"LNG as a marine fuel – the speed of change"

The following is the text of a presentation made to the CMA, on 19 March 2014, by Capt. Marcus Dodds, Partner at ReedSmith LLP:

"When I was asked if I might speak about the use of LNG as fuel for ships, two thoughts came to mind.

Firstly, the old Latin maxim: *volenti non fit injuria*. Or in my vernacular: "*well, you asked for it*".

Secondly, the words of the Secretary-General of the IMO (Koji Sekimizu-san) when speaking at the SIGTTO panel meeting in London last October: "*A great deal has been said and written about the potential for LNG as a fuel for ships, but there is little practical experience of it as yet and almost no infrastructure to supply it. Much work needs to be done to develop all aspects of the use of LNG as bunkers, including design, operations, training and competency standards, maintenance, acceptable risks and associated control measures*."

I would not like to prompt that first sentence to be amended to "*too much has been said…*"; besides, there are far more worthy persons at this Conference to speak about the commercial potential or debate the technical issues.

So, noting that the theme of the Conference is speed; that there are CLE points at stake; and attorneys to distract from the bar, I thought that I would speak about the relative speed of change between the adoption of maritime regulations and utilisation of LNG as a marine fuel.

Do I have a thesis? Not really. Save that, perhaps, it is fair to say that international maritime regulations have propelled rather than restrained such change.

However, let us start at the beginning and adopt a chronological approach. That way, if anyone does fall asleep they will have some means of measuring for how long they were out.

In 1964 the first purpose built LNG carriers, the sisters "METHANE PROGRESS" and "METHANE PRINCESS" entered into service. They were built to carry LNG from Algeria to England and France in non-pressurised (well, less than about 250mb) insulated cargo tanks. This arrangement meant that as the cargo evapourated ('boiled-off') on passage, the corresponding pressure in the tanks had to be released. Rather than venting to the atmosphere (or flaring) the boil-off this was piped into the engine room and burned as fuel for the boilers. For, unlike the aptly-named "METHANE PIONEER" (the first deep-sea LNG carrier[1]), these sisters were fitted with steam turbines and the boil-off all but removed the reliance on HFO, at least on laden voyages. For the next forty years or so, this arrangement was, broadly speaking but with improvements in efficiency, to remain the same.

[1] converted from the general cargo vessel "MARLINE HITCH", which was propelled by a slow speed diesel engine

Now, it is worth noting that there were already thirty-five LNG carriers in operation, before the IMO adopted any specific regulations pertaining to the design and construction of gas carriers; by which I mean both LNG and LPG carriers, for the latter first appeared in the mid 1930s. These regulations were contained in the GC code[2], that was adopted in late 1975.

However, one must recall the context. These ships were being built as part of value chains and serving between the associated liquefaction and regasification terminals. So, practically speaking, the number of jurisdictions that might necessarily be concerned with the design and construction of each such ship was quite limited; indeed, perhaps only the two port states and the Flag state might be of relevance and all would have a vested (be it economic or strategic) interest in confirming assurance on the ship-owner.

Further, in terms of LNG cargo-handling, piping and transfer arrangements[3] (that are, perhaps, the most relevant to our context), the approved Classification Societies of such Flag states had developed appropriate rules. So much so, that the GC Code recorded that its development "*has been greatly assisted by the work of the International Association of Classification Societies (IACS) and full account has been taken of the IACS Unified Requirements for Liquefied Gas Tankers*".

It might seem surprising, but the GC Code was not mandatory. States were invited "*to take appropriate steps to give effect to the Code as soon as possible*". Although, it would *de facto* become a standard for new LNG carriers through contractual reference to the GC Code.

After the GC Code was adopted, the IMO produced what was to be known as the EGC Code[4]. This had the status of an IMO recommendation and, for our purposes, addressed those thirty-six LNG carriers built prior to 1977. However, to some extent it *de facto* regulated these existing ships as certain states adopted this as a standard for Flag (particularly change thereof) or port state purposes.

In any event, the absence of international maritime regulations did nothing obvious to hinder the expansion of the LNG carrier fleet. As, by 1983, when the IGC Code[5] was adopted, there were sixty-nine LNG carriers in operation.

When the IGC Code finally came into force on 1 July 1986, unlike its predecessors, it was compulsory for ships built from then onwards. However, it was only retrospective to the extent that any Flag state "*deems reasonable and practicable*". A provision that was to invite a degree of lobbying in relation to LPG carriers, but quiet restraint in relation to LNG carriers; a difference more explicable, perhaps, by reference to their markets than their design and construction.

Now, let us turn to another string of maritime regulations or at least divert to the subject of air borne pollution. Around this time my family had adopted the habit of taking Summer holidays in Scandinavia. We stayed by beautiful lakes, with crystal clear waters and no fish. The local explanation for why fishing licences were still sold to foreigners was that we were responsible for this state of affairs - by which it was meant that the acid rain (attributed to emissions of sulphur dioxide and nitrogen oxide) had originated from, amongst others, my own home islands.

At such point in time, there were no enforceable international standards applicable to air pollution from ships. However, as against onshore and offshore installations, ships were not a significant contributor, or at least studies at the time concluded.

Change was afoot though, and in 1985, the UN adopted the Vienna Convention for the Protection of the Ozone Layer, followed, in 1987, by the adoption of the Montreal Protocol on Substances that Deplete the Ozone Layer.

Therefore, by 1990, the shipping community, or at least the IMO, recognised both the growing environmental concern regarding emissions and that shipping was or would start to become a comparatively significant contributor to the same, as improvements were made elsewhere. So, in 1997, MARPOL[6] was amended by a further Protocol incorporating, as Annex VI, the Regulations for the Prevention of Air Pollution from Ships.

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[2] the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk
[3] which correspond to Chapters IV, V and VI of the GC Code
[4] the Code for Existing Ships Carrying Liquefied Gases in Bulk
[5] the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk
[6] the 1973 International Convention for the Prevention of Pollution from Ships (as modified by the 1978 Protocol)

Once in force, these Regulations would impose tiered and time-staged global and regional regimes to reduce the emission of sulphur dioxide and nitrogen oxide (as well as chlorofluorocarbons, halon and volatile organic compounds).

Now, one of the advantages of LNG as a fuel is that the liquefaction process removes from the feed gas much of the compounds that the Regulations are concerned with. That is because to liquefy methane (the dominant component of LNG), it has to be cooled to about minus 160°C (at atmospheric pressure). Therefore, any compound that freezes above such temperature (or any with corrosive qualities) has to be removed beforehand, for obvious reasons. The net result is that burning LNG, or rather its vapour, is compliant with even the uppermost (last) tiers in the Regulations.

Now, given my earlier reference to acid rain and Scandinavia, it was perhaps unsurprising that Norway appeared as a particularly strong proponent of the Regulations (along with active interest from her neighbours) and that the first LNG fuelled ships (non LNG carriers) were to be under her Flag; the first of which was the small RoRo ferry "GLUTRA".

Indeed, note that the "GLUTRA" came into operation in 2000, some five years ahead of when sufficient other nations had ratified the Regulations, such that they (and the associated Emission Control Areas in the Baltic and North Seas) would come into force (on 19 May 2005).

The "GLUTRA" and other such LNG fuelled ships are not covered by the IGC Code, as they are not engaged in "*the carriage*" of LNG, i.e. as a cargo[7]. However, these early ships were designed and constructed for employment solely within national waters, to the standards required by the approved Classification Society (DNV) and registered under the national Flag. Therefore, as with the early LNG carriers, the absence of international regulations were of little practical consequence or hindrance. Further, as early as 2002, Norway introduced its own domestic regulations '*concerning cargo ships with natural gas fuelled internal combustion engines*'[8].

Nonetheless, if LNG were to be utilised as a marine fuel on a broader scale, clearly the establishment of harmonised international regulations (better still harmonised operational procedures) could only promote this, or at least confidence in investment in such ships and the necessary infrastructure. Unsurprisingly, therefore, it was also Norway that made the proposal to the IMO's Marine Safety Committee (MSC) in 2004, for the "*development of international regulations for gas-fuelled ships*", or what is to become the IGF Code[9].

The proposal was accepted, but a year later the relevant IMO Sub-Committee[10] determined upon a staged approach, whereby interim guidelines would be produced first, followed by the introduction of the Code.

Further, it was decided that the Code should not be dedicated to LNG, but should include low-flashpoint fuels (such as ethanol, methanol, propane, butane and hydrogen). Some of which have quite particular characteristics and quite particular supporters. For example, methanol, which is a by product of pulp and paper mills had notable support from Sweden – a heavily wooded country.

In the meantime, in 2005, Norway introduced[11] further domestic regulations '*concerning the construction and operation of gas-fuelled passenger ships*'[12].

A point to note here is that the "GLUTRA" was not the first ship to operate with internal combustion engines fuelled by natural gas. There were already such ships in operation, but they bunkered CNG (compressed natural gas). CNG is different: although it has a 3:1 disadvantage in terms of energy density and storage (MMBtu per unit of volume (cu ft over here?)) – CNG has none of the cryogenic issues associated with stemming and storing LNG as bunkers. It is therefore quite a different proposition.

In any event, as we reach 2006 in our chronology, note that this was when the "PROVALYS" came into operation – and becoming the first LNG carrier to use her boil-off as fuel for an internal combustion engine (using dual fuel diesel electric (DFDE) technology).

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[7] For context note that the capacity of her fuel tanks are smaller than the daily boil-off volume from the average laden LNG carrier.

8 as Regulation No. 644 of 17 June 2002

9 the International Code of Safety for Ships Using Gas or Other Low Flash-point Fuels

10 on Bulk Liquid and Gases (BLG) – which is also responsible for the IGC Code

11 as Regulation No.1218 of 9 September 2005

12 Applicable only to those certificated to carry more than 12 passengers.

Since then, and in the absence of deep-sea LNG fuelled ships entering into operation, another fifty or so LNG carriers have entered service with and developed DFDE (and even tri fuel) technology. A change encouraged by both the greater efficiency of internal combustion over steam engines and the imposition and projected extension of ECAs (with the corresponding need to consume more expensive low sulphur diesel fuel).

Further encouragement for developing the use of LNG as a marine fuel would come in 2008, when the IMO adopted revisions to Annex VI of MARPOL, which prescribed that a worldwide (i.e. outside the ECAs) 0.5% cap on sulphur content might be introduced by 2020[13].

By 2009, the '*Interim Guidelines on safety for natural gas-fuelled engine installation in ships*' (Interim Guidelines) were approved by the IMO (or rather the MSC) and adopted.

However, in March 2011, it was recognised that more operational experience, field data and research related to low-flash point fuels was needed in order to develop specific technical requirements for these fuels. Therefore, the intention to produce a general code with supplementary chapters addressing different fuels was abandoned in favour of a general code for all fuels covered by it. It was also confirmed that the IGC and IGF Codes were to remain independent but harmonised.

As all here will be acutely aware, this was also about the time that shale gas became a game-changer for the US energy market. With that revolution came a corresponding surge of interest in using LNG as fuel for ships operating in US waters (particuarly, Jones Act ships). So much so, that in April 2012, the US Coastguard was prompted to issue Policy Letter No. 01-12, which on a national level brought into force the Interim Guidelines.

Indeed, as 2013 ended, hardly a week seemed to go by without headlines in the world's maritime press announcing the intention of various US operators to build LNG fuelled ships. That trait has continued this year and it is notable that the US Coastguard started 2014 with Policy Letter No. 01-14 and 02-14 addressing '*guidelines for LNG fuel transfer operations and training of personnel on vessels using natural gas as fuel*' and '*guidance related to vessels and waterfront facilities conducting LNG marine fuel transfer (bunkering) operations*' respectively.

In the meantime, the Norwegian Flag has claimed the first LNG fuelled passenger ship (which is engaged on short-sea international voyages; with bilateral approvals from other Hanseatic states); the first product tanker (the BIT VIKING); and a number of offshore support vessels. Also, around 2012, China appears to have committed to a rapid development of LNG fuelled river and coastal vessels.

So, amongst all this progress or expected progress, where are we with the international regulations?

In February 2013, the responsible IMO Sub-Committee[14] gave instructions to the correspondence group as to the priority fuels, citing LNG as the primary priority with methanol and fuel cells as the secondary priority[15].

The outstanding issues appear to be relatively confined now. Although in some cases quite fundamental to the design: such as the approach to determining the acceptable locations (protective areas) for LNG bunker tanks.

In this respect, perhaps unsurprisingly, Norway appears to favour the (risk based distance) approach that DNV implemented for the existing fleet of LNG fuelled ships that DNV classed; even though the IGF Code would not have retrospective effect on these ships.

By contrast, France in particular appears to have favoured a deterministic approach (with set damage scenarios), which would seem to give greater scope for the inclusion of membrane rather than type 'C' bunker tanks; which coincidentally would include the (French) GTT designs.

Such contra-positioning is not isolated though. The cruise-ship industry[16] has also lobbied against the Norwegian approach[17]. Their concerns including that: "*If the the placement of tanks were to be such that it infringed significantly*

[13] The EU has already confirmed (see Directive 2012/32/EU) that this cap will come into effect within EU waters in 2020, notwithstanding that Annex VI provides for a feasibility review in 2018, before the cap is imposed world wide.
14 At that time still the BLG
15 Such that in the following eight rounds of working groups, six exclusively addressed LNG.
16 To the extent represented by the Cruise Lines International Association.
17 Their submission to the sub-committtee dated 29 November 2013.

on revenue sensitive spaces on cruise passenger ships, then the economics would likely not justify building such a ship irrespective of the technical practicality. *Thus although safety must be the primary consideration, we urge that any final solution allow for placement of tanks that is both safe and consistent with the operational characteristics of potential future cruise passenger ships*".

I quote this in full, because it characterises the use of LNG as a marine fuel as being an environmental (not economic) benefit of such measure that it should be encouraged to the extent that safety considerations are legitimately bound within the parameters of what is (at that time) considered economically viable.

An argument that points towards the legitimacy of my 'thesis' that international maritime regulations (at least in so far as Annex VI of MARPOL is concerned) have done more to propel than restrain the change to LNG as a marine fuel.

There are other contentious issues under consideration that may simply be excluded from the IGF Code. Such as whether simultaneous (e.g. cargo) operations can be conducted at the same time as LNG bunker transfers: something of a philosophical (and economic) divide between those with a LNG carrier operator's perspective as to what constitutes best practice and those with a view to the commercial demands on (and viability of) LNG fuelled ships.

In any event, the expectation was that the IGF Code would be ready for adoption by the IMO in November 2014. For reasons other than those differences that I have mentioned,[18] it seems that this could not now be until Spring 2015. Nonetheless, it is still anticipated that the IGF Code will come into force as a mandatory international regulation in 2017.

In light of what I have discussed it will be interesting to see what impact on the growth (particularly internationally) of LNG fuelled shipping this has, as opposed to the 2018 'Review' and proposed 2020 entry into force of the last (for now) and most stringent air pollution provision. Perhaps, the timings will be too close to tell…….

Thank you for listening"

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[18] Note that the IMO sub-committees have been restructured, with the Carriage of Cargoes and Containers (CCC) now taking the place of the BLG for the purposes of the IGF Code, which puts back by one month the next meeting (i.e. to September 2014, not August 2014)