

METHOD OF INTEGRATING NEW BUILT STRUCTURAL BLOCK AND SPONSON WITH EXISTING LNG CARRIER

TECHNICAL FIELD

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The present disclosure relates to an existing Liquefied Natural Gas (LNG) carrier that can be reconstructed or converted through a jumboisation technique by adding a new built structural block which contains a LNG storage tank facility/Liquefied Natural Gas process facility for liquefaction production/regasification modules on
10 deck space. As liquefaction production modules require more deck space, additional deck space may be provided by adding one or more new built sponsons on either one or both sides of an existing LNG carrier hull.

BACKGROUND

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When the charterer period of an existing LNG carrier comes to an end, the existing LNG carrier may be laid up or scrapped if a life extension program for continuous services as a LNG carrier or other purposes is not available. The availability of a life extension program depends on the condition of the LNG carrier. In one possible
20 life extension program for an existing LNG carrier, a new lease of life for a floating LNG production/Regasification facility onboard is provided as an added asset to the existing LNG carrier to further extend the life period of the existing LNG carrier.

In order to enlarge a ship or increase the storage capacity of an existing crude oil tanker, cruise vessel or bulk carrier, jumboisation technique is adopted by adding an
25 entire section to the ship or crude oil tanker, cruise vessel or bulk carrier. In addition, crude oil tanker vessels may be converted to Floating Production Storage and Offloading (FPSO) units, which are utilized by many operators around the world since there are markets for this kind of conversions. Similar to this kind of conversion, the existing LNG carriers may also be converted into offshore or near

shore gas process production/ regasification facilities for smaller gas process facilities.

However, on an existing LNG carrier, there is no sufficient deck space or required storage capacity to accommodate LNG production facility. Although some existing LNG carriers may accommodate a small scale Regasification facility, since all new built Floating storage and Regasification Units (FSRU) come with bigger storage capacities and regasification facilities, the existing LNG carriers cannot be utilized to accommodate a new built FSRU due to lack of enough storage capacity and sufficient deck space. Because of this reason, some existing LNG carriers are even scrapped. It is a great wastage of resources.

Current market requires a bigger storage capacity to accommodate Floating LNG production/ regasification facilities, either they go for a new built Floating LNG production facility (FLNG) / FSRU vessel or having an existing LNG carrier with a Floating Regasification facility with additional floating storage unit (FSU) vessel either at Jetty terminal or side by side mooring to compete with new built FSRU vessels, as these are conventionally carried out at the offshore or near shore terminals. Similarly new built Floating LNG production barge/Vessel with additional FSU vessel at jetty terminal or side by side mooring to compete with new build FLNG vessels, as these are conventionally carried out at the offshore or near shore terminals.

SUMMARY OF THE INVENTION

In accordance with an aspect of the invention, there is provided a method for constructing an FLNG, FSRU or a LNG carrier, the method comprising: separating a first existing LNG carrier to form a forward section and an aft section; fabricating a structural block prior to separating the first existing LNG carrier, the structural block includes a gas process facility, the gas process facility includes a regasification plant or a liquefaction plant; (c) placing a structural block into a space between the forward section and the aft section, the structural block having a front end and a rear end; (d) joining the forward section to the front end of the structural block and joining the aft section to the rear end of the structural block to form a new integrated

vessel; and (e) placing at least one sponson on a side of the new integrated vessel. Alternatively, a sponson is placed on each side of the new integrated vessel. For ease of reference, each side of the vessel may be the left and right side of the vessel.

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Preferably, the structural block and sponson include one or more LNG storage tanks. More preferably, the LNG storage tank is selected from a group consisting of a MOSS type tank, a Gaztransport & Technigaz (GTT) tank, a self-supporting prismatic type B (SPB) tank, an independent type A tank and an independent type C tank.

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Preferably, the structural block is fabricated at a first site, the sponsons are fabricated at a second site, and separating the first existing vessel is carried out at a third site, wherein the first, second and third sites are independently operable from each other. The structural block is fabricated at a site while the first existing vessel is absent from the site. The sponsons may be fabricated at a site while the first existing vessel is absent from the site.

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Preferably, the structural block is a structure section of a second existing LNG carrier. Prior to fabricating the structural block from the second existing LNG carrier, characteristics of the first existing LNG carrier for fabrication of the structural block are first determined.

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The method of claim 1 further comprising, prior to separating the first existing LNG carrier, determining characteristics of the first existing LNG carrier for fabrication of the structural block.

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Preferably, the sponsons may be the same size or of different sizes depending on the process facilities in them.

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Preferably, the sponsons includes a ballast tank. Advantageously, a ballast tank may provide buoyancy.

Preferably, the structural block includes at least one LNG storage tank having a containment system different from that of the first existing LNG carrier.

5 In accordance with another aspect of the invention, there is provided a method for constructing an FLNG, FSRU or a LNG carrier, the method comprising: separating a first existing LNG carrier to form a forward section and an aft section; fabricating a structural block prior to separating the first existing LNG carrier, the structural block includes a gas process facility, the gas process facility includes a regasification plant or a liquefaction plant; joining a structural block with one of the forward section
10 and the aft section to form a new integrated vessel; and placing at least one sponson on each side of the new integrated vessel.

Preferably, the structural block and sponson include one or more LNG storage tanks. More preferably, the LNG storage tank is selected from a group consisting of
15 a MOSS type tank, a Gaztransport & Technigaz (GTT) tank, a self-supporting prismatic type B (SPB) tank, an independent type A tank and an independent type C tank.

Preferably, the structural block is fabricated at a first site, the sponsons are
20 fabricated at a second site, and separating the first existing vessel is carried out at a third site, wherein the first, second and third sites are independently operable from each other. The structural block is fabricated at a site while the first existing vessel is absent from the site. The structural block is a structure section of a second existing LNG carrier.

25 Preferably, the structural block includes a bow section of a second LNG carrier, the forward section of the first existing LNG carrier is a bow of the first existing LNG carrier, the method comprising jointing the structural block to the aft section of the first LNG carrier to form the new integrated LNG carrier. The structural block further
30 includes a turret built on the bow section.

Preferably, the structural block includes a stern section of a second LNG carrier, the aft section of the first existing LNG carrier is a stern of the first existing LNG carrier,

the method comprising jointing the structural block to the forward section of the first LNG carrier to form the new integrated LNG carrier.

Preferably, the method further comprising, prior to separating the first existing LNG carrier, determining characteristics of the first existing LNG carrier for fabrication of the structural block.

The object of the present disclosure is hence to provide a service life extension program for an existing LNG carrier to both accommodate additional storage facilities and create more deck space for gas process production/regasification facilities.

The present disclosure relates to creating additional LNG storage space and deck space for gas process production/regasification modules, which is achieved by enlarging an existing LNG carrier by jumboisation technique and then by adding newly built sponsons which are proposed to be integrated with the existing LNG carrier to increase the value of the existing LNG carrier without needing to purchase or build an entirely new floater.

According to one embodiment of the invention, a newly built structural block is prefabricated with LNG storage space. The structural block may contain at least one LNG storage tank having a containment system which may be same as or different from that of the existing LNG carrier. Most of the existing LNG carriers are either MOSS type containment systems or membrane type containment systems, only few LNG carriers are built using other types of containment system. New additional space created for LNG storage can be either one of the two types of containment system and it depends on the gas process facilities. MOSS type containment system cannot be utilized because of spherical dome and we don't have deck space for gas process production facility. Membrane type tank, IHI SPB tank, Type C pressurized tank and other international approved new containment systems can be utilized for new LNG storage space and deck space for gas process production/regasification facility.

Jumboisation technique requires re-engineering and integration of existing storage system to newly added system that offset safe flexibility and functionality asset. An

existing LNG carrier is cut apart to form a forward section and an aft section which include existing cryogenic pipelines, electrical cables, bulkhead, stiffeners, longitudinal and transverse beam which need to be reinforced and hook up with new structural block and connect with new pipeline, electrical cables, etc.

- 5 Necessary steps should be followed while integrating an existing storage system with a new built storage system.

After integration, the existing LNG carrier and new built storage space, deck space can be utilized for gas process production/regasification facility or machinery space for other uses. For bigger LNG production facilities which the deck space is still not
10 enough to accommodate the production modules after jumboisation, a new built sponson(s) is provided to both sides of the integrated ship hull or one side of integrated ship hull. This sponson will provide additional deck space for gas process production/regasification facility, Type C LNG containment system or mechanical deck space for other uses.

- 15 Different cutting locations on an existing LNG carrier from fwd section until bow section have been proposed in this invention to integrate the existing LNG carrier with a new built LNG storage space and other existing hookup. In order to merge the shape of the newly added sponson(s) with the shape of the existing LNG carrier hull, proper steps need to be carried out. Since the existing LNG carrier may be cut
20 at different locations, the size of the sponson(s) also changes accordingly, some places requiring at least one sponson on one side. One side of the sponson can be used as ballast tank for stability of the Integrated LNG carrier.

New built structural block fabrication can be done in-house for membrane tank, Keppel holds license to build such tank in Keppel yard. If new built structural block
25 uses IHI (Ishikawajima-Harima Heavy Industries Prismatic IMO type B LNG tanks) SPB (self-supporting prismatic type B) tank then it will be fabricated in IHI yard, after completion of the complete structural block, it will be deployed to Keppel yard for integrating with the existing LNG carrier. During fabrication of the new built structural block, the existing LNG carrier does not need to be present at yard. This
30 will allow the existing LNG carriers to continue to operate as LNG transportation vessel during the fabrication period of the new structural block. New built structural block may be fabricated based on optimized working schedule, construction sequence and coordination with the existing LNG carrier work process.

Upon near completion of the new structural block, the existing LNG carrier will be dry-docked for cutting of the hull for vessel assembly. When the existing hull is separated into a forward and an aft section, either one or both sections are moved away from each other to form a space between them. The new structural block is then placed into the created space and joined to the forward and aft sections, by welding, to form an integrated storage space to the existing LNG carrier. This new structural block provides the new dimension to the existing LNG carrier by increasing the storage space and deck space for gas process production/regasification facility or other machinery space.

Newly built sponsons can serve several purposes based on user's requirements; it can serve as type C LNG storage system, machinery space, deck space for gas process production/regasification facility, ballast tank, etc. Sponsons can be installed on both sides of the ship hull or one side of the ship hull. The new built sponsons may be in different size and shape based on deck space required and the cutting location.

The new built structural block contains a LNG storage space which may be merged with the ship hull of the existing LNG carrier or slightly extend the space on both sides of the new-built structural block to provide additional LNG storage space as well deck space. The new built sponson(s) should be built based on new built extended structural block. The extended new built structural block will be integrated with the new built sponson(s), accordingly some places are required for at least one sponson on one side of the ship hull.

Embodiments of the present disclosure can provide the following advantages:

- The new integration to an existing LNG carrier provide additional LNG storage spaces, create new additional deck space for process production/regasification facility & utilities, add new sponson(s) on both sides of the ship hull of the existing LNG carrier to provide additional space which can be utilized for other additional machinery space.
- The existing LNG carrier is only needed during vessel assembly period in the yard, which minimizes the period for the existing LNG carrier to be present in a yard. This will maximize the utilization of the existing LNG carrier.

- The newly integrated LNG carrier can be utilized as gas process production/regasification facility.
- This integration will also provide a new lease of life for a floating LNG production/regasification platform or asset.

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BRIEF DESCRIPTION OF THE DRAWINGS

These and other aspects of the present disclosure will be described in detail with reference to the accompanying drawings, in which:

10 Fig.1A is a partial cross sectional view of an existing LNG carrier;

Fig.1B is a partial top view of the existing LNG carrier of Fig.1A;

Fig. 1C shows a method for integrating an existing LNG carrier according to one embodiment of the present disclosure;

15 Fig.2A is a partial cross sectional side view showing the integrating process of an integrated LNG carrier using an existing LNG carrier of Fig.1A and a new built structural block according to one embodiment of the present disclosure;

Fig.2B is a partial top view of the integrating process of an integrated LNG carrier of Fig.2A;

20 Fig.2C is a partial cross sectional side view of an integrated LNG carrier according to the process shown in Fig.2A and Fig.2B;

Fig.2D is a partial top view of an integrated LNG carrier according to the process shown in Fig.2A and Fig.2B;

25 Fig.2E is a partial cross sectional side view showing the process of integrating new built sponsons with the integrated LNG carrier of Fig.2C according to another embodiment of the present disclosure;

Fig.2F is a partial top view showing the process of integrating new built sponsons with the integrated LNG carrier of Fig.2E;

Fig.2G is a partial cross sectional side view of an integrated LNG carrier according to the process shown in Fig. 2E and Fig. 2F;

Fig.2H is a partial top view of an integrated LNG carrier according to the process shown in Fig.2E and Fig.2F;

- 5 Fig.3A is a partial cross sectional side view showing the integrating process of an integrated LNG carrier using an existing LNG carrier of Fig.1A and a new built structural block according to an alternative embodiment of the present disclosure;

Fig.3B is a partial top view of the integrating process of an integrated LNG carrier of Fig.3A;

- 10 Fig.3C is a partial cross sectional side view of an integrated LNG carrier according to the process shown in Fig.3A and Fig.3B;

Fig.3D is a partial top view of an integrated LNG carrier according to the process shown in Fig.3A and Fig.3B;

- 15 Fig.3E is a partial cross sectional side view showing the process of integrating new built sponsons with the integrated LNG carrier of Fig.3C according to another embodiment of the present disclosure;

Fig.3F is a partial top view showing the process of integrating new built sponsons with the integrated LNG carrier of Fig.3E;

- 20 Fig.3G is a partial cross sectional side view of an integrated LNG carrier according to the process shown in Fig. 3E and Fig. 3F;

Fig.3H is a partial top view of an integrated LNG carrier according to the process shown in Fig. 3E and Fig. 3F;

- 25 Fig.4A is a partial cross sectional side view showing the integrating process of an integrated LNG carrier using an existing LNG carrier of Fig.1A and a new built structural block according to an alternative embodiment of the present disclosure;

Fig.4B is a partial top view of the integrating process of an integrated LNG carrier of Fig.4A;

Fig.4C is a partial cross sectional side view of an integrated LNG carrier according to the process shown in Fig.4A and Fig.4B;

Fig.4D is a partial top view of an integrated LNG carrier according to the process shown in Fig.4A and Fig.4B;

- 5 Fig.4E is a partial cross sectional side view showing the process of integrating new built sponsons with the integrated LNG carrier of Fig.4C according to another embodiment of the present disclosure;

Fig.4F is a partial top view showing the process of integrating new built sponsons with the integrated LNG carrier of Fig. 4E;

- 10 Fig.4G is a partial cross sectional side view of an integrated LNG carrier according to the process shown in Fig. 4E and Fig. 4F;

Fig.4H is a partial top view of an integrated LNG carrier according to the process shown in Fig. 4E and Fig. 4F;

- 15 Fig.5A is a partial cross sectional side view showing the integrating process of an integrated LNG carrier using an existing LNG carrier of Fig.1A and a new built structural block according to an alternative embodiment of the present disclosure;

Fig.5B is a partial top view showing the integrating process of an integrated LNG carrier of Fig.5A;

- 20 Fig.5C is a partial cross sectional side view of an integrated LNG carrier according to the process shown in Fig.5A and Fig.5B;

Fig.5D is a partial top view of the integrated LNG carrier according to the process shown in Fig.5A and Fig.5B;

- 25 Fig.5E is a partial cross sectional side view showing the process of integrating new built sponsons with the integrated LNG carrier of Fig.5C according to another embodiment of the present disclosure;

Fig.5F is a partial top view of showing the process of integrating new built sponsons with the integrated LNG carrier of Fig.5E;

Fig.5G is a partial cross sectional side view of an integrated LNG carrier according to the process shown in Fig. 5E and Fig. 5F;

Fig.5H is a partial top view of the integrated LNG carrier of Fig.5G;

5 Fig.6A is a partial cross sectional side view showing the integrating process of an integrated LNG carrier using an existing LNG carrier of Fig.1A and a new built structural block according to an alternative embodiment of the present disclosure;

Fig.6B is a partial top view showing the integrating process of an integrated LNG carrier of Fig.6A;

10 Fig.6C is a partial cross sectional side view of an integrated LNG carrier according to the process shown in Fig.6A and Fig.6B;

Fig.6D is a partial top view of the integrated LNG carrier of Fig.6C;

Fig.6E is a partial cross sectional side view showing the process of integrating new built sponsons with the integrated LNG carrier of Fig.6C according to another embodiment of the present disclosure;

15 Fig.6F is a partial top view showing the process of integrating new built sponsons with the integrated LNG carrier of Fig.6E;

Fig.6G is a partial cross sectional side view of an integrated LNG carrier according to the process shown in Fig. 6E and Fig. 6F;

Fig.6H is a partial top view of the integrated LNG carrier of Fig.6G;

20 Fig.7A is a partial cross sectional side view showing the integrating process of an integrated LNG carrier using an existing LNG carrier of Fig.1A and a new built structural block according to an alternative embodiment of the present disclosure;

Fig.7B is a partial top view showing the integrating process of an integrated LNG carrier of Fig.7A;

25 Fig.7C is a partial cross sectional side view of an integrated LNG carrier according to the process shown in Fig.7A and Fig.7B;

Fig.7D is a partial top view of the integrated LNG carrier of Fig.7C;

Fig.7E is a partial cross sectional side view showing the process of integrating new built sponsons with the integrated LNG carrier of Fig.7C according to another embodiment of the present disclosure;

Fig.7F is a partial top view showing the process of integrating new built sponsons with the integrated LNG carrier of Fig.7E;

Fig.7G is a partial cross sectional side view of an integrated LNG carrier according to the process shown in Fig. 7E and Fig. 7F;

Fig.7H is a partial top view of the integrated LNG carrier of Fig.7G;

Fig.8A is a partial cross sectional side view showing the integrating process of an integrated LNG carrier using an existing LNG carrier of Fig.1A and a new built structural block according to an alternative embodiment of the present disclosure;

Fig.8B is a partial top view showing the integrating process of an integrated LNG carrier of Fig.7A;

Fig.8C is a partial cross sectional side view of an integrated LNG carrier according to the process shown in Fig.8A and Fig.8B;

Fig.8D is a partial top view of the integrated LNG carrier of Fig.8C;

Fig.8E is a partial cross sectional side view showing the process of integrating new built sponsons with the integrated LNG carrier of Fig.8C according to another embodiment of the present disclosure;

Fig.8F is a partial top view showing the process of integrating new built sponsons with the integrated LNG carrier of Fig.8E;

Fig.8G is a partial cross sectional side view of an integrated LNG carrier according to the process shown in Fig. 8E and Fig. 8F;

Fig.8H is a partial top view of the integrated LNG carrier of Fig.8G;

Fig.9A is a partial cross sectional side view showing the integrating process of an integrated LNG carrier using an existing LNG carrier of Fig.1A and a new built structural block according to an alternative embodiment of the present disclosure;

Fig.9B is a partial top view showing the integrating process of an integrated LNG carrier of Fig.9A;

Fig.9C is a partial cross sectional side view of an integrated LNG carrier according to the process shown in Fig.9A and Fig.9B;

5 Fig.9D is a partial top view of the integrated LNG carrier of Fig.9C;

Fig.9E is a partial cross sectional side view showing the process of integrating new built sponsons with the integrated LNG carrier of Fig.9C according to another embodiment of the present disclosure;

10 Fig.9F is a partial top view showing the process of integrating new built sponsons with the integrated LNG carrier of Fig.9E;

Fig.9G is a partial cross sectional side view of an integrated LNG carrier according to the process shown in Fig. 9E and Fig. 9F;

Fig.9H is a partial top view of the integrated LNG carrier of Fig.9G;

15 Fig.10A is a partial cross sectional side view showing the integrating process of an integrated LNG carrier using an existing LNG carrier of Fig.1A and a new built structural block according to an alternative embodiment of the present disclosure;

Fig.10B is a partial top view showing the integrating process of an integrated LNG carrier of Fig.10A;

20 Fig.10C is a partial cross sectional side view of an integrated LNG carrier according to the process shown in Fig.10A and Fig.10B;

Fig.10D is a partial top view of the integrated LNG carrier of Fig.10C;

Fig.10E is a partial cross sectional side view showing the process of integrating new built sponsons with the integrated LNG carrier of Fig.10C according to another embodiment of the present disclosure;

25 Fig.10F is a partial top view showing the process of integrating new built sponsons with the integrated LNG carrier of Fig.10E;

Fig.10G is a partial cross sectional side view of an integrated LNG carrier according to the process shown in Fig. 10E and Fig. 10F;

Fig.10H is a partial top view of the integrated LNG carrier of Fig.10G;

Fig.11A is a partial cross sectional side view showing the integrating process of an integrated LNG carrier using an existing LNG carrier of Fig.1A and a new built structural block according to an alternative embodiment of the present disclosure;

- 5 Fig.11B is a partial top view showing the integrating process of an integrated LNG carrier of Fig.11A;

Fig.11C is a partial cross sectional side view of an integrated LNG carrier according to the process shown in Fig.11A and Fig.11B;

Fig.11D is a partial top view of the integrated LNG carrier of Fig.11C;

- 10 Fig.11E is a partial cross sectional side view showing the process of integrating new built sponsons with the integrated LNG carrier of Fig.11C according to another embodiment of the present disclosure;

Fig.11F is a partial top view showing the process of integrating new built sponsons with the integrated LNG carrier of Fig.11E;

- 15 Fig.11G is a partial cross sectional side view of an integrated LNG carrier according to the process shown in Fig. 11E and Fig. 11F;

Fig.11H is a partial top view of the integrated LNG carrier of Fig.11G;

- 20 Fig.12A is a partial cross sectional side view showing the integrating process of an integrated LNG carrier using an existing LNG carrier of Fig.1A and a new built structural block according to an alternative embodiment of the present disclosure;

Fig.12B is a partial top view showing the integrating process of an integrated LNG carrier of Fig.12A;

Fig.12C is a partial cross sectional side view of an integrated LNG carrier according to the process shown in Fig.12A and Fig.12B;

- 25 Fig.12D is a partial top view of the integrated LNG carrier of Fig.12C;

Fig.12E is a partial cross sectional side view showing the process of integrating new built sponsons with the integrated LNG carrier of Fig.12C according to another embodiment of the present disclosure;

Fig.12F is a partial top view showing the process of integrating new built sponsons with the integrated LNG carrier of Fig.12E;

Fig.12G is a partial cross sectional side view of an integrated LNG carrier according to the process shown in Fig. 12E and Fig. 12F;

5 Fig.12H is a partial top view of the integrated LNG carrier of Fig.12G;

Fig.13A is a partial cross sectional side view showing the integrating process of an integrated LNG carrier using an existing LNG carrier of Fig.1A and a new built structural block according to an alternative embodiment of the present disclosure;

10 Fig.13B is a partial top view showing the integrating process of an integrated LNG carrier of Fig.13A;

Fig.13C is a partial cross sectional side view of an integrated LNG carrier according to the process shown in Fig.13A and Fig.13B;

Fig.13D is a partial top view of the integrated LNG carrier of Fig.13C;

15 Fig.13E is a partial cross sectional side view showing the process of integrating new built sponsons with the integrated LNG carrier of Fig.13C according to another embodiment of the present disclosure;

Fig.13F is a partial top view showing the process of integrating new built sponsons with the integrated LNG carrier of Fig.13E;

20 Fig.13G is a partial cross sectional side view of an integrated LNG carrier according to the process shown in Fig. 13E and Fig. 13F;

Fig.13H is a partial top view of the integrated LNG carrier of Fig.13G;

Fig.14A is a partial cross sectional side view showing the integrating process of an integrated LNG carrier using an existing LNG carrier of Fig.1A and a new built structural block according to an alternative embodiment of the present disclosure;

25 Fig.14B is a partial top view showing the integrating process of an integrated LNG carrier of Fig.14A;

Fig.14C is a partial cross sectional side view of an integrated LNG carrier according to the process shown in Fig.14A and Fig.14B;

Fig.14D is a partial top view of the integrated LNG carrier of Fig.14C;

Fig.14E is a partial cross sectional side view showing the process of integrating new built sponsons with the integrated LNG carrier of Fig.14C according to another embodiment of the present disclosure;

- 5 Fig.14F is a partial top view showing the process of integrating new built sponsons with the integrated LNG carrier of Fig.14E;

Fig.14G is a partial cross sectional side view of an integrated LNG carrier according to the process shown in Fig. 14E and Fig. 14F;

Fig.14H is a partial top view of the integrated LNG carrier of Fig.14G;

- 10 Fig.15A is a partial cross sectional side view showing the integrating process of an integrated LNG carrier using an existing LNG carrier of Fig.1A and a new built structural block according to an alternative embodiment of the present disclosure;

Fig.15B is a partial top view showing the integrating process of an integrated LNG carrier of Fig.15A;

- 15 Fig.15C is a partial cross sectional side view of an integrated LNG carrier according to the process shown in Fig.15A and Fig.15B;

Fig.15D is a partial top view of the integrated LNG carrier of Fig.15C;

- Fig.15E is a partial cross sectional side view showing the process of integrating new built sponsons with the integrated LNG carrier of Fig.15C according to another
20 embodiment of the present disclosure;

Fig.15F is a partial top view showing the process of integrating new built sponsons with the integrated LNG carrier of Fig.15E;

Fig.15G is a partial cross sectional side view of an integrated LNG carrier according to the process shown in Fig. 15E and Fig. 15F;

- 25 Fig.15H is a partial top view of the integrated LNG carrier of Fig.15G.

DETAILED DESCRIPTION OF THE INVENTION

In the following description, numerous specific details are set forth in order to provide a thorough understanding of various illustrative embodiments of the invention. It will be understood, however, to one skilled in the art, that embodiments of the invention may be practiced without some or all of these specific details. It is understood that the terminology used herein is for the purpose of describing particular embodiments only, and is not intended to limit the scope of the invention. In the drawings, like reference numerals refer to same or similar functionalities or features throughout the several views.

Before cutting an existing LNG carrier, some of the major procedures need to be followed on the existing LNG carrier. All systems which contain flammable or toxic vapours or inert gas should be gas-freed, and a gas-free certificate must be obtained from a competent person, before or immediately upon entry into a port for cutting. Before commencing any hot work, the yard would normally be expected to take its own precautions and arrange for the issue of certificates allowing hot work to be carried out.

All equipment on board should be checked internally for the presence of flammable or toxic vapours or inert gas and should be purged if necessary before work proceeds. It is usually necessary to gas-free deck storage tanks before hot work can be commenced in the vicinity, the following precaution should be observed:

- All pipe connections to the cargo system should be disconnected and securely blanked
- Smoking and hot work should not be allowed in the restricted area
- No work should be permitted on the tanks or their fittings
- Tank pipework and fittings should be protected from mechanical damage
particular care is necessary if cranes are being used nearby
- All electrical connections should be totally shutdown
- All electrical cable connections at cutting area need to be properly secured the ends
- Any ventilation ducting connections at cutting area need to be properly secured at all time
- Any lift craft on the deck at cutting area need to be relocated to a different location.

Once the pre-check procedure is followed, an existing LNG carrier is brought into yard for cutting operation as elaborated below. Cutting an existing LNG carrier involves severing and splicing all the coordination system, including cables, cryogenic pipes and ducts; this job should not be underestimated. Once an existing LNG carrier is cut, the shortest portion will be moved away by using a heavy lifting crane. The forward section and aft section of an existing LNG carrier have many topside cryogenic pipelines carrying LNG at -163 degrees Celsius; if any leak in the pipelines, it will damage the structure of the existing LNG carrier. Once the existing LNG carrier is cut, it is needed to immediately blank the line on both forward and aft sections. All electrical cables, junction box terminal, ventilation ducting, etc. need to be properly secured at all times.

A new structural block will be fabricated based on the existing LNG carrier cutting dimension as well required LNG storage capacity, deck space requirement for gas processing production/regasification facility and utility. The longitudinal strength limits of the hull girder determine the elongation size. The increase in the longitudinal bending moment will require a corresponding amount of additional steel in order to maintain the required modulus.

The following steps are required for the ship hull and structural part of the conversion:

- The longitudinal strength of the existing LNG carrier has to be evaluated. The maximum allowable bending moment can become a showstopper if the ship hull is already designed to its optimum and cannot sustain any additional length.
- A damage stability study needs to be carried out in order to determine the location of the new structural block.
- The evacuation arrangements need to be sorted out when planning the new inserted structural block arrangement.
- The location of the vent mast needs to be considered in order to avoid disruption on the upper decks.

Jumboisation technique requires re-engineering, integration of an existing storage system to a newly added system that offsets safe flexibility and functionality asset. Outfitting is the process of installing parts and various subassemblies (e.g., piping

systems, ventilation equipment, and electrical components) on the new built block prior to joining the new built block with the existing LNG carrier at the stage of erection of a LNG carrier. The existing LNG carrier's power supply will need to be recalculated due to the increased load.

- 5 Once jumboisation is done, then the following necessary steps need to be carried out: necessary steps carried out to the existing cryogenic pipeline and the new cryogenic pipeline. In addition, the atmospheric pressure of the existing tank and new tank might differ, so proper necessary step may be taken while transferring LNG from the existing tank to a new storage tank. The pump capacity of the existing
- 10 LNG storage tank might be affected while doing jumboisation as a new structural block increases its deck space and cryogenic line pipes, it needs to carry out re-engineering work to size up the pump or having additional tank to make up the loss during LNG transfer. Similarly, re-engineering work needs to be carried out for machinery, electrical system, hull structure, outfitting and required reinforcement.
- 15 The present jumboisation is not only a technical solution of using an existing LNG carrier for newly integrated additional storage space and increasing deck space for gas processing production/regasification facility, utility and machinery space for other uses but also financially feasible compared to the new built LNG production/regasification vessel. Through using the present disclosure, certain
- 20 existing LNG carriers may widen their opportunity to serve as gas process production/regasification facility with additional LNG storage capacity and extend life of their service.

Turning to the Figures, Fig.1A and Fig.1B show an existing LNG carrier 10 based on which jumboisation method according to one embodiment of the present

25 disclosure may be applied. Existing LNG carrier 10 includes a bow 101, a stern 110 and a midship between bow 101 and stern 110. The midship includes five segments 102, 104, 106, 108 and 109. Each segment has a corresponding first, second, third & fourth LNG storage tank and wheel house 112, 114, 116, 118 and 120 built therein. Each individual LNG storage tank has its fixed storage capacity and hence

30 the total storage and transportation capacity of the LNG carrier is the sum of capacity of all the individual LNG storage tanks.

A method 250 for integrating an existing LNG carrier according to one embodiment of the present disclosure comprises the following steps, as shown in Fig. 1C:

In Step 252, a new built structural block will be fabricated or provided as a prefabrication unit from other sources. Then in Step 254, an existing LNG carrier is cut apart into a forward section and an aft section. After that in Step 256, the new built structural block is placed into a space created between an existing LNG carrier cut apart forward and an aft section and, then in Step 258, the new built structural block is jumboized to the forward and an aft section to form an integrated LNG carrier. Besides the steps above, in Step 260, one or more new built sponsons may be fabricated to be integrated with the integrated LNG carrier, as shown in Step 262.

Before proceeding to cut an existing LNG carrier, measurements and/or site inspections may be carried out to determine the characteristics of an existing LNG carrier, e.g. the dimensions of an existing LNG carrier width, longitudinal & transverse beam location, stiffeners, and existing cryogenic & utility pipelines, cable tray, hookup points and connection interfaces, etc. such information will be used for the fabrication of the new built structural block to ensure compatibility.

Further details of this and other embodiments will be illustrated below in conjunction with the accompanying drawings.

As shown in Fig. 2A and Fig. 2B, a new built structural block 200 will be fabricated using either one of the containment systems, i.e. MOSS type containment system or membrane type containment system or provided as a prefabrication unit from other sources. When the fabrication of a new built structural block is completed, the existing LNG carrier 10 may be brought to the shipyard dry dock to undergo the cutting. Once cutting is done, then either forward or aft section will be moved away to create space and then jumboize the new built structural block with the existing LNG carrier.

In the embodiment shown in Fig. 2A and Fig. 2B, cutting is performed between stern 110 and the fourth LNG storage tank 118, forming a forward section 201 which includes bow 101, first 112, second 114, third 116 & fourth LNG storage tank 118 and aft section 202 which includes stern 110 and wheel house 120. A newly created space 205 is formed between the forward section 201 and the aft section

202. The new built structural block 200 is then placed in space 205 by floating or a heavy lift crane, with the forward section 201 jumboized to front end 203 of the new built structural block 200, the aft section 202 jumboized to rear end 204 of the new built structural block 200 . Upon jumboizing, the new built structural block 200 together with the forward section 201 and aft section 202, form an integrated LNG carrier 20 with the new built structural block 200 integrated to an existing LNG carrier, as shown in Fig.2C and Fig.2D

In the other embodiment shown in Fig 2E and Fig. 2F, new built sponsons in different size configuration on both sides of ship hull will be fabricated. New built sponsons on port side 350 and starboard side 300 with different size configuration will be fabricated separately and integrated with the LNG carrier 20 to form a newly integrated LNG carrier 30, as shown in Fig 2G and Fig 2H.

The LNG storage tank of the new built structural block 200 may be same as or different from that in the existing LNG carrier. LNG containment system of the LNG storage tank may be selected from a group consisting of a MOSS type spherical tank, a Gaztransport & Technigaz (GTT) membrane tank, IHI self-supporting prismatic type B SPB tank and an independent type A tank.

The present disclosure provides a newly integrated LNG carrier by a new built structural block and one or more new built sponsons which provide additional LNG storage, create deck space for gas process production/regasification facility, utilities and deck space for other machinery usage. This integration also provides new life extension to the existing LNG carrier to serve for current industrial demand with a much shorter delivery schedule than that of required to build new floater from sketch, and also reduces capital expenditure.

According to another embodiment, an existing LNG carrier may be cutting at different location into forward and aft sections, for integration of a new built structural block there between. Later the integrated LNG carrier will again integrate with at least one new built sponson to form a newly Integrated LNG carrier.

As shown in Fig. 3A to 3H, an existing LNG carrier 10 is cut apart into forward section 206 and an aft section 207. Cutting is performed between a third LNG

storage tank 116 and fourth LNG storage tank 118, hence the forward section 206 includes the bow 101, first, second and third LNG storage tank 112, 114 and 116. The aft section 207 includes stern 110, wheel house 120, and fourth LNG storage tank 118. A new built structural block 210 will be fabricated and then placed into the space 208 created between forward section 206 and aft section 207, and jumboized forward and aft section 206 & 207 to form an integrated LNG carrier 22 with the new built structural block 210 integrated to the existing LNG carrier 10, as shown in Fig. 3C and Fig. 3D.

In the other embodiment shown in Fig 3E and Fig. 3F, new built sponsons in different size configuration on both sides of the ship hull will be fabricated. New built sponsons on port side 350 and starboard side 300 with different size configuration will be fabricated separately and integrated with the integrated LNG carrier 22 to form a newly integrated LNG carrier 32, as shown in Fig 3G and Fig 3H.

Alternatively, as shown in respective Fig. 4A to 4H, 5A to 5H and 6A to 6H, an existing LNG carrier 10 may be cut apart into forward section 211, 216, 221 and an aft section 212, 217, 222. In Fig. 4A to 4H, cutting is performed between second LNG storage tank 114 and third LNG storage tank 116 at a mid-ship section. In Fig. 5A to 5H, cutting is performed between first LNG storage tank 112 and second LNG storage tank 114 at forward section. In Fig 6A to 6H, cutting is performed between bow 101 and first LNG storage tank 112 at forward bow section. A new built structural block 215, 220, 225 is fabricated and then placed at the space 213, 218, 223 formed by cutting of an existing LNG carrier 10, finally jumboized the cut-apart forward 211, 216, 221 and aft section 212, 217, 222 to form an integrated LNG carrier 24 (Fig. 4C, 4D), 26 (Fig. 5C, 5D), 28 (Fig. 5C, 5D). In the other embodiment shown in Fig 4E & Fig. 4F, Fig. 5E & Fig. 5F, and Fig. 6E & Fig. 6F, new built sponsons in different size configuration on both sides of the ship hull are fabricated. New built sponsons on port side 350 and starboard side 300 with different size configuration will be fabricated separately and integrated with the integrated LNG carrier 24, 26 & 28 to form a newly integrated LNG carrier 34, 36 & 38.

In a further embodiment, as shown in Fig. 7A to 7H, a new built structural block 230 will be fabricated. An existing LNG carrier 10 is cut apart into forward section 226 and an aft section 227, creating a space 228 there between. Forward section includes first, second, third & fourth LNG storage tank 112, 114, 116 & 118, wheel house 120 and stern 110. An aft section includes a new bow section 600 which may or may not build with turret 700. Turret 700 provides a non-rotating platform for supporting the mooring lines and flexible risers dedicated for gas export/import and associated control/service lines. The new structural block 200 is then placed in the space 228 and jumboized forward section 226 and the new built aft bow section 600 to form an integrated LNG carrier 40, as shown in Fig. 7C & Fig. 7D.

In the other embodiment shown in Fig 7E and Fig. 7F, new built sponsons in different size configuration on both sides of ship hull will be fabricated. New built sponsons on port side 350 and starboard side 300 with different size configuration will be fabricated separately and integrated with the integrated LNG carrier 40 to form a newly integrated LNG carrier 50, as shown in Fig 7G and Fig 7H.

In another further embodiment, as shown in Fig. 8A to 8H, a new built structural block 235 will be fabricated. An existing LNG carrier 10 is cut apart into forward section 231 and an aft section 232, creating a space 233 there between. Forward section includes new stern 650 and aft section includes bow 101, first, second, third and fourth LNG storage tank 112, 114, 116 & 118 and wheel house 120. New stern 650 which can be fabricated along with new structural block and then joined with aft section 232. The new structural block 200 is then placed in the space 233 and jumboized forward section 231 and aft section 232 or new stern section 650 to form an integrated LNG carrier 42 as shown in Fig. 8C and Fig. 8D.

In the other embodiment shown in Fig 8E and Fig. 8F, new built sponsons in different size configuration on both sides of ship hull will be fabricated. New built sponsons on port side 350 and starboard side 300 with different size configuration will be fabricated separately and integrated with the integrated LNG carrier 42 to form a newly integrated LNG carrier 52, as shown in Fig 8G and Fig 8H.

As shown in Fig. 9A and Fig. 9B, a new built structural block 400 will be fabricated using either one of the containment systems or provided as a prefabrication unit from other sources. The new built structural block has a similar design to the earlier ones but this structural block width is extended on both starboard and port side with same or different width from the ship hull. When the fabrication of a new built structural block 400 is completed, the existing LNG carrier 10 may be brought to the shipyard dry dock to undergo the cutting. Once cutting is done, then either forward or aft section will be moved away to create space and then jumboized the new built structural block 400 with an existing LNG carrier 10.

- 10 In the embodiment shown in Fig. 9A and Fig. 9B, cutting is performed between stern 110 and the fourth LNG storage tank 118, forming a forward section 201 which includes bow 101, first 112, second 114, third 116 & fourth LNG storage tank 118 and aft section 202 which includes stern 110 and wheel house 120. A newly created space 401 is formed between forward section 201 and an aft section 202.
- 15 The new built structural block 400 is then placed in space 401 by floating or a heavy lift crane, with the forward section 201 jumboized to front end 403 of new built structural block 400, the aft section 202 jumboized to rear end 404 of the new built structural block 400. Upon jumboizing, the new built structural block 400 together with the forward section 201 and aft section 202 to form an integrated LNG carrier 44 with the new built structural block 400 integrated to an existing LNG carrier 10, as shown in Fig.9C and Fig.9D
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In the other embodiment shown in Fig 9E and Fig. 9F, new built sponsons will be fabricated based on the existing LNG carrier 10 and new built structural block 400.

- 25 New built sponsons may include more than one sponson on both starboard side 800 & 801 and port side 821 & 822 of ship hull in different size configuration which will be fabricated separately and integrated with the integrated LNG carrier 44 to form a newly integrated LNG carrier 54, as shown in Fig 9G and Fig 9H.

- 30 Alternatively, as shown in respective Fig. 10A to 10H, 11A to 11H, 12A to 12H and 13A to 13H, an existing LNG carrier 10 may be cut apart into forward section 206, 211, 216 and 221 and an aft section 207, 412, 417 and 222. In Fig. 10A to 10H, cutting is performed between third LNG storage tank 116 and fourth LNG storage

tank 118. In Fig. 11A to 11H, cutting is performed between second LNG storage tank 114 and third LNG storage tank 116 at amidship section. In Fig. 12A to 12H, cutting is performed between first LNG storage tank 112 and second LNG storage tank 114 at forward section. In Fig 13A to 13H, cutting is performed between bow 101 and first LNG storage tank 112 at forward bow section. A new built structural block 405, 410, 415 and 420 is then placed at the space 406, 411, 416 and 421 formed by cutting of an existing LNG carrier 10, jumboized the cut-apart forward section 206, 211, 216 and 221 and aft section 207, 212, 217 and 222 to form an integrated LNG carrier 46 (see Fig. 10C, 10D), 48 (see Fig. 11C, 11D), 62 (see Fig. 12C, 12D) & 64 (see Fig. 13C, 13D).

In the other embodiments shown in Fig. 10E & Fig. 10F, Fig. 11E & Fig. 11F, Fig. 12E & Fig. 12F and Fig. 13E & Fig. 13F, new built sponsons will be fabricated based on the existing LNG carrier 10 and new built structural block 405, 410, 415 & 420. New built sponsons may include more than one sponson on both starboard sides 803 & 804, 805 & 806, 807 & 808 and 810; port side 823 & 824, 825 & 826, 827 & 828 and 830 of the ship hull in different size configuration which will be fabricated separately and integrated with the integrated LNG carrier 46, 48, 62 & 64 to form a newly integrated LNG carrier 56, 58, 72 & 74, as shown in Fig 10G & Fig 10H, Fig 11G & Fig 11H, Fig 12 G & Fig 12H and Fig 13G & Fig 13H.

In a further embodiment, as shown in Fig. 14A to 14H, a new built structural block 425 will be fabricated. An existing LNG carrier 10 is cut apart into forward section 226 and an aft section 227, creating a space 426 there between. Forward section 226 includes first, second, third & fourth LNG storage tank 112, 114, 116 & 118, wheel house 120 and stern 110. The aft section 227 includes a new bow section 800 which may or may not build with turret 900. Turret 900 provides a non-rotating platform for supporting the mooring lines and flexible risers dedicated for gas export/import and associated control/service lines. The new structural block 425 is then placed in the space 426 and jumboized forward section 226 and new built aft bow section 800 to form an integrated LNG carrier 66, as shown in Fig. 14C & Fig. 14D.

In the other embodiment shown in Fig 14E and Fig. 14F, new built sponsons on both sides of the ship hull in different size configuration will be fabricated. New built

sponsons on port side 815 and starboard side 835 with different size configuration will be fabricated separately and integrated with Integrated LNG carrier 66 to form a newly integrated LNG carrier 76, as shown in Fig 14G and Fig 14H.

- 5 In another further embodiment, as shown in Fig. 15A to 15H, a new built structural block 430 will be fabricated. An existing LNG carrier 10 is cut apart into forward section 231 and an aft section 232, creating a space 233 there between. Forward section 231 includes new stern 850 and aft section 232 includes bow 101, first, second, third and fourth LNG storage tank 112, 114, 116 & 118 and wheel house
10 120. New stern 850 which can be fabricated along with the new built structural block 430 and then joined with aft section 232. The new built structural block 430 is then placed in the space 431 and jumboized forward section 231 and aft section 232 or new built stern 850 to form an integrated LNG carrier 68, as shown in Fig. 15C and Fig. 15D.

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- In the other embodiment shown in Fig 15E and Fig. 15F, new built sponsons on both sides of the ship hull in different size configuration will be fabricated. New built sponsons on port side 820 and starboard side 840 with different size configuration will be fabricated separately and integrated with the integrated LNG carrier 68
20 to form a newly integrated LNG carrier 78, as shown in Fig 15G and Fig 15H.

- Other embodiments will be apparent to those skilled in the art from consideration of the specification and practice of the invention. Furthermore, certain terminology has been used for the purposes of descriptive clarity, and not to limit the disclosed
25 embodiments of the invention. The embodiments and features described above should be considered exemplary.

CLAIMS

1. A method for constructing an FLNG, FSRU or a LNG carrier, the method comprising:
 - 5 (a) separating a first existing LNG carrier to form a forward section and an aft section;
 - (b) fabricating a structural block prior to separating the first existing LNG carrier, the structural block includes a gas process facility, the gas process facility includes a regasification plant or a liquefaction plant;
 - 10 (c) placing a structural block into a space between the forward section and the aft section, the structural block having a front end and a rear end;
 - (d) joining the forward section to the front end of the structural block and joining the aft section to the rear end of the structural block to form a
15 new integrated vessel; and
 - (e) placing at least one sponson on a side of the new integrated vessel.
2. The method of claim 1, wherein a sponson is placed on each side of the new integrated vessel.
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3. The method of claim 1, wherein the structural block and sponson include one or more LNG storage tanks.
4. The method of claim 3, wherein the LNG storage tank is selected from a
25 group consisting of a MOSS type tank, a Gaztransport & Technigaz (GTT) tank, a self-supporting prismatic type B (SPB) tank, an independent type A tank and an independent type C tank.
5. The method of claim 1, wherein the structural block is fabricated at a first
30 site, the sponson is fabricated at a second site, and separating the first existing vessel is carried out at a third site, wherein the first, second and third sites are independently operable from each other.

6. The method of claim 1, wherein the structural block is fabricated at a site while the first existing vessel is absent from the site.

7. The method of claim 1, wherein the sponson is fabricated at a site while the existing vessel is absent from the site.

8. The method of claim 1, wherein the structural block is a structure section of a second existing LNG carrier.

9. The method of claim 7 further comprising, prior to fabricating the structural block from the second existing LNG carrier, determining characteristics of the first existing LNG carrier for fabrication of the structural block.

10. The method of claim 1 further comprising, prior to separating the first existing LNG carrier, determining characteristics of the first existing LNG carrier for fabrication of the structural block.

11. The method of claim 1, wherein the sponsons are of different sizes.

12. The method of claim 1, wherein one of the sponsons includes a ballast tank.

13. The method of claim 1, wherein the structural block includes at least one LNG storage tank having a containment system different from that of the first existing LNG carrier.

14. A method for constructing an FLNG, FSRU or a LNG carrier, the method comprising:

- (a) separating a first existing LNG carrier to form a forward section and an aft section;
- (b) fabricating a structural block prior to separating the first existing LNG carrier, the structural block includes a gas process facility, the gas process facility includes a regasification plant or a liquefaction plant;
- (c) joining a structural block with one of the forward section and the aft section to form a new integrated vessel; and

- (d) placing at least one sponson on each side of the new integrated vessel.

15. The method of claim 13, wherein the structural block and sponson include one or more LNG storage tanks.

16. The method of claim 14, wherein the LNG storage tank is selected from a group consisting of a MOSS type tank, a Gaztransport & Technigaz (GTT) tank, a self-supporting prismatic type B (SPB) tank, an independent type A tank and an independent type C tank.

17. The method of claim 13, wherein the structural block is fabricated at a first site, the sponsons are fabricated at a second site, and separating the first existing vessel is carried out at a third site, wherein the first, second and third sites are independently operable from each other.

18. The method of claim 13, wherein the structural block is fabricated at a site while the first existing vessel is absent from the site.

19. The method of claim 13, wherein the structural block is a structure section of a second existing LNG carrier.

20. The method of claim 13, wherein the structural block includes a bow section of a second LNG carrier, the forward section of the first existing LNG carrier is a bow of the first existing LNG carrier, the method comprising jointing the structural block to the aft section of the first LNG carrier to form the new integrated LNG carrier.

21. The method of claim 19, wherein the structural block further includes a turret built on the bow section.

22. The method of claim 13, wherein the structural block includes a stern section of a second LNG carrier, the aft section of the first existing LNG carrier is completely removed and install with a stern of the second existing LNG

carrier, the method comprising jointing the structural block to the forward section of the first LNG carrier to form the new integrated LNG carrier.

23. The method of claim 13 further comprising, prior to separating the first existing LNG carrier, determining characteristics of the first existing LNG carrier for fabrication of the structural block.

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