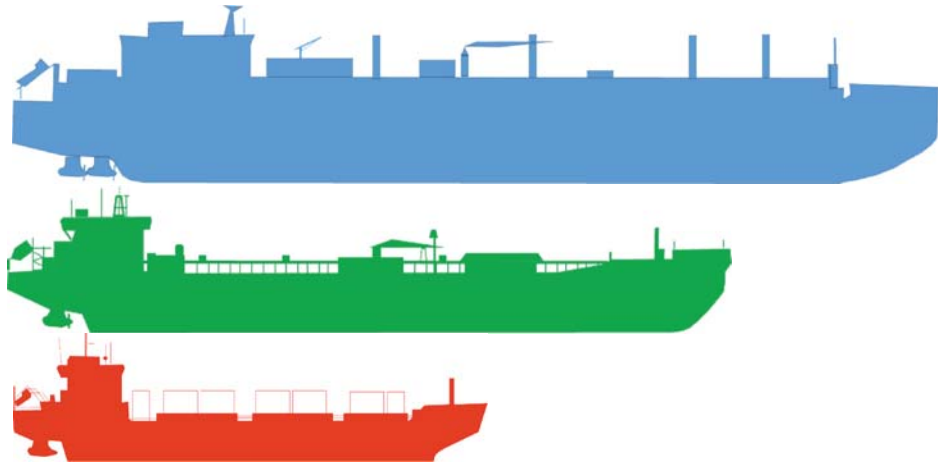
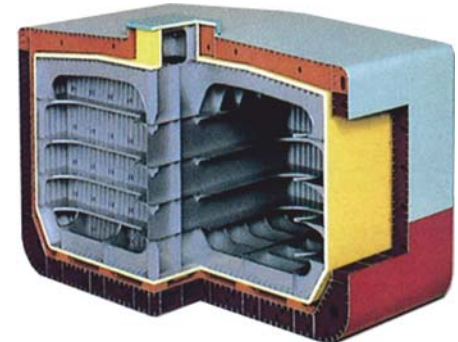
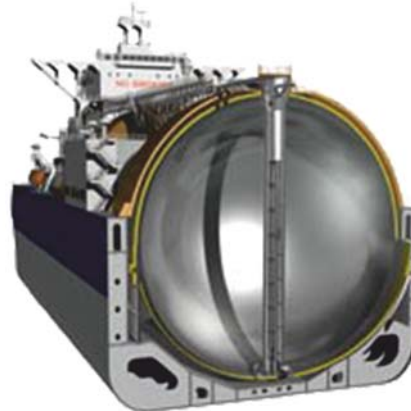
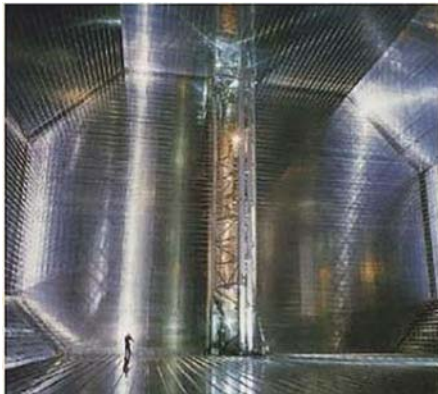


Different cargo containment systems for LNG Carriers

The selection of the LNG cargo containment systems has a large effect on the ship design. Therefore, two to three of the most common LNG tank concepts are usually studied and regarded as potential alternatives for Arctic LNG carriers.



The developed LNG carrier is significantly larger than any previous vessel for the Arctic: An 80,000 dwt LNG carrier, 70,000 dwt oil tanker and 15,000 dwt multi-purpose cargo vessel.



The cargo containment types for large LNG carriers: Membrane, Moss- and SPB type tanks.

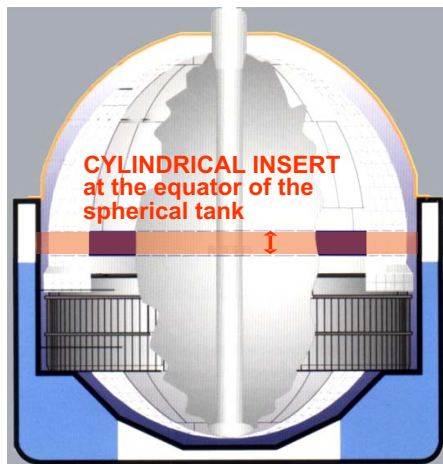
Today, the so-called **Membrane**-type ship concepts are used for the majority of large LNG carriers. Specific to the membrane tank system are the prismatic shape of the cargo tanks and the double internal tank insulation system with thin fluid tight layers.

Moss tank ships are distinguished by their robust, spherical, self-supporting, cargo tanks that extend halfway above main deck and are covered by similarly shaped tank covers.

A third containment type suited for larger ships is the SPB tank that resembles the membrane tank concept in shape, but is another self-supporting and robust tank type, which has become successful only recently. However, the first two SPB concept based ships were built already in 1993 in Japan.

"The main LNG cargo containment types differ from each other quite much although they all serve the same purpose," says Senior Designer Mauri Lindholm. "During transportation LNG is kept at atmospheric pressure in well insulated tanks. The cargo is slowly boiling and will maintain its low boiling temperature during the entire voyage. The vaporized gas, the boil-off, is utilised as gas fuel for propulsion. More fuel gas can be generated from the ship's LNG cargo with heat. Or, the rest of the required energy comes from oil fuel, as usual."

Any new LNG carrier builder needs to choose their own or their client's favourite tank concept and will thereafter usually stick to it.



Tank stretching: Moss cargo tanks made larger by inserting a vertical extension in the middle. The ship's steel hull remains almost unchanged.



Integrated Hull Structure: Moss cargo tanks are covered by a structurally continuous cover, common to all cargo holds, which improves hull strength.



"Seri Campaka" – The third ship in a series of five IHS-Moss type LNG carriers for a Malaysian owner built by Hyundai Heavy Industries. The hull design with its continuous tank cover is based on Aker Arctic's "IHS" concept with improved hull strength and reduced steel weight.

"The reason is that the different tank concepts have totally different and specific materials, production, assembly and quality assurance methods, and the building yard needs to make large, long-term investments. Additionally, the tank concepts are licensed by their developers," adds Lindholm.

Interest towards smaller sized LNG feeders and bunker ships has grown rapidly in line with the growing use of LNG as ship's fuel. Pressure vessel type tanks have proven to be the most feasible solution. Similar tank types have been used for decades in transporting other gas cargoes that are in refrigerated or pressurized form. Smaller LNG ships with a cargo capacity from 1,000 to 35,000 m³ fitted with such tanks are becoming more common.

Finnish designs

At the beginning of the 1990s, Finnish engineers in Turku began further developing the well-known Moss-tank and ship concept in order to create improved solutions; ships with fewer but larger tanks and based on new tank production methods.

Four Moss-type vessels built in 1996/1997 are still delivering LNG from the United Arab Emirates to Japan on a long-term basis. They were the first

larger carriers with only four spherical cargo tanks.

Somewhat later, the experiences from the modern Moss ship design process produced two new Finnish innovations related to the Moss cargo containment system.

Aker Arctic is marketing an Integrated Hull Structure (IHS) concept – an extension to the Moss ship concept that is especially favourable for Arctic trade with several advantages compared to conventional gas ship concepts. In the IHS concept the individual tank covers are constructed into one continuous hull element for improved hull strength and reduced steel weight.

The other innovation is "tank stretching" meaning the spherical tanks are fitted with an extension ring in the middle for increased cargo capacity. By now the present Moss ship builders have constructed tens of such ships.

"Mitsubishi Heavy Industries in Japan and Hyundai Heavy Industries in Korea have been using our patented IHS-technology in their building projects for years," says Suojanen.

"It is worth mentioning that both inventions can be utilised in the same ship design as is the case with the Japanese 'Sayaendo' concept, an unusual Moss-type ship series built lately," Lindholm adds.

