LNG Cargo Operations

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LNG Cargo Operations

If we consider that the gas carrier is coming directly from a shipbuilder or a drydock, the sequence of cargo operations would be as follows:

Source: Liquefied Gas Handling Principles On Ships and in Terminals
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Tank inspection: The first step is to thoroughly check that the tank is clean.

Drying: water vapour and free water must all be removed from the system. Methods used:

- Drying using inert gas from the shore
- Drying using inert gas from ship's plant
- On board air-drying systems

Inerting: It is necessary to ensure that the tank is not flammable. Methods:

- Inerting by displacement
- Inerting by dilution (can be dilution by repeated pressurisation, Dilution by repeated vacuum or continuous dilution)
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**Gassing up:** Neither nitrogen nor carbon dioxide can be condensed by a ship's reliquefaction plant. Removal of inert gas from the cargo tank is necessary, done by gassing-up, using vapour from the cargo to be loaded at ambient temperature and venting the incondensibles to atmosphere so that the reliquefaction plant can then operate efficiently.

**Methods:**

- Gassing-up at sea using liquid from deck storage tanks: only available to fully refrigerated, or semi-pressurised ships.

- Gassing-up alongside: cargo supplied from the shore.
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Cool-down:

• Refrigerated ship: it is necessary to avoid excessive tank pressures during bulk loading. Before loading a refrigerated cargo, ship's tanks must be cooled down slowly in order to minimise thermal stresses. Cool-down should continue until boil-off eases and liquid begins to form in the bottom of the cargo tanks.

• Semi-pressured ships: it is necessary to maintain a pressure within the cargo tank at least equal to the saturated vapour pressure corresponding to the minimum allowable steel temperature. This can be done by passing the liquid through the cargo vaporiser and introducing vapour into the tank with the cargo compressor. Alternatively, vapour can be provided from the shore.
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The main steps to follow for cargo loading are:

• Preliminary procedures: checking info from ship/shore procedures:
  ▪ Trim, stability and stress
  ▪ The ship's seagoing safety
  ▪ Sloshing
  ▪ Cargo tank loading limits
• Control of vapours during loading
• Early stages:
  ▪ Loading refrigerated ships
  ▪ Loading pressurised ships
  ▪ Loading pressurised ships from refrigerated storage
  ▪ Loading semi-pressurised ships from refrigerated storage
  ▪ Terminal pipeline system and operation
  ▪ Small ship problems at large berths
• Bulk loading
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The maximum volume to which any tank may be filled is governed by the following formula:

$$LL = FL \frac{\rho_R}{\rho_L}$$

where

- $LL$ = loading limit expressed in per cent which means the maximum liquid volume relative to the tank volume to which the tank may be loaded.
- $FL$ = filling limit = 98 per cent unless certain exceptions apply.
- $\rho_R$ = relative density of cargo at the reference temperature.
- $\rho_L$ = relative density of the cargo at the loading temperature and pressure.
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During the loaded voyage it is necessary to:

- Maintain cargo temperature control
- Prevent polymerisation
- Make inspection of conditions

Operation of the reliquefaction plant during the loaded voyage: the plant may be operated continuously or intermittently.

LNG boil-off as fuel: boil-off is used as fuel for the ship's main propulsion during sea passages.
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Discharging: at the discharge terminal, cargo tank pressures and temperatures should be in accordance with terminal requirements. Methods used:

- Discharge by pressurising the vapour space
- Discharge with or without booster pumps
- Discharge via booster pump and cargo heater

Draining tanks and pipelines: liquid cargo must be drained from all deck lines and cargo hoses or hard arms. Such draining can be done from ship to shore using a cargo compressor.
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The ballast voyage: Often some refrigerated trades to retain a small quantity of cargo on board after discharge and the amount retained is known as the heel. It is used to maintain the tanks at reduced temperature during the ballast voyage. It is done only if the same grade of cargo is to be loaded at the next loading terminal.

The quantity retained depends on:

- Commercial agreements
- The type of gas carrier
- The duration of the ballast voyage
- The next loading terminal's requirements, and
- The next cargo grade
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Changing cargo: The steps to follow (depending on the grade switch, it may not be necessary to include all these steps):

• Removal of remaining liquid
• Warming-up
• Inerting after discharge (the need of inerting will depend on A desire to gain tank entry for inspection, last cargo, next cargo, charter party terms, requirements of the loading terminal, requirements of the receiving terminal, and permissable cargo admixture)
• Aerating
• Ammonia — special procedures
THANK YOU FOR YOUR ATTENTION