. At this time, the utility facilities 31 and 32a to be installed on the hull 10 may also be modularized and manufactured in the fabrication yard. Meanwhile, the hull 10 is constructed in a shipbuilding dock together with the hull-side utility facility 32b.

Then, at a predetermined timing, the modules 21 and the utility facilities 31 and 32a are transported to the shipbuilding dock and installed on the hull 10 to constitute the FLNG 1.

[0031]

Here, an influence of disposing the plant utility facility 31 and the plant-side utility facility 32a on the hull 10 on the FLNG 1 manufacturing process will be described.

When the plant utility facility 31 that is installed

in a space in the hull 10 in prior art is moved to a deck side, it may be necessary to secure a new space for disposing the plant utility facility 31. Furthermore, when the plant-side utility facility 32a is disposed separately from the hull-side utility facility 32b instead of the common utility facility 32 disposed in the hull 10 in prior art, a new space to be secured on the hull 10 is wider.

[0032]

As a method for securing a new installing space, it is conceivable to make a ship length L of the hull 10 according to the embodiment longer than a ship length L_0 of the hull 10 in prior art illustrated in Fig. 1.

At this time, in the example illustrated in Fig. 2, LNG tanks 11, which are separately arranged in two rows to the full width of the hull 10 in prior art, are arranged in one row within a range of the tank width that does not cause sloshing. Meanwhile, in order to maintain the tank capacity of the entire FLNG 1 at the same level as that in prior art, the number of LNG tanks 11 to be installed in the length direction is increased by taking advantage of the longer ship length of the hull 10.

[0033]

In construction of the LNG tanks 11, a tank structure is formed in the hull 10, and then tank domes 110 serving as pull-out positions where various pipes (a

loading pipe, an offloading pipe, a vapor pipe, and the like) connected to the LNG tanks 11 are pulled out above a deck are installed, which is a final step. Unless the installation of the tank domes 110 is completed, work of disposing a structure above the tank domes 110 cannot be started.

[0034]

The tank domes 110 are often disposed at the central positions when the LNG tanks 11 are viewed in the ship width direction of the hull 10, for example, from a viewpoint of evenly discharging LNG from the insides of the LNG tanks 11.

At this time, when the LNG tanks 11 are arranged in two rows as in the FLNG 1a in prior art illustrated in Fig. 1(c), there is a high possibility that the tank dome tank domes 110 may be located below the modules 21. For this reason, there is a restriction that it is necessary to wait for the tank domes 110 to be installed, and installation of the modules 21 on the hull 10 cannot be started in some cases.

[0035]

Meanwhile, in the FLNG 1 of the present embodiment, as illustrated in Fig. 2(c), the plurality of modules 21 is separately disposed in areas on both right and left sides with respect to the positions where the tank domes 110 are

arranged in one row in each hull 10. As a result, there is an advantage that the installation of the modules 21 on the hull 10 can be started without waiting for completion of the installation of the tank domes 110. Note that as the arrangement of the LNG tanks 11, a two-row arrangement and a one-row arrangement may be combined.

[0036]

The construction of the LNG plant 2 sandwiching the tank domes 110 of the LNG tanks 11 arranged in one row is applied not only to a method for installing the modules 21 constructed in a fabrication yard or the like. The construction of the LNG plant 2 sandwiching the tank domes 110 of the LNG tanks 11 arranged in one row may be applied to a so-called stick-built construction method for assembling devices constituting the LNG plant 2 on a deck of the hull 10. In this case as well, an area where the construction of the LNG plant 2 can be started without waiting for completion of the installation of the tank domes 110 is widened.

[0037]

The FLNG 1 according to the present embodiment has the following effects. The plant utility facility 31, the plant-side utility facility 32a, and the hull-side utility facility 32b are installed inside or outside the hull 10 according to a utility supply destination, and therefore a

burden associated with design and manufacture of these utility facilities 31, 32a, and 32b can be shared and reduced.

[0038]

Here, the utility facilities 31, 32a, and 32b according to the embodiment are disposed not only on the newly constructed FLNG 1. The present technology can also be applied to a case where a floating body is added to both sides of an existing LNG transport ship, and the LNG plant 2 is disposed on the floating body to dispose the FLNG 1.

For example, an existing utility facility installed on the LNG transport ship side serves as the hull-side utility facility 32b, and a utility facility installed together with the LNG plant 2 on the additional floating body serves as the utility facilities 31 and 32a of the LNG plant 2.

Reference Signs List

[0039]

1, 1a FLNG

10 Hull

11 LNG tank

2 LNG plant

21 Module

31 Plant utility facility

32 Common utility facility

32a Plant-side utility facility

32b Hull-side utility facility

CLAIMS

1. A floating facility comprising:

a floating body disposed on the sea;

a liquefied natural gas plant disposed on the floating body;

a plant utility facility that supplies utilities to the liquefied natural gas plant; and

a first utility facility that supplies utilities to the floating body and a second utility facility that supplies utilities to the liquefied natural gas plant, the first utility facility and the second utility facility being utility facilities having a mutually common function, wherein

the plant utility facility and the second utility facility are disposed on the floating body, and the first utility facility is disposed in the floating body.

2. The floating facility according to claim 1, wherein the plant utility facility includes at least one facility selected from a cooling water supply facility group consisting of a seawater pump, a heat exchanger, and a cooling water pump, and the utility facilities having the common function each include at least one facility selected from a facility group consisting of a fresh water manufacturing apparatus, a nitrogen manufacturing apparatus, an air compressor, a fuel oil supply apparatus,

a hydraulic supply apparatus, a fire extinguishing water supply facility, a fire extinguishing medium supply facility, and an inert gas generator.

3. The floating facility according to claim 1, wherein the liquefied natural gas plant includes a plurality of modules in each of which a device group constituting the liquefied natural gas plant is installed in a frame or on a base.

4. The floating facility according to claim 1, wherein a plurality of liquefied natural gas tanks is disposed in the floating body, and at least some of these liquefied natural gas tanks are arranged in one row in a ship length direction of the floating body, and

in a central area of the floating body in a ship width direction, pull-out positions where pipes connected to the tanks are pulled out to an upper surface side of the floating body are formed, and the modules are separately disposed in areas on both right and left sides in the ship width direction with respect to these pull-out positions.