DEVICE AND METHOD FOR THE DELIVERY OF LNG

Abstract: The present invention is directed to a device for the delivery of LNG, comprising a main storage for storing supplied LNG, a pressure build-up device for increasing the pressure of the LNG, an intermediate storage for storing the LNG with increased pressure, and a dispenser for dispensing LNG at a pre-conditioned state to a refuelling vehicle. Furthermore, the invention is directed to a method for the delivery of LNG, comprising the steps of storing supplied LNG in a main storage, increasing the pressure of the LNG with a pressure build-up device, storing the LNG with increased pressure in an intermediate storage, and dispensing LNG at a pre-conditioned state with a dispenser to a refuelling vehicle.
DEVICE AND METHOD FOR THE DELIVERY OF LNG

The present invention is directed to a device and a method for the delivery of Liquefied Natural Gas (LNG).

There is a difference between the conditions (i.e. supply pressure) of LNG supplied by a LNG supply truck, and the conditions required by the engine of a truck using LNG as fuel. Because the engine of a refuelling truck requires LNG at a pressure that is higher than the pressure level at which the LNG is supplied by a LNG supply truck, a time-consuming process of increasing the pressure, i.e. conditioning the LNG, needs to take place before an engine of refuelling truck can run on the LNG.

It is an object of the present invention to at least partially overcome the drawbacks of the state of the art, and more especially to provide a device and method that enable refuelling vehicles to continue their journey shortly or preferably directly after filling up their fuel tanks with LNG. A further object is to provide a device and method to enable this LNG in a substantially continuous delivery.

This object is achieved with the device for the delivery of LNG according to the present invention, said device comprising:

- a main storage for storing supplied LNG;
- a pressure build-up device for increasing the pressure of the LNG;
- an intermediate storage for storing the LNG with increased pressure; and
- a dispenser for dispensing LNG at a pre-conditioned state to a refuelling vehicle.

By pre-conditioning the LNG in the device, it is ready for direct use by the engine of a refuelling vehicle. The device thereby prevents that a time-consuming LNG
pressure increasing conditioning process has to be carried out by the refuelling vehicle. The invention provides a device for the continuous delivery of pre-conditioned LNG, especially saturated LNG at a desired pressure.

In a preferred embodiment the pressure build-up device and the intermediate storage for storing the LNG with increased pressure are arranged in a pressure build-up loop. By looping the LNG through the pressure build-up device, the pressure of the LNG contained in the intermediate storage can be maintained within a desired bandwidth. Furthermore, it is possible to obtain an even higher pressure level by gradually increasing the pressure level.

In a further preferred embodiment, the device further comprises one or more dispenser storages for storing and/or further pre-conditioning the LNG. The dispenser storages can be used to store LNG under the conditions (e.g. pressure) obtained in the intermediate storage, but can also be used to further pre-condition the LNG. When more than one dispenser storage is used, different pre-conditioned states, such as different pressures, can be stored in the different dispenser storages. This enables the device to continuously deliver saturated LNG on one or more pressure levels.

In a further preferred embodiment, the dispenser storage comprises a heater for heating the LNG contained therein. When the LNG in the dispenser storage cools down, or when the LNG level drops due to dispensing LNG to a refuelling vehicle, the pressure of the LNG in the dispenser storage will decrease. The heater can be applied to heat the LNG in order to maintain the LNG within a preferred bandwidth for the pressure level. It is even possible to use heating to obtain a further increased pressure level which is significantly higher than that available in the intermediate storage. For example a pressure level of 9 bar
obtained from the intermediate storage can in the dispenser storage be increased to 18 bar.

In a further preferred embodiment, the pressure build-up device is a heater. By heating the LNG, it expands and the pressure increases.

In a further preferred embodiment, the device further comprises a main LNG process pump arranged in a main LNG process pump vessel, said pump being adapted to at least pump LNG from the main storage to the intermediate storage.

The main LNG process pump in a first step pumps LNG from the main storage to the LNG process pump vessel. In a second step, the main LNG process pump forces the LNG contained in the LNG process pump vessel via the pressure build-up device to the intermediate storage. If desired, the procedure of pressure build-up can be repeated by looping the LNG more than once via the pressure build-up device, thereby further increasing the pressure. It is also possible to maintain the desired pressure level by compensating for any pressure losses.

In a further preferred embodiment, the device further comprises a dispenser LNG pump arranged in a dispenser LNG pump vessel, said pump being adapted to at least pump LNG from the dispenser storage to a dispenser. When a separate main LNG process pump and dispenser LNG pump are used, together with at least one dispenser storage, it is possible to execute a pressure build-up loop for filling the intermediate storage with pre-conditioned LNG, and a dispenser storage refill simultaneously. The main storage can be filled with a new supply of LNG, while simultaneously delivering pre-conditioned LNG to a refuelling vehicle.

In a further preferred embodiment, the main LNG process pump vessel and/or the dispenser LNG pump vessel are arranged in an isolated space within a larger pump vessel.
The LNG is prevented from cooling down, resulting in a preservation of the pressure level obtained in the previous process steps.

In a further preferred embodiment, the isolation of the isolated space comprises a combined vacuum multi-layered isolation and vacuum perlite isolation, which has proven to be a very effective and reliable isolation.

In a further preferred embodiment, the device further comprises:

- a boil-off collecting means for collecting boil-off gasses evaporated from any of the storage tanks; and
- means for cooling down the boil-off gasses. By collecting boil-off gasses and cooling them down, these gasses can be re-condensated, thereby providing a device with zero boil-off. Although this re-condensation of LNG boil-off gas can also be obtained via direct condensation on a cold LNG liquid interface, an additional internal heat exchanger such as a refrigerator has been proven to be more reliable.

The invention is further directed to a method for the delivery of LNG, said method comprising the steps of:

- storing supplied LNG in a main storage;
- increasing the pressure of the LNG with a pressure build-up device;

- storing the LNG with increased pressure in an intermediate storage; and
- dispensing LNG at a pre-conditioned state with a dispenser to a refuelling vehicle.

Further advantageous embodiments of the method are the subject of the dependent method claims.

Preferred embodiments of the present invention are further elucidated in the following description with reference to the drawing, in which:
Figure 1 discloses a schematic overview of the present invention;
Figure 2 shows a detailed schematic overview of the device according to the present invention;
Figure 3 shows a detailed schematic figure of the process of pumping LNG from a main storage to a LNG process pump vessel;
Figure 4 shows a detailed schematic figure of the process of pumping LNG from the LNG process pump vessel to an intermediate storage;
Figure 5 shows a detailed schematic figure of the process of pumping LNG from the intermediate storage to a dispenser storage;
Figure 6 shows a detailed schematic figure of the pumping of LNG from the dispenser storage to a dispenser;
Figure 7 shows a detailed schematic figure of boil-off re-condensation;
Figure 8 shows a schematic graph of the LNG level and pressure in the main storage;
Figure 9 shows a schematic graph of the LNG level, pressure and heater power in the intermediate storage; and Figure 10 shows a schematic graph of the LNG level, pressure and heater power in the dispenser storage.

As shown in figure 1 the device according to the present invention comprises a main storage 2, an intermediate storage 4 and a dispenser storage 6. An LNG supply truck 8 supplies LNG to the main storage 2, after which it is processed to a preferred preconditioned state in the intermediate storage 4 and/or dispenser storage 6 in order to obtain pre-conditioned LNG that is suitable for supply from a dispenser 12. Due to the pre-conditioned state of the LNG supplied by the dispenser 12, a refuelling
vehicle 6 4 (not shown in figure 1) can drive further directly after refuelling with LNG.

The detailed basic flow diagram of figure 2 discloses a main storage 2 to which a LNG supply truck 8 supplies LNG via a supply pipe 10. The supplied LNG is stored in the main storage 2, from which it is delivered to a main LNG process pump vessel 18 that is arranged in pump vessel 14. The main LNG process pump 16 that is arranged in the main LNG process pump vessel 18 supplies the LNG via a pressure build-up device 30 to the intermediate storage 4, in which the LNG is stored with increased pressure. The LNG with increased pressure in intermediate storage 4 can be supplied to the dispenser storage 6 via a dispenser LNG pump vessel 22 which is also arranged in the pump vessel 14. Both the main LNG process pump 16 and the dispenser LNG pump 20 are arranged in an own vessel, respectively the main LNG process pump vessel 18 and the dispenser LNG vessel 22.

By choosing an appropriate circulation speed of the main LNG process pump 16, the pressure increase rate of the intermediate storage 4 pressure can match the dispenser storage 4 pressure at the precise moment the dispenser storage 4 needs to be refilled, thereby creating a zero boil-off storage.

The intermediate storage 4 is heated to bring it to a higher pressure. It therefore is required that the boiloff gas remains inside the storage taking care of the pressure buildup, otherwise the intermediate storage 4 would simply boil at the vent-line pressure. During filling of the dispenser storage 6 the intermediate storage 4 drops in pressure which restart the chain of events. Only if the set-pressure of the intermediate storage 4 is reached before a refill of the dispenser storage (s) 6 is required, the
intermediate storage 4 will generate build-off gas which then is fed back to the main storage 2 for re-condensation.

Both the main LNG process pump vessel 18 and dispenser LNG pump vessel 22 are isolated by an isolated space 24 which preferably comprises a combined vacuum multi-layered isolation and vacuum perlite isolation. Typical flow rates are 350 l/min for the main LNG process pump 16, and 130 l/min for the dispenser LNG pump 20.

A valve box 26, which comprises a vacuum isolated space 28, is located in the upper part of pump vessel 14. The pre-conditioned LNG can be delivered from the dispenser storage 6, via the dispenser LNG vessel 22, to the dispenser 12, where it is ready to be dispensed to a refuelling vehicle. The valve box 26 is located below the minimum filling levels of the main storage 2, the intermediate storage 4 and the one or more dispenser storages 6 to ensure a sub-cooled LNG feed to the LNG main process pump 16 and the one or more dispenser LNG pumps 20 located in separate pump vessels, respectively the main LNG process pump vessel 18 and the dispenser LNG pump vessel 22. Pump vessels 18 and 22 are both arranged in the lower part of the pump vessel 14.

All process open/close cryogenic valves are located in the upper part of the valve box 26. Furthermore, all interconnecting LNG transfer pipes from all storage vessels to the valve box 26 are mounted pointing downwards, so that any LNG gas will flow back to the storage vessels which therefore also act as a phase separator.

In the following figures 3-7 the separate circuits will be described in more detail.

The LNG supplied by the LNG supply truck 8 is stored in the main storage 2 from where it is delivered to the main LNG process pump vessel 18 via supply pipes 38, 40.
The main LNG process pump 16, which drives the flow of this circuit, is located in the main LNG process pump vessel 18 (figure 3).

In a preferred embodiment the supply pipe 40 can also be used as a return pipe for emptying the main LNG process pump vessel 18 by delivering the LNG in the LNG process pump vessel 18 via the supply pipe 40 to the main storage 2. Once the main LNG process pump vessel 18 is empty, it is available for e.g. maintenance of the main LNG process pump 16 located in the pump vessel 18.

As shown in figure 4, the LNG that has been pumped from the main storage 2 to the main LNG process pump vessel 18 will be subjected to a main LNG process pump 16 pressure build-up loop via pipes 42, 44 and 46. The LNG in the pump vessel 18 is delivered from the pump vessel 18 to a pressure build-up device 30 via a pipe 42. The LNG is heated by the heater which forms the pressure build-up device 30, after which it is transported via a pipe 44 to the intermediate storage 4. The LNG can be delivered back to the pump vessel 18 via pipe 46 to be subjected to a further build-up loop in order to further increase the pressure, if desired. Finally, the intermediate storage 4 will comprise LNG at an elevated pressure of e.g. 9 bar.

Typically, the main storage 2 capacity to the intermediate storage 4 capacity ratio is in the order of 5:1, but can also vary depending on the main LNG process pump 16 capacity and/or bulk LNG delivery logistics.

The preconditioned LNG with an elevated pressure of e.g. 9 bar that is contained in the intermediate storage 4, can now be delivered via a pipe 46 to the main LNG process pump vessel 18 and via a pipe 48 to the dispenser storage 6 where it is stored for later use by the dispenser 12.
Typically, the intermediate storage 4 capacity to the dispenser storage 6 ratio is also in the order of 5:1, but can also vary depending on the dispenser LNG pump 20 capacity. Furthermore, a typical delivery rate is 130 l/min, while a typical storage capacity is in the order of 2 m³.

The LNG that is contained in the dispenser storage 6 comprises preconditioned LNG at an elevated pressure of e.g. 9 bar. Due to factors such as partially emptying the dispenser storage 6, heat loss, et cetera, the pressure of the LNG in the dispenser storage 6 may be lowered, which can be compensated by heating the LNG with a heater 50, thereby increasing the pressure contained in the dispenser storage 6 (figure 5). The electrical heater 50 comprises an energy supply 52, and can also be activated to maintain the pressure within a desired bandwidth during LNG delivery.

If a higher pressure than the pressure of the intermediate storage 4 is desired, the heater 50 can also be used to increase the pressure of the LNG in the dispenser storage 6, for example from 9 bar up to 18 bar.

In a further preferred embodiment (not shown) the system comprises two or more separate dispenser storages 6, so that preconditioned LNG at different pressure levels can be readily available to be delivered to a dispenser 12. When for example two dispenser storages 6 are applied, one dispenser storage can be conditioned to provide an LNG pressure of 9 bar, while the other dispenser storage 6 can be conditioned to deliver LNG preconditioned at 18 bar.

In the embodiment shown in figure 6, the preconditioned LNG is transported via a supply pipe 54 to the dispenser LNG pump vessel 22. Vessels 22 and 6 are interconnected by pipe 56 thus creating a thermosyphon loop between both vessels 22, 6. This thermosyphon loop assures an uninterrupted LNG flow from the dispenser storage 6 to
the pump vessel 14 under transient and steady state conditions.

The LNG is transported via a delivery pipe 58 to the dispenser 12, where it is available for a truck 64 that is refuelling. The dispenser 12 furthermore comprises a back flow pipe 60 which allows the gas contained in the dispenser LNG pump vessel 22 to be pumped around continuously, thereby preventing gas build-up. The dispenser 12 comprises a delivery hose connected to delivery pipe 58, and a return hose connected to back flow pipe 60, enabling a continuous backflow of LNG to keep the system saturated and cold up to the nozzle. The balance between the LNG supply flow and LNG return flow is for example set at 10:1 and is fixed by calibrated restrictions interconnecting the supply and return LNG lines.

The dispenser LNG pump 20 maintains a low flow circulation to keep the dispenser circuit cold and filled with LNG in the periods wherein there is no LNG delivery.

Furthermore, the difference of the measured values between a flow gas meter (not shown) in the delivery pipe 58 and a back flow gas meter (not shown) in the back flow pipe 60 is equal to the mass delivered to the refuelling truck 64. Integrated software can be provided to calculate the delivery volume of LNG, i.e. by calculating the difference of the existing delivery flow and the back flow. If desired, this software can be linked to a fuel station payment system.

Optionally, a further gas return flow pipe 62 can be provided to allow equalization between the fuel tank of the refuelling truck 64 and LNG dispenser storage 6.

Figure 7 shows the re-condensation of boil-off gasses. Boil-off gasses from the different storages are directed via pipes to a boil-off pipe 36. All expected
sources of CNG gas production (which are under normal operation, intermediate storage, dispenser storage(s), pump vessel(s), dispensers, LCNG pump) are venting CNG on the boil-off pipe 36 via overpressure valves. Pipe 36 is connected to a CNG buffer (e.g. low pressure buffer 32 as shown in figure 2 via heater 30) that is typically at ambient temperature. The pressure of the low pressure buffer 32 varies with the main storage 2 pressure to which the CNG is fed for re-condensation. The low pressure buffer 32 can also be connected to an external refrigerator 34 which re-liquefies the CNG to LNG in case the recondensation capacity of the main storage is not enough (for instance if the facility is operated far outside its specification for delivery) or in case the main storage has reached its maximum pressure. The external refrigerator 34 produces LNG into pump vessel 18 from which it is returned to the main storage 2.

The main storage 2 also provides refrigeration power to the return LNG boil-off gas from all components of the device, thereby creating an effective zero boil-off system. The enthalpy difference between the main storage 2 pressure after refill and the upper main storage 2 pressure setting, which is typically around 3.5 bar, can be used as refrigeration capacity for re-condensation of evaporated LNG from the device.

Each delivery from the main storage 2 to the intermediate storage 4 lowers the pressure in the main storage 2 through the expansion occurring by this delivery, thereby increasing the refrigeration power.

Buffer 32 accumulates all CNG, from boil-off or other sources, that is released during normal operation of the plant. As the CNG flow in pipe 36 is not constant buffer 32 damps the pressure fluctuations that otherwise would
occur and might have a negative effect on the recondensation in main storage 2 which in basis is a steady state process. Furthermore, buffer 32 allows the proper operation of the refrigerator 34.

Figures 8-10 together show an operational timeline of the main storage 2 (figure 8), the intermediate storage 4 (figure 9) and the dispenser storage 6 (figure 10). Please note that the X access of the graphs shown in figures 8-10 represent the timescale, which is different for the separate figures 8 to 10.

When a truck 64 starts refuelling at time $T$, the LNG level 80 in the dispenser storage 6 will decrease during the time span $T'$ of the refuelling (figure 10). Together with this decrease in LNG level 80, also the pressure 82 of the LNG in the dispenser storage 6 will decrease. In order to obtain the pressure within the desired bandwidth 84 for LNG delivery, the heater power 86 of heater 50 is temporarily increased until the pressure 82 is increased to stay within the bandwidth 84.

After a number of trucks 64 have refuelled, four refills are shown in figure 10, the LNG level 80 in the dispenser storage 6 has been reduced significantly and is refilled at time $D$ during time span $D'$ by transporting LNG from the intermediate storage 4 to the dispenser storage 6.

As shown in figure 9, the LNG level 74 in the intermediate storage 4 lowers when the dispenser storage refill $D'$ takes place. Also the pressure 76 in the intermediate storage 4 reduces, which pressure is increased again to the desired pressure level by turning on the heater 30. The heater 30 functions as a pressure build-up device and the power delivered to the heater 30 is shown in figure 9 as line 78. When the LNG level 74 in the intermediate storage 4 has been lowered by one or more dispenser storage
6 refills D', there are four refills shown in figure 9, an intermediate storage 4 refill is executed at time I during time span I'.

As shown in figure 8, the LNG level \(70\) in the main storage 2 lowers during time span I' when an intermediate storage refill takes place at time I.

The pressure in the main storage is regulated by three mechanisms:

1) Due to the thermal heat loads (due to normal isolation losses and recondensation), the pressure in the main storage 2 steadily increases to its maximum allowed pressure;

2) During filling of the intermediate storage 4 the pressure in the main storage 2 drops - see line 72 dropping in figure 8 during delivery in interval I'; and

3) During refill of the main storage 2 the LNG is delivered at typically 1 bar pressure so after refill, the pressure in the main storage 2 is approximately 1 bar and the level is full (starting point in figure 8).

When the LNG level \(70\) in the main storage 2 is lowered by a number of intermediate storage 4 refills I', the main storage 2 can be refilled by the delivery of LNG by a LNG supply truck 8.

Although they show preferred embodiments of the invention, the above described embodiments are intended only to illustrate the present invention and not to limit the scope of the invention in any way. It is particularly noted that the skilled person can combine technical measures of the different embodiments. The scope of the invention is therefore defined solely by the following claims.
CLAIMS

1. Device for the delivery of LNG, comprising:
   - a main storage (2) for storing supplied LNG;
   - a pressure build-up device (30) for increasing
     the pressure of the LNG;
   - an intermediate storage (4) for storing the LNG
     with increased pressure; and
   - a dispenser (12) for dispensing LNG at a pre-
     conditioned state to a refuelling vehicle.

2. Device according to claim 1, wherein the
   pressure build-up device (30) and the intermediate storage
   (4) for storing the LNG with increased pressure are arranged
   in a pressure build-up loop.

3. Device according to claim 1 or 2, further
   comprising one or more dispenser storages (6) for storing
   and/or further pre-conditioning the LNG.

4. Device according to claim 3, wherein the
   dispenser storage (6) comprises a heater (50) for heating
   the LNG contained therein.

5. Device according to any of the foregoing
   claims, wherein the pressure build-up device is a heater
   (30).

6. Device according to any of the foregoing
   claims, further comprising a main LNG process pump (16)
   arranged in a main LNG process pump vessel (18), said pump
   (16) being adapted to at least pump LNG from the main
   storage (2) to the intermediate storage (4).
7. Device according to any of claims 3-6, further comprising a dispenser LNG pump (20) arranged in a dispenser LNG pump vessel (22), said pump (20) being adapted to at least pump LNG from the dispenser storage (6) to a dispenser (12).

8. Device according to claim 6 or 7, wherein the main LNG process pump vessel (18) and/or the dispenser LNG pump vessel (22) are arranged in an isolated space (24) within a pump vessel (14).

9. Device according to claim 8, wherein the isolation of the isolated space (24) comprises a combined vacuum multi-layered isolation and vacuum perlite isolation.

10. Device according to any of the foregoing claims, further comprising:

- a boil-off collecting means (36) for collecting boil-off gasses evaporated from any of the storage tanks; and

- means (34) for cooling down the boil-off gasses.

11. Method for the delivery of LNG, comprising the steps of:

- storing supplied LNG in a main storage (2);
- increasing the pressure of the LNG with a pressure build-up device (30);
- storing the LNG with increased pressure in an intermediate storage (4); and
- dispensing LNG at a pre-conditioned state with a dispenser (12) to a refuelling vehicle.
12. Method according to claim 11, wherein increasing the pressure of the LNG with the pressure build-up device (30) comprises subjecting the LNG to a pressure build-up loop until the desired pressure is reached, after which it is stored in the intermediate storage (4).

13. Method according to claim 11 or 12, further comprising the step of storing and/or further pre-conditioning the LNG in one or more dispenser storages (6).

14. Method according to claim 13, wherein the LNG contained in the dispenser storage (6) is heated with a heater (50) for obtaining and/or maintaining a desired pre-conditioned state.

15. Method according to any of claims 11-14, wherein the pressure build-up device (30) is a heater, and the step of increasing the pressure of the LNG comprises heating the LNG.

16. Method according to any of claims 11-15, further comprising the step of pumping LNG from the main storage (2) to the intermediate storage (4) with a main LNG process pump (16) arranged in a main LNG process pump vessel (18).

17. Method according to any of claims 13-16, further comprising the step of pumping LNG from the dispenser storage (6) to a dispenser (12) with a dispenser LNG pump (20) arranged in a dispenser LNG pump vessel (22).
18. Method according to any of claims 11-17, further comprising the steps of:
- collecting boil-off gasses evaporated from any of the storage tanks with a boil-off collecting means (36);
and
- cooling down the boil-off gasses with cooling means (34).

19. Method according to any of claims 11-18, wherein a device according to any of claims 1-10 is applied.
**INTERNATIONAL SEARCH REPORT**

**A. CLASSIFICATION OF SUBJECT MATTER**

INV. F17C5/02  F17C9/00

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

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

F17C

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

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

EPO-Internal

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>US 2005/016185 A1 (EMMER CLAUS D [US] ET AL) 27 January 2005 (2005-01-27) paragraphs [0027], [0030], [0034], [0035]; figures 1-5</td>
<td>1,2,11, 12,19</td>
</tr>
</tbody>
</table>

* Further documents are listed in the continuation of Box C

**Date of the actual completion of the international search**

28 January 2010

**Date of mailing of the international search report**

12/04/2010

Name and mailing address of the ISA/

European Patent Office, P B 5818 Patentlaan 2

NL - 2280 HV Rijswijk

Tel (+31-70) 340-2040,

Fax (+31-70) 340-3016

Authorized officer

Nicol, Boris
### Box No II  Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. **Claims Nos**
   - because they relate to subject matter not required to be searched by this Authority, namely

2. **Claims Nos**
   - because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically

3. **Claims Nos**
   - because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6(4)(a)

### Box No III  Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

- see additional sheet

1. **As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims**

2. **As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees**

3. **As only some of the required additional search fees were timely paid by the applicant, this international search report does not cover the inventions**

4. **No required additional search fees were timely paid by the applicant Consequently this international search report is restricted to the invention first mentioned in the claims, it is covered by claims Nos 1, 2, 11, 12, 19**

### Remark on Protest

- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation
- No protest accompanied the payment of additional search fees
This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1,2,11,12,19
   Device and method for the delivery of LNG, according to claims 1 and 11, further comprising a pressure build up device and an intermediate storage arranged in a pressure build up loop.

2. claims: 3,4,7-9,13,14,17
   Device and method for the delivery of LNG, according to claims 1 and 11, further comprising one or more dispenser storage for storing and/or preconditioning the LNG.

3. claims: 5,15
   Device and method for the delivery of LNG, according to claims 1 and 11, further comprising a heater.

4. claims: 6,16
   Device and method for the delivery of LNG, according to claims 1 and 11, further comprising an LNG pump arranged in an LNG vessel.

5. claims: 10,18
   Device and method for the delivery of LNG, according to claims 1 and 11, further comprising a boil-off collecting means and means for cooling down the boil-off.
<table>
<thead>
<tr>
<th>Patent document cited in search report</th>
<th>Publication date</th>
<th>Patent family member(s)</th>
<th>Publication date</th>
</tr>
</thead>
<tbody>
<tr>
<td>US 2005016185 A1</td>
<td>27-01-2005</td>
<td>NONE</td>
<td></td>
</tr>
</tbody>
</table>