Arctic LNG carriers for Yamal LNG

During the past years, the works related to Arctic LNG Carriers have focused on making plans become reality. From 2010, Aker Arctic has worked for the Yamal LNG company supporting its development project to design LNG-carriers and related port infrastructure and a port fleet for transporting natural gas from Sabetta to the markets elsewhere in the world.

“We have been extremely happy to see our long-term development, persistent work, new ideas and ships finally come true. It has been fantastic to work with our clients who have displayed an innovative attitude and the rock solid expertise, which will make LNG transports from the Arctic happen,” says Suojanen.

Regarding ships for the Yamal LNG project, a series of 170,000 m³ sized Arctic LNG carriers that will carry gas to Europe and the Far East from the Yamal peninsula was proposed. The project stakeholders made the selection for the potential builder and the membrane tank concept.

The carriers need to be large so that they can transport a substantial amount of cargo – 16.5 million tons a year. The new, but today very common, size class of 170,000 m³ was also favoured, as it would allow transhipment operations to similarly sized ordinary open water LNG carriers that can transport gas cargoes further to overseas destinations more economically than the Arctic ships. In addition to the Far East destinations, the ships will call on a regular basis at the Zeebrugge LNG terminal in Belgium where the transhipment of cargoes via onshore storage will also take place.

The first Arc7 Arctic LNG Carrier “Christophe de Margerie”

The first real Arctic LNG carrier, the “Christophe de Margerie”, is currently in service and will start regular LNG shipments later this year from Sabetta port in the Yamal peninsula. Her sister ships will join the fleet of 15 ships, one by one as they are completed and the LNG plant has reached its full capacity of 16.5 million tons of LNG a year. Read more about the Christophe de Margerie in its full-scale ice tests last winter on page 9.

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.
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.

**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.

**Integrated Hull Structure**

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