Sean Bond, ABS, USA, considers the importance of LNG as fuel today, as well as in the future.

A FUEL for the ages

The story of LNG as fuel has been one of a slow and steady evolution, as technical, regulatory and infrastructure barriers have been overcome. This process is far from finished, however the challenges that remain are multiple rather than insurmountable.

One of the primary issues for shipowners is that the regulatory framework covering LNG as fuel is not yet finalised.

However, there are existing International Maritime Organization (IMO) interim guidelines that can be applied, which have been in large part incorporated into the ABS *Guide for Propulsion and Auxiliary Systems for Gas Fuelled Ships*. Using this resource and with the right agreements in place, ABS can assist clients in applying the latest criteria so that projects can move forward with agreement from the flag and to the client's satisfaction.

Figure 1. Dual-fuel vessel for GNS Shipping/Nordic Hamburg.

From a class perspective, one of main challenges of technology is that the design approach is often risk-based and conceptual, which brings it into new territory for designers who are not familiar with LNG or the risk-based approval process.

It should be noted that many risk identification studies have already been performed by class societies, operators and ship designers, and much of the technology for LNG as fuel is not new. The technology has been developed and used on numerous LNG carriers over decades, and is being transferred to conventional tonnage where there is a more limited amount of design history.

It is this transfer to a new sector that the risk assessments mainly address, including any special operational elements of the vessel under consideration. It is therefore equally important that owners and operators provide adequate training to ensure that their crew understand the potential risks.

While some larger shipyards have LNG teams, or years of experience with LNG carriers, many designers of LNG-fuelled ships have never worked with gas. ABS is able to provide advice and support to help these shipyards understand the issues to be considered.

Notations that define the relevant class requirements are detailed in the ABS *Guide for Propulsion and Auxiliary Systems for Gas Fuelled Ships*, and generally reflect the traditional, prescriptive approach to vessel design. However, there are elements of LNG-fuelled designs that are not traditional for fuel concepts, such as boil-off gas (BOG) handling equipment. In this instance, the guide's specific notations help to tie the requirements to the right components.

In terms of vessel design and operations, some challenges are generic while others are LNG specific. However, one of the most fundamental challenges is assessing the location of the fuel tanks.

On a tanker, for example, there might be space for the tanks on deck in areas already designated as hazardous and designed accordingly. On a containership, a major challenge is finding a space for the fuel tanks (above or below decks) that provides equivalent levels of safety in what is already a congested cargo area.

The designers must also consider the potential risks associated with bunkering during cargo operations, if this is intended and permitted, during which there may be considerable activity in numerous areas of the ship, all of which needs to be accounted for in any safety assessment.

Containerships lead the way

The fact that certain containerships are among the early adopters of LNG as fuel is unsurprising, given their trades to and from fixed ports, which enable operators to gain a clearer picture of relevant regulatory requirements and available bunkering infrastructure.

Although the regulatory regime is still evolving, a framework of rules currently exists for the design and construction of an LNG-fuelled ship. This typically means meeting the existing requirements of class, flag state and other stakeholders. The impact on design of building in advance of mature regulations is mainly related to any desire to be compliant with future design requirements.

One of the outcomes of the 94th IMO Maritime Safety Committee meeting – which saw the approval of the draft IGF Code and proposed amendments to make the Code mandatory under SOLAS – was that the level of uncertainty has been reduced. That the regulation might change in the future is not necessarily a problem, depending on the approach of ports to the developing regulations and their application to the early adopters.

If a designer makes the decision to anticipate future requirements based on draft regulations, they are free to include specific concepts for their own commercial or operational reasons. From the class perspective, the design must still meet current class requirements as well as those of their flag state.

Industry gets LNG-ready

ABS has considerable experience in supporting owners as they evaluate the use of LNG as fuel, undertaking Approvals in Principle (AIP) and completing numerous LNG-ready evaluations for the future use of LNG fuel.

Aware of the market risk of building ships that may ultimately have to compete against LNG-fuelled vessels, some owners have opted to prepare their tonnage for future conversion, even though it will use conventional fuel on delivery.

These AIP projects and evaluations have demonstrated the variability of the requirements from the perspective of the designer and owner, such as types of fuel systems and propulsion components, and have highlighted the impact on the design of the vessel. They have also assisted in understanding

Figure 2. TOTE's LNG propulsion system.

the possible implications associated with making a vessel 'LNG-ready'.

To meet this need, ABS has recently published the *Guide for LNG Fuel Ready Vessels*, to support members and clients preparing newbuildings for future conversion to gas propulsion. The guide formalises the process for shipowners who wish to plan for conversion to LNG fuel at a future date, and provides review options ranging from the conceptual to the highly detailed.

The guide includes a basic level for concept design approval and further levels for general design review and for installed equipment. Overall, this constitutes a complete design review and survey of a system that is installed on the LNG-ready ship.

The first two levels result in a descriptive note in the ABS record, listing the parts of the system that have been reviewed. The third level results in an LNG-ready class notation for the parts of the system that have been installed. All levels require that the evaluated systems be in full compliance with the ABS *Guide to Gas Fuelled Ships*.

The correct selection of optional notations from the ABS guide could enable an owner to request conversion tenders at a later date, without having to approach the newbuilding yard or appoint a separate designer to prepare a tender package.

Case study

ABS has been chosen by GNS Shipping/Nordic Hamburg to provide classification services for a series of LNG-powered feeder containerships, currently under construction at Yangzhou Guoyu Shipbuilding.

Capable of operating at a speed of 19 knots, the 170 m vessels will be chartered on a long-term basis to Finland-based Containerships Oy. They will have a capacity of 1368 TEU and will feature specially designed cell guides within the cargo hold that will allow the vessels to carry 45 ft containers, along with a total of 372 reefer boxes.

GNS Shipping/Nordic Hamburg selected LNG as the most economical fuel option, as the ships will be sailing solely in the sulfur Emission Control Areas (ECAs) of the Baltic and North Seas. LNG has the potential to deliver significant savings per round trip compared to conventional vessels, which would have to use more expensive distillate fuel.

Even though LNG bunkering infrastructure is still developing around Europe, GNS Shipping/Nordic Hamburg is confident that the fuel needed could be available almost immediately. Each vessel is able to bunker just once on a round trip, as the ships will have a range of approximately 3200 nautical miles, drawing on 700 m^3 capacity gas tanks.

The ships will trade a round loop service from St. Petersburg, Russia, westwards via the Kiel Canal to the UK before returning via Helsinki, Finland. By the time the first ship is delivered in 2016, the shipowner will have established the primary bunkering points, most likely to be in Rotterdam and St. Petersburg, though the ports of Hamburg and Antwerp are also considering LNG bunkering facilities.

GNS Shipping/Nordic Hamburg believes the direction for the shipping industry is set. In the long-term, the ECA zones will be widened, while the EU and the US are currently leading the way. In the future, there could be an extension of the European ECA to the Mediterranean, and China is spending billions of dollars to convert coal-fired power stations to LNG.

The project marks both the first major order for shortsea containerships to feature dual-fuel LNG engines, and the first application of Wärtsilä's RT-flex 50DF low pressure engine in this type of ship. Nordic Hamburg selected the low pressure engines because of the potential efficiency gains compared to high pressure units.

Using low pressure engines means LNG can still be used when the vessel is slow steaming. Low pressure units also comply with Tier III emission regulations without requiring exhaust gas recirculation, which is an additional investment and reduces engine efficiency.

Designed by Dutch naval architects SMB in partnership with Nordic Hamburg and Yangzhou Guoyu, the vessels are intended to be environmentally friendly and as efficient as possible, in terms of their operational profile.

Specific design measures include the configuration of the propulsion system and optimisation of the hull to deliver an estimated 5 – 10% in operational efficiency, compared to vessels built five years earlier.

Conclusion

LNG is a fuel of the present, as well as the future. The industry is now at a point where the impediments and obstacles to adoption are being removed, and the next few years will see an acceleration in the number of projects moving from the drawing board to reality.

The numbers of LNG-fuelled conventional cargo ships are still small, however they are growing. There is more interest from owners who wish to explore it, while governments are increasingly expressing interest in promoting it. An increasing number of ports are building bunkering infrastructure and more suppliers are examining the business case for providing LNG for marine applications.

The regulatory landscape is also becoming clearer, with comprehensive class requirements applicable today and maturing IMO requirements. Moreover, for shipowners who are building vessels for future conversion to LNG fuel, the ABS *Guide to LNG Fuel Ready Vessels* is a powerful tool that helps them specify work to be done in both the new construction phase and when they are ready to convert.

A change in the oil price and its effect on bunker prices might grab the headlines in the short-term, but LNG as fuel is a story that will continue to be relevant for shipowners in 2015 and beyond. **LNG**