TRAINING AND MANNING FOR THE EXPANDING FLEET OF LNG CARRIERS

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ABSTRACT

Over the next few years, the world LNG fleet is set to expand at an unprecedented rate. With many new ships and new Operators entering the fleet.

The LNG trade depends on safe & reliable ship operation for its continued commercial success. International requirements are set by IMO in respect of minimum training standards for sea-farers, with specific extra training required to meet the exacting challenge of carrying cryogenic LNG cargoes. SIGTTO has voluntarily introduced training standards above and beyond IMO levels, and has also published a minimum experience level for the various Senior Officer ranks on board any LNGC.

The paper will examine the challenges facing individual Operators - and the LNG shipping industry as a whole - from this sudden upsurge in demand for experienced and highly-trained sea staff. Set against a background where recruitment of seagoing personnel is increasingly difficult, and the fact that it takes around 10 years to train a Cadet to take Command (either of an engine room or of the entire ship). The growing shortage of sea-staff is also affecting experience levels ashore, which in turn can impact the reliability of the shipping operation itself.

The Author will draw on many years - experience in training sea-staff LNG to suggest solutions to this growing problem in our industry.

1. INTRODUCTION

Over the next few years, the world Liquefied Natural Gas (LNG) fleet is set to expand rapidly, with many new ships and new Operators entering the fleet. This upsurge in demand for experienced and highly-trained sea staff will pose challenges to individual Operators – and the LNG shipping industry as a whole.

The LNG trade depends on safe & reliable ship operation for its continued commercial success. International requirements are set by International Maritime Organization (IMO) in respect of minimum training standards for sea-farers, with specific extra training required to meet the exacting challenge of carrying cryogenic LNG cargoes. The industry has also set voluntary standards in excess of IMO requirements.

The manpower situation must be seen against a background where recruitment of seagoing personnel is increasingly difficult, and the fact that it takes around 10 years to train a Cadet to take Command (either of an engine room or of the entire ship). The growing shortage of sea-staff is also affecting experience levels ashore, which in turn can impact the reliability of the shipping operation itself.

However, there are potential solutions to the manpower problem – mostly involving three elements; training, training and more training. Some specific examples are outlined in this paper.

2. HOW THE LNG SHIPPING INDUSTRY HAS DEVELOPED

Following some experimental trans-Atlantic LNG voyages on a converted “C1” standard vessel from 1959, the first commercial cargo of LNG was loaded in Arzew, Algeria and delivered to Canvey Island, UK in 1964 – nearly 50 years ago. Two ships were built for this trade.
The initial trails were conducted by an Anglo-American consortium, and very similar trials were conducted by a French team in 1961 using a converted “C2” ship, which resulted in a vessel being built to carry LNG from Algeria to France, starting in 1965.

The original 3 ships were small by today’s standards – between 27,500 and 29,000 m³ cargo capacity. The designers of the original ships faced numerous problems, the most fundamental of which was “what to do with the cargo boil-off”. The Laws of Physics dictate that if the cargo is at about – 160°C and the ambient temperature is some 180 – 200°C above that, the result will be some evaporation of the cargo regardless how efficient is the insulation system fitted to the cargo tanks.

It was clearly unacceptable for a commercial ship so simply vent this boil-off gas to atmosphere, and because the cargo tanks had a relatively large surface-to-volume area on the early ships, the insulation adopted gave a “boil-off rate” of over 0.3% per day. But this boil-off gas was a potential fuel for the ship. After much discussion with the Class and Regulatory Authorities, safety systems were agreed to permit the burning of the boil-off gas (BOG) in the main machinery of the commercial LNG carriers, and a relatively fast service speed was adopted to match the fuel consumption to the rate of boil-off gas production.

The pioneering ships delivered in 1964/65 were designed at the time when about half of the world’s merchant fleet was steam-propelled. So it was no surprise that the LNG pioneers adopted this system. Steam propulsion had the added advantage that the main boilers could be adapted readily to burn either heavy fuel oil or cargo boil-off in virtually any proportion – though for safety the Class rules required a minimum of 10% oil at all times (to act as a “pilot light” and prevent any furnace explosions with gas). Using the boil-off gas as fuel was a very elegant solution to the problem of how to handle it.

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The development of Liquefied Natural Gas Carriers (LNGCs) since then is well documented, and need not be repeated here. The focus of the trade moved to the Far East, and ship sizes increased significantly to a benchmark of 125,000m³ within a decade. New terminals were built to suit this ship size and the increasing voyage length.

In that time, merchant ships in general had increasingly adopted diesel propulsion – especially after the bunker price rises of 1973. But LNG remained the exception – steam propulsion was still the "norm". And this continued to be the case until quite recently.

It is also relevant to our understanding of training requirements to look at what precisely is required of an LNGC. Most merchant ships carry cargoes that can be obtained from many other sources, and there is sufficient flexibility in the supply/demand balance to allow for some degree of unreliability.

The LNG trade is a complete contrast to normal shipping services. LNG ships carry a very special cargo from an unusual type of production plant to customers that rely on a safe and reliable delivery service. The requirements for an LNGC can be summarised as follows:

- Highest standards of safety
- Exceptionally high reliability & availability
- Long service life
- High service speed
- Fast turn-around in port

The “link-in-the-chain” aspect of LNGC operation also highlights another fundamental difference between these vessels and more conventional ships. Namely that if a normal ship has a breakdown for say 24 hours, the penalty is one day “off hire” at the daily charter rate of the ship. With an LNGC, any outage during service could mean that the exporting liquefaction plant may have to shut down if there was no storage available for LNG production until the next ship arrived. So the “out of service” cost of an LNGC has to be seen as a potential “opportunity loss” for the LNG production plant rather than in terms of ship charter hire.

And even today, LNGCs are frequently built for specific projects and dedicated routes. The project could not operate without the ships, hence the emphasis on reliability. However, many LNGCs have comparable length/beam/draught footprints – so some degree of compatibility and flexibility does exist.

In terms of the total world merchant shipping fleet – estimated to number some 50,000 in total - the number of LNG ships is quite modest at about 370 ships, with some 70+ additional vessels on order. This is a contrast to all other types of tankers – including LPG carriers.
Until recently the majority of LNGCs still used steam propulsion – with a layout very similar to the early ships. The system is proven, has low maintenance requirements and practically non-existent lubricating costs, plus the ability to burn Heavy Fuel Oil (HFO) and BOG in any proportion. Furthermore, the steam plant offers an easy method to dispose of excess BOG – by burning it to raise steam, which is then condensed.

However, steam propulsion systems have low thermal efficiency due to the limitations of turbine design, which in turn means high fuel costs and CO₂ emissions. A further drawback of this design is the long delivery time for turbines because of the very limited production capacity around the world, which in turn can cause major delays in case of a turbine or gearbox failure when the ship is in service.

The recent development of high-efficiency medium-speed diesels that can run on gas or oil – and that can change between fuels while running – has given the LNG industry a real alternative, and it is hardly surprising that very few steam ships are now on order. Many of the LNG ships ordered and delivered in the past 5 years have adopted these engines coupled to alternators and driving the ship’s propeller via electric motors – in a classic diesel-electric drive system.

The other alternative to steam propulsion adopted in the past 5 years is on-board cargo reliquefaction. This concept was introduced on board fully refrigerated Liquefied Petroleum Gas Carrier (LPGCs) at about the same time as the LNG trade began, but LNG reliquefaction requires much higher power. The low thermal efficiency of steam systems makes it uneconomic to reliquefy LNG cargo boil-off, so these systems can only work commercially on ships with diesel generators. To date, the ships in service with LNG reliquefaction use oil fuel only in their diesel propulsion and generator engines.

It is technically feasible to burn boil-off gas in 2 stroke engines, and some examples of this machinery are in use on shore plants. The disadvantage of this layout is that high gas injection pressures of about 300 Bar (gauge) are required – compared to the more modest gas supply pressures of about 6 Bar (gauge) for medium speed engines. To date, no gas-burning 2 stroke engines have been ordered for LNG carriers, but there are reports that two container ships will be built using this system. It is very likely that LNGCs will also adopt gas-fired 2 stroke propulsion in the future, as this type of machinery offers greater simplicity than medium speed engines.

3. THE TRAINING OF SEAFARERS – AN OVERVIEW

With this perspective on the design alternatives for LNG carriers, and the requirements for them in service, the question of how to train the sea-staff for these unique vessels can be addressed.
The shipping business is one of the truly global industries in the world. It is very common for the ships to be built one place, to carry cargoes between two different countries and to be operated by an organisation in yet another location that employs sea-staff from two or more nations.

This truly international nature of seafaring requires that training standards for ship staff be comparable internationally, and this was recognised when IMO introduced the original Convention on Standards of Training, Certification & Watchkeeping in 1978 (better known as “STCW 78”). The Convention has been updated twice since then and is now known as “STW”, but the basic principle stands. Seafarers must complete several levels of college education combined with practical service on board ship to rise through the ranks from Junior to Senior Rating, or likewise from Junior to Senior Officer.

In addition to this general seafaring knowledge, Ratings and Officers that chose to sail on board specialist ships such as LNG tankers must also complete specific training in the safety aspects of these cargoes.

Within this broad framework, differences exist between how different countries integrate the seafarers training into their national education system; for example some countries concentrate more on the academic aspects of the subject and combine the STW courses within their University systems. In other words, the candidate can obtain both a Certificate of Competency as a seafarer and a BSc in Nautical Studies, for example.

This variety of routes to reach the same objective can be quite confusing to those outside the shipping industry. For example, in many countries, seafarers broadly chose to go into the Deck or Engine departments – and follow the STW courses to obtain their Certificates. However, these departments are not exclusive, and some nations – France, for example – have the tradition of educating seafarers in both disciplines.

Trainees usually start training as seafarers at the completion of their Secondary education – which for example in many European countries equates to an age of between 16 & 18 years old (depending on what level they have reached).

From a purely academic perspective, the STW training could probably be completed in a time-period similar to that taken to complete an undergraduate Degree. However the STW Convention also mandates that the candidate serves for a minimum period at sea in addition to the time spent in college ashore. So in reality it takes several years longer to complete the training process. This is why it is often stated that to train a Master or a Chief Engineer takes 10 years.

As simply stated in an old saying from the days of sailing ships, it takes time to learn the ropes.

Part of the process is, of course, to allow the young person that enters the industry to develop into a responsible adult. Because the role of a Senior Officer on any ship is a highly responsible one. If an incident occurs on any ship in the middle of the Pacific Ocean, for example, the only people who can respond quickly are the crew on board – who have to have training among them to deal with fires, medical emergencies as well as normal malfunctions of mechanical plant. In short, the key qualities of seafarers can be seen in the form of self-reliance and flexibility.
4. TRAINING & MANNING FOR THE EXPANDING LNG FLEET

Training will undoubtedly be one of the most crucial areas to address as the world LNG fleet expands significantly during the next few years.

As can be appreciated from the overview above, LNG is but one area of the shipping industry, and seafarers can chose to earn their living on board cargo ships or cruise liners or oil tankers if they take the relevant training modules in addition to the generic STW courses.

LNG is correctly perceived as a very high-prestige part of the shipping industry, and there is an interest to join this sector. However, the specialist training required is expensive, and the opportunities to gain the sea-time needed are limited.

Furthermore the LNG industry has collectively decided through Society of International Gas Tanker and Terminal Operators (SIGTTO) to introduce training standards above and beyond IMO STW levels – and has also published a minimum experience level for the various Senior Officer ranks on board any LNGC. In short, the training standards required for Officers on board LNG tankers are among the highest in the industry.

Over recent years, Bernhard Schulte Shipmanagement (BSM) has invested heavily in training facilities. We have our own Marine Training Centres in Cyprus, Gdynia, Manila, Mumbai, & Shanghai – the areas where we recruit the majority of our seagoing personnel. Through this network, we have the capability to develop the bespoke training required to meet the demanding standards required for the LNG sector – which we actually helped to develop as active members of SIGTTO. BSM makes extensive use of Simulators and Computer-based Training (CBT) in our Training Centres; CBT is also used extensively on board BSM managed ships.

In addition, we pro-actively develop courses specifically to our requirements in collaboration with other Training Institutes or equipment makers. We strive continuously to improve the quality & content courses – irrespective if these are in-house, outsourced or CBT, and to use the opportunity to feedback valuable lessons learned from our large managed fleet of ships.

BSM has a large pool of managed gas carriers – presently totalling some 130+ ships in total (including LPG, Ethylene & LNG carriers, both fully managed or crew managed). This gives BSM a large pool of experienced gas ship operators to draw upon when new ships come into management.

Several new entrants to the LNG sector have entrusted their ships to BSM for management, and the process of rolling out the training programme for the project develops along these lines:
- The crew complement is agreed with the Owners – every client has different ideas about how the ship will be operated, and it is always very interesting to discuss this aspect and agree a manning structure.

- The detailed specification of the ship is reviewed – including both types of equipment and individual makers – to identify any specific makers training courses that will be required.

- The delivery schedule and any specific trading requirements for the ships are identified, and then

- Candidates are identified from the existing BSM pool and training programmes are developed to match their experience with the specific requirements & equipment of the vessel.

11 ton “ride on” scale model of an 140k type LNGC at the Ilawa Facility in Poland. Model can be customised to reproduce the handling characteristics of:
- single screw, duel screw (Q-Flex) and azipod propulsion

In some cases, it is necessary to develop special Courses or even facilities to enable experienced sea staff from one sector of the industry to move into LNG. For example, LNG carriers are mainly large ships of up to 300 metres in length. Many of our LPG officers are more used to handing ships of half that size. So to bridge this gap, we developed a “ride on” scale model of a large LNGC with the world-renowned Shiphandling & Manned Model Facility at, Poland. The model is unique, and can be customised to reproduce the handling characteristics of single screw or twin screw steam or diesel propulsion or an azipod arrangement. We are currently adapting the model to match the characteristics of a diesel-electric vessel for a new client.

Many Maritime colleges around the world are no longer able to offer specialist training in steam propulsion – because this layout is practically exclusive to LNG carriers. So BSM instigated the development of a steam training syllabus via SIGTTO, and we developed a course for our own staff who were taking over new steam LNG ships a few years ago. This capability still exists – though we have not taken any steamships into management for some time.

Our most recent focus has been to develop training courses for the latest generation of Tri-Fuel Diesel-Electric LNGCs – which are due to enter our fleet in Autumn 2013. These ships have very sophisticated machinery arrangements – especially in respect of the power management and computer control systems. We are also adapting our Liquid Cargo Operations Simulator (LICOS) courses to cover these new layouts.
5. CONCLUSION

The current expansion of the world’s LNG fleet requires a commitment from all parties to recruit and train more staff to the exacting standards so that we can operate the vessels to the highest standards required.

This is a policy to which SIGTTO members pledge to uphold when they join the industry, and as outlined above it can be understood there is no “quick fix”. Training and developing sea staff takes time and commitment – which has been demonstrated by the industry.

We are likely to see further demands for LNG training if – as widely expected - the market for LNG as ship fuel starts to expand. Once again, SIGTTO is looking to this area, and it is important that a rigorous training regime is developed here – especially if LNG is to be used aboard cargo ships that are not operated to the normal “hazardous cargo” standards of the LNG business.

In the longer term, it is essential that the LNG industry offers an attractive career at sea to attract the high calibre of ship staff which the industry needs. The SIGTTO Board has addressed this concern, and there is a Working Group studying the subject at the moment.

It is quite obvious that any well-motivated, fit, ambitious and intelligent young person could enjoy a varied and well-rewarded career in the LNG shipping industry – both at sea or in shore management. It is important for the future of the industry that we get this message across.