





Technology and Rule Development

R&D

Rule Development

Advanced Technology

With the rapid advancement of gas carrier and gas related floating system technology, ClassNK works in cooperation with international partners to carry out cutting-edge R&D to provide services with the latest technology.

Rules and Guidelines

ClassNK develops rules and guidelines based on knowledge obtained from R&D and damage investigations to help support the safer, greener design and construction of gas carriers, while allowing designers and operators to smoothly implement the latest technology.

Contributions to International Standards Development

With major amendments made to the IGC Code and the introduction of the IGF Code among others, the framework for gas related technology is expanding. As part of the International Association of Classification Societies (IACS), ClassNK contributes its knowledge and experience to develop new rational standards for the industry.

Services for Individual Projects

Class & Statutory (Regulatory)

ClassNK

AIP/General Approval

When applying new technologies, the concept and basic design may require third party approval at the request of stakeholders.

To fulfil these needs, ClassNK offers design approval services such as Approval In Principle and General Approval to support the realization of new projects.

Planning



Plan Approval

Designs for gas carriers employ the latest and most specialized technologies. ClassNK experts use knowledge based on their rich experience in plan approval together with hands on survey experience at shipyards to provide quick and accurate plan approval services.

Design



On-site Surveys

Expert knowledge of gas carrier designs is essential for carrying out site surveys for gas carriers. ClassNK's newbuilding surveyors with a wealth of plan approval experience are at the field.

ClassNK gas experts are stationed at exclusive survey offices strategically located along the main gas routes to enable smooth operations after a ship enters into service.

Operation

Construction

Risk Assessment and Engineering Analysis

experience, ClassNK offers a diverse range of services necessary for each project.

Depending on factors such as specifications from the ordering party, gas carrier designs using the latest technology and complex systems may be subject to risk assessment provided by a third party and various other engineering analyses. Based on a wealth of

CAP/Residual Life Assessment

In some cases, gas carriers will stay in service beyond the assumed lifespan that was planned at the time of construction. ClassNK provides Condition Assessment Program and longevity or residual life

Third Party Technical Services

study (TLA) services to meet the needs of each project.

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A Gas Carrier Milestone





1961 World's First Type A LPG Vessel **Goshu Maru**

1969

World's First Semi-membrane Type LPG Vessel **Bridgestone Maru No.5**



I 1980
World's First Type B LPG Vessel
Genkai Maru

I 1981

World's First Semi-membrane Type LEG Vessel **Shokaku Maru No.2**



1983 ClassNK's First MOSS LNG Vessel Bishu Maru, Banshu Maru, Echigo Maru



1988
World's First Type B LEG Vessel
Kayo Maru



1993 World's First Technigaz Mark III Membrane LNG Vessel Aman Bintulu



2012
ClassNK's First Sayaendo Type MOSS LNG Vessel
LNG Venus



2003 ClassNK's First Small Scale Type C LNG Vessel **Shinju Maru**



 ${\it ClassNK's\,First\,SPB\,LNG\,Vessel\,(Under\,Construction)}$

















Worldwide

■1958
World's First Successful transport of LNG
by Oceangoing Vessel

by Oceangoing Vessel

Methane Pioneer
(Independent Prismatic Tank)

■1964
World's First Membrane
LNG Vessel
Pythagore

■1965
World's First Cylindrical Tank
LNG Merchant Vessel
Jules Verne

■1973
World's First MOSS LNG Vessel
NORMAN LADY

■1993 World's First SPB LNG Vessel **Polar Eagle** ■2016 GTT Membrane New System Mark V / NO 96 Max

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R&D for Cutting-edge **Solutions**

Rule and Guideline Development for New Technologies

Rules and Guidance for the Survey and Construction of Steel Ships Part N: Liquefied Gas Carriers



ClassNK established class and installation related requirements for liquefied gas carriers based on the International Code for Construction and Equipment of Ships Carrying Liquefied Gases in include those from the IGC Code as we**ll** as their interpretations.

Safety Assessment for **New LNG Tank Designs**

With LNG trade and transportation patterns changing, the need for partial filling of LNG tanks has expanded.

LNG cargo tank technology is constantly advancing in an effort to achieve ever greater transport efficiency and capabilities. Safety assessments for sloshing effects are crucial in such cases. ClassNK carries out a wide range of safety assessment study for sloshing and other loads related to cargo containment system of LNG carriers.









CO₂ Shuttle Vessel

ClassNK carries out investigations into the implementation of CO₂ Capture and Storage (CCS) using vessels.



LNG Carrier and Bunkering Vessel

With the growing number of LNG fueled vessels on the horizon, ClassNK is supporting the development of the related technologies, including the provision of Approval in Principle for a Small Scale LNG carrier/bunkering ship design developed by the Cooperative Association of Japan Shipbuilders and other companies.

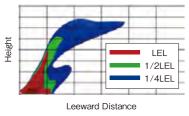


Analysis and Risk Assessment Services for LH2 Carriers

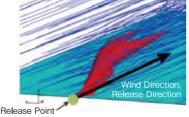
As the world turns towards clean energy, the use of hydrogen has the potential to realize a low carbon society. ClassNK has been involved in the development of LH2 carrier since its early research stage, providing risk and safety assessments for the transport of cryogenic liquid hydrogen. As one of its outcomes, ClassNK published the world's first guidelines for the LH2 carriers.



[LH2 at Sea Disposal Analysis Results]



Side Elevation



Bird's Eye View (Hydrogen Concentration 1% Isosurface)

Guidelines for Liquefied Gas Carrier Hull Structures - Independent Spherical Tanks of Type B -



These guidelines were developed for hull structure strength evaluations of liquefied gas carriers designed with independent spherical tank type B such as Moss tank systems, which include the latest expertise from the IACS Common Structural Rules.

Guidelines for Compressed Natural Gas Carriers



While the IGC Code plays a central regulatory role for LNG carriers, there are currently no international standards for the carriage of CNG. These guidelines are specific to CNG, taking into account the unique hazards of carriage of CNG associated with handling high pressure gas to provide requirements for the safe design and construction of equipment and systems.

Guidelines for Floating Offshore Facilities for LNG/LPG Production, Storage, and Offloading (Fourth Edition)



Since the release of the first edition in 2011, ClassNK has regularly updated the quidelines for FLNG/FLPG, FSU and FRSU technical requirements in line with the advancement of technology and the introduction of new rule amendments. These guidelines also contain requirements for the conversion of older LNG vessels. LPG vessels into FSU and FRSU.

Risk Assessment Guidelines



These guidelines give a general overview of risk assessment procedures, which can also be applied in the verification on various technical elements of liquefied gas carriers through risk assessment techniques.

Guidelines for Liquefied Hydrogen Carriers



In realizing the long anticipated hydrogen powered society, the establishment of safe and stable bulk transportation infrastructure of hydrogen is essential. Liquefied hydrogen carrier is considered one of the most prospective elements of this infrastructure. ClassNK developed guidelines to ensure the safety of liquefied hydrogen carriers based on the interim recommendations developed by IMO as well as requirements from other major recognized standards used in the design of hydrogen facilities onshore.

Guidelines for Gas Fuelled Ships (Ver. 4)



These guidelines contain safety regulations for the construction of LNG fuelled vessels. Based on IGF Code regulations developed by the IMO to safeguard gas fueled vessels, these guidelines have been regularly updated since their first publication in 2009.

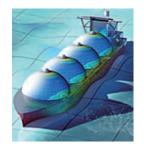
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Third Party Technical Services

Hull/Cargo Tank Structural Analysis

ClassNK offers structural analysis services required to verify that hull/cargo tanks have sufficient strength during the design period for specified sea environments.

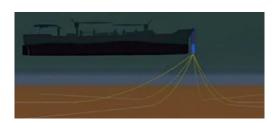




Mooring Analysis

Mooring analysis is required for offshore facilities such as when liquefied gas carriers are converted into FSU or FSRU, or even for LNG carriers when they are used as LNG-RV (regasification vessel).

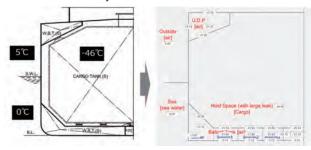
ClassNK provides a series of mooring strength analysis services to cater to these customer needs.



Hull Heat Transmission Analysis

Heat transmission calculations need to be carried out for the design of hull material grade when carrying low temperature cargoes such as most liquefied gases.

ClassNK provides hull heat transmission calculation services using well-proven in-house software based on the common heat transfer theory.

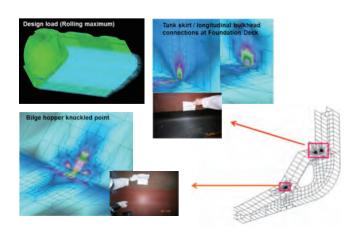


Condition Assessment Program (CAP)/ Total Life Assessment (TLA) Service

LNG carriers and other vessels will sometimes be in service longer than the assumed lifespan that was planned at the time of construction. This extended service life requires third-party condition assessment and total life assessment.

ClassNK offers CAP based on fatigue analysis and in-depth condition surveys, as well as TLA which analyzes the remaining life of a vessels based on the results of further detailed fatigue analysis and in-depth condition surveys.

These third party appraisal results carried out by our experts can be used when vetting vessels for further use.



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