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SIGTTO

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MESSAGE FROM GENERAL MANAGER



Farewell and thank you

SIGTTO General Manager

Andrew Clifton is leaving the Society after a record-breaking tenure in the role

As many of you know by now, I tendered my resignation to the SIGTTO President at the end of January and will step down as General Manager of the Society as of 4 March 2022 after nine years and five months in the role. I have chosen to pursue the opportunity of a fresh challenge.

It has been an honour and privilege to serve as SIGTTO General Manager and to oversee a number of major changes since taking up the post in October 2012. In tandem with dynamic developments in the liquefied gas industry, the Society has been completely transformed over the past nine years into a more modern organisation, with a much greater processing capability, improved efficiency, a more diversified resource base and a stronger structure than was previously the case.

Chris Clucas is taking over from me on a temporary basis and will serve as Interim General Manager for an expected 4-6 months, until a long-term successor is appointed. I first worked with Chris back in 1991 when I was chief officer on very old and challenging (to say the least!) LPG carriers with Dorchester Maritime and Chris was the office gas consultant. Chris, as an ex-SIGTTO Panel Meeting and General Purposes Committee (GPC) chair, is very familiar with the Society and is an excellent choice to see SIGTTO through this transitional period.

SIGTTO remains a highly visible and notable industry leader that has evolved with the changing times and the rapid



At the Secretariat's farewell dinner for Andrew are, from left to right, SIGTTO President Steffen Jacobsen, Andrew and Interim General Manager Chris Clucas

"It has been an honour and privilege to serve as SIGTTO General Manager and to oversee a number of major changes since taking up the post in October 2012"

expansion and diversification of the liquefied gas market to meet the demands of its membership. The Society's wide-ranging workload now also encompasses activities focused on the complex issue of decarbonisation and the carriage of non-hydrocarbon liquefied gases such as hydrogen and carbon dioxide (CO₂).

The SIGTTO organisation I leave has a record level of Secretariat staff – double

the number in place when I joined. For example, we now have a dedicated IMO representative and a marketing executive for the first time. Since 2018 the SIGTTO >

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MESSAGE FROM GENERAL MANAGER

Secretariat has resided in state-of-the-art office facilities in central London, over twice the size of our old premises and with office and meeting facilities fit for the membership's various requirements.

I would like to take this opportunity to thank the SIGTTO Board of Directors and members for their continuous support. We should never forget that without the membership there would be not only no SIGTTO but also no progress. I have worked with over 50 directors and participated in 20 Board Meetings and 10 Annual General Meetings (AGMs) during my tenure as General Manager. It will be interesting to see if any future General Manager can top that! A measure of the Board's ongoing support for me is given by the fact that since I tendered my resignation most of the current Directors have contacted me by email or phone with kind words of appreciation and best wishes for the future.

Past experience tells us it takes a full 12 months for a new SIGTTO General Manager to become fully familiar with the role, including the Society's structure, meetings schedule, governance, policies, activities, workload, expectations and goals. Over that one-year period a General Manager will go through a busy and full meetings and procedural cycle.

I remember in my first year in the job I was instructed by the Board to form a brand new non-governmental organisation (NGO) – the Society for Gas as a Marine Fuel (SGMF) – from scratch! This task kept me fully occupied during my familiarisation process but I'm pleased to say that the new NGO was up and running and had started to develop its own membership base within four months of the go-ahead decision. A new period of familiarisation is about to start at SIGTTO and I know that his past experience of the Society will not only stand Chris Clucas in good stead in his Interim General Manager role and but also facilitate the handover to, and settling in of, my fulltime successor later in the year, a year which will see two SIGTTO Presidents and three General Managers.

SIGTTO currently has over 20 projects underway, underpinned by an agreed Strategic Plan, robust internal processes and a committee structure that boasts a Human Element Committee (HEC) and an Environmental Sub-committee (ESC) in addition to our GPC. I am proud to say that in terms of the productivity of industry best practice guidance we often outperform much larger NGOs.

I would also like to pay full credit to my very hard-working Secretariat colleagues who have maintained the Society's impressive productivity levels over the past two years despite the COVID-19

“I would urge SIGTTO to ensure that its ever-increasing amount of work on the environment is made in addition to, and not instead of, its traditional work on safety.”

situation. I would like to thank Cherian Oommen, Senior Technical Advisor, in particular. Cherian has been my right hand man throughout my tenure. The present Secretariat staff members are the best I have worked with while General Manager and I wish them all well.

SIGTTO is hopeful that its regular Regional Forums and other face-to-face meetings can resume in the near future. Although we are presently not scheduling any such meetings until the situation becomes clearer, they can be arranged at fairly short notice.

I was pleased to attend our Autumn Board and AGM in Athens on 18 November last year, gatherings kindly hosted by Naftomar. This was SIGTTO's first in-person event since early 2020. The benefits of having a face-to-face meeting, as opposed to the world of Zoom and Teams we have got used to in the last two years, were readily apparent to all in Athens. SIGTTO is hopeful that its 65th Panel Meeting, scheduled for the end of March 2022 and also in Athens, can go ahead as planned, and at the time of writing the signs are good that this will happen.

Our latest member of staff, Yunzhe He (Jack), joined us as Technical Adviser in November 2021 from China Classification Society (CCS). We thank CCS and are grateful to have Jack's services for

three years. As a result of the new appointment SIGTTO's Secretariat now has 11 members, the highest ever in the Society's history, as mentioned earlier.

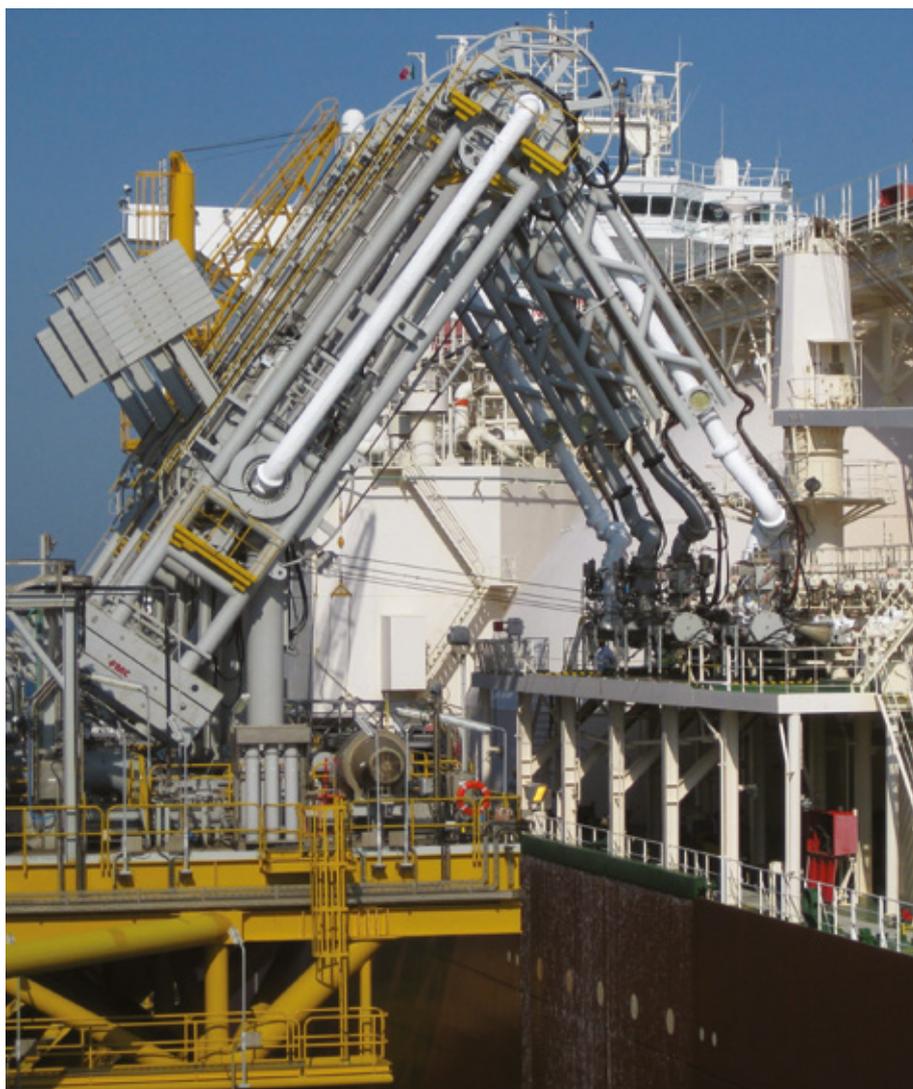
I would like to conclude with a couple of personal observations about SIGTTO's direction in the immediate future. Environmental protection has taken up a central position on the IMO radar in recent years and the shipping industry's resolution of the decarbonisation issue over the next three decades will require some dedicated, well-informed and wide-ranging work. I would only urge SIGTTO to ensure that its ever-increasing amount of work on the environment is made in addition to, and not instead of, its traditional work on safety.

Another trend is emerging, this time within the energy industry itself. The oil tanker sector has reached a mature level, with volumes of crude oil and refined products moved by sea relatively stable and likely to go into decline in the years ahead. In contrast, with gas likely to play a key role in the transition to a net zero emissions future, liquefied gas shipping is in the midst of a dramatic growth and diversification phase. The energy majors have involvements in both oil and gas and for many their gas interests are beginning to outstrip those in oil. In this changing scenario I think that in the near-to-mid-term future there will be increasing calls for SIGTTO to merge with the Oil Companies International Marine Forum (OCIMF). I believe that this would be wrong; oil and gas shipping are two very distinct and different disciplines. I hope that the SIGTTO Board and its members can resist such calls and retain the Society's autonomy as it fulfils its remit in meeting its membership's unique requirements.

I would like to reiterate my thanks to the SIGTTO President and Board of Directors for the unique opportunity to serve the Society over the last nine years. It has truly been an honour and privilege to do so. I wish SIGTTO well for the future and thank you all for your support over the years.

UPCOMING MEETINGS 2022	DATE	LOCATION
84 th General Purposes Committee	29 Mar	Athens
65 th SIGTTO Panel Meeting	30-31 Mar	Athens
Spring Board Meeting	12 May	London
13 th Human Element Committee	7 Jul	London
Gastech 2022	5-8 Sep	Milan
85 th General Purposes Committee	4 Oct	London
Board/Annual General Meetings	16 Nov	Singapore (TBC)

***A regular schedule of Regional Forums (usually 10-12 per year) will be resumed once the COVID situation at the various locations is deemed to be suitable.**



One of the aims of the LNGC Fugitive Methane Emissions working group is to provide guidance that helps standardise reporting methodology

The following paragraphs provide updates of progress being made by currently active working groups and the Environmental Sub-committee (ESC) established under the auspices of the SIGTTO General Purposes Committee (GPC).

Design and Operation of Liquefied Gas Terminals

This working group, chaired by Guy Nicholls of Cheniere, is combining two existing SIGTTO documents, *Site Selection and Design for LNG Ports and Jetties* (1997) and *LNG Operations in Port Areas – Essential Best Practices for the Industry* (2003). The single revised document will consider technical advances made and lessons learnt from incidents since the original documents were published and will introduce a risk-based approach. The working group has met five times so far and continues to develop the draft document.

Gas Carrier Propulsion Systems

This working group continues to work on an initial draft document on environmental and operational issues associated with gas carrier propulsion systems. The document deals with the International Gas Carrier (IGC) Code, the Energy Efficiency Design Index (EEDI), the Energy Efficiency Existing Ship Index (EEXI) and lessons learnt from incidents. All topics included in this draft will be used to align future revisions to the appropriate IGC Code chapters. The working group last met in February 2022 and is working to compile a first draft.

Gas Carrier Reliquefaction Systems

This working group is producing a document on the safety, environmental and operational issues associated with gas carrier reliquefaction systems. Like the Gas Carrier Propulsion Systems working group, it will cover the IGC Code, EEDI, EEXI and

incident lessons. All topics included in this draft will be used to align future revisions to the appropriate IGC Code chapters. The working group last met in February 2022 and is working to compile a first draft.

Gas Carrier Salvage

This working group, chaired by Ian Wolfarth of Chevron, continues to make good progress and initial content has been received to produce the first draft. The document will cover potential salvage situations on gas carriers, with the primary focus being on prevention and emergency preparedness.

The Selection and Testing of Valves for LNG/LPG Applications

Chaired by John Taylor of Shell, this working group is combining two existing SIGTTO documents, *The Selection and Testing of Valves for LNG Applications* (2008) and *The Selection and Testing of Valves for LPG Applications* (2012), into a single revised publication. The working group has met three times so far, most recently in January 2022, and is compiling the first draft of the document.

Guide for Planning Gas Trials for LNG Vessels

This working group, chaired by Rose Brooks of BP, is working to revise the existing SIGTTO publication *Guide for Planning Gas Trials for LNG Vessels* (2008). The updated version will take into account recent technology advances, including Type A and large Type C cargo containment system developments. The reduction of greenhouse gas (GHG) emissions from gas trials is also being considered.

The working group has completed a concept draft for comment at the 84th session of the GPC (GPC 84) on 29 March 2022 and will next meet in March 2022.

Gas Concentrations in the Insulation Spaces of Membrane Gas Carriers

This working group will revise *Gas Concentrations in the Insulation Spaces of Membrane LNG Carriers* (2007). The group will begin work shortly and the revision will recognise new reference material and environmental considerations.

Gas Carrier CO₂ Emissions

Chaired by John Taylor of Shell, this working group aims to identify all distinct processes that generate CO₂ emissions on board gas carriers and outline guidance to assist standardisation of reporting methodology.

The working group has held four meetings so far, most recently in January 2022. The working group submitted a

HUMAN ELEMENT COMMITTEE: WORKING GROUPS

concept draft to GPC 83 for comment in October 2021 and submitted a final draft to GPC 84 for approval in March 2022.

The work this working group has done will be built upon by a separate group, the Reduction of Gas Carrier CO₂ Emissions Working Group, which is set to begin shortly.

LNGC Fugitive Methane Emissions

This working group, chaired by Ajay Edakkara of Shell, aims to identify all distinct equipment and systems that could generate fugitive methane (CH₄) emissions on board LNGCs; consider best practice measurement and monitoring functions; and outline guidance to assist with the standardisation of reporting methodology.

The working group has held four meetings so far, most recently in January 2022. The working group submitted a concept draft to GPC 83 for comment in October 2021 and submitted a final draft to GPC 84 for approval in March 2022.

The work this working group has done will be built upon by a separate group, the LNGC Methane Emissions Working Group, which held its first meeting in February 2022.

Jetty Maintenance and Inspection Guide (OCIMF/SIGTTO)

This working group has been established by the Oil Companies International Marine Forum (OCIMF) to lead the revision of *Jetty Maintenance and Inspection Guide (2008)*, a document that it produced jointly with SIGTTO.

SIGTTO Principal Technical Adviser Rob Farmer is acting as liaison with this working group and is assisting in aligning it with SIGTTO publications. The working group has held six meetings so far, most recently in February 2022. SIGTTO's GPC will review and comment on the revised document prior to approval.

Environmental Sub-committee (ESC)

Chaired by John Boreman of BP, the Environmental Sub-committee (ESC) is comprised of GPC members representing BP, Cheniere, Chevron, Enagas, ExxonMobil, Maran Gas, Shell and TotalEnergies.

The Sub-committee has held five meetings so far, most recently in December 2021. Progress updates were provided on the four ESC-initiated working groups on CO₂ and fugitive methane emissions. Current work items at the IMO were also reviewed and discussed, including outcomes of the 77th Session of IMO's Marine Environment Protection Committee (MEPC 77) which took place on 22-26 November 2021. The Sub-committee will hold its next meeting in March 2022.



The revised edition of the LPG Shipping Suggested Competency Standards updates a SIGTTO document published 14 years ago

The following paragraphs provide updates of progress being made by currently active SIGTTO Human Element Committee (HEC) working groups.

LPG Shipping Suggested Competency Standards

This working group has completed the revision and updating of *LPG Shipping Suggested Competency Standards (2008)*, an earlier SIGTTO publication. The group is chaired by Steve Allibone of MOL and its revision focuses on how working practices and competencies have been affected by changes in the industry, new technologies and improvements in safety, as well as lessons learnt from past incidents. A major addition to this revision is coverage of the use of LPG as a fuel. The working group submitted a final draft to 12th meeting of the Human Element Committee (HEC 12) in January 2022 where it was approved. The document will now be submitted to SIGTTO's spring Board of Directors meeting in May 2022.

Shore Staff Competency Management System Standards

Chaired by Jo McDade of Chevron, this working group continues to gather and refine information associated with suggested best practices. The aim is to identify and define components that may be used to develop a high-hazard competence management framework for shore staff that adds to a company's human factor toolkit. This publication will align with concepts provided in SIGTTO's upcoming Human Element Guide publication. The working group submitted a framing document for comment in July 2021 and will submit a final draft to HEC 13 for approval in July 2022.

Cargo Resource Management

This working group, chaired by Steve Allibone of MOL, is developing a document on a model gas cargo resource management training course. The group held the most recent of its six meetings to date in January 2022 and submitted a concept draft of the document to HEC 12 later in the month for comment. The aim is to submit a final draft to HEC 13 for approval in July 2022.

NEW MEMBERS

Liquid Bulk joins membership

One company has joined the Society's membership since the Autumn 2021 edition of SIGTTO News was published. The new member and its date of joining the Society are shown below. The SIGTTO membership now stands at 139 full members, 50 associate members and 29 non-contributory members.

Liquid Bulk Ltd

1 Dec 2021

Headquartered at Port Harcourt in Nigeria's Rivers State, **Liquid Bulk Ltd** is adding LPG-handling facilities at its petroleum products terminal on the nearby Bonny River.

An LPG loading arm will be added to the company's existing liquids jetty while the adjacent oil tank farm will be augmented with a separate facility dedicated to LPG storage and road tanker loading bays. The new commitment to handling liquefied gases makes Liquid Bulk eligible for associate membership in SIGTTO.



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The liquefied gas sector has a good story to tell and SIGTTO is helping tell it

Profile-enhancing initiatives

Good progress has been made with SIGTTO's marketing initiatives in 2021 and early 2022 as the worst effects of COVID-19 have begun to ease and the liquefied gas shipping sector has renewed the strong growth path it was on before the pandemic hit in early 2020. Aimed at reinforcing the long-lasting relationships and engagement the Society has with its members, current marketing activities are grouped under the goals of membership expansion, including acquisition and retention, and visibility enhancement.

Twelve new members from various sectors of the liquefied gas shipping and terminal industry joined the SIGTTO family in 2021, bringing the total membership up to 218 companies and organisations. Communications with industry professionals

through the Society's social media accounts, especially LinkedIn, have doubled in volume over the period, a development which has been accompanied by growing traffic to the Society's website and total online impressions amongst all channels.

The Society is consistently invited to speak and chair sessions at various industry events and, as has been the case at past conferences in the series, the SIGTTO General Manager will be the technical co-chair of proceedings and moderate the shipping sessions at the Gastech 2022 event which takes place in Milan on 5-8 September.

In response to SIGTTO's own robust growth profile and the increased number of technical projects the Society is handling, the Secretariat published a *How we work* document in December 2021 to facilitate cooperation between the SIGTTO Secretariat, the membership

and the wider industry. The pandemic also prompted the Society to acquire the equipment and systems which enable it to host virtual Panel Meetings and live stream other internal meetings when the Wi-Fi environment permits.

The industry has changed out of all recognition since SIGTTO was formed in 1979, and the numbers of members and technical projects handled by the Society are both at their highest levels in 42 years. To ensure that the Society remains relevant and fit for purpose in meeting the evolving needs of its membership, a membership survey has been launched to enable individual members to express their views on how SIGTTO's Strategic Plan can be revised and updated and how the portfolio of industry best practice guidelines can be further enhanced going forward.

The Society is also planning to update its promotional film to reflect both the forthcoming personnel changes within the Secretariat and the activities of the new Environmental Sub-committee (ESC). All SIGTTO members are being encouraged to contribute video footage for this project, on the premise that a compilation of individual company activities and achievements will reflect beneficially on the liquefied gas shipping and terminal sector as a whole.

The opportunity for members to submit their profiles and stories about their journey with SIGTTO for inclusion on the Society's website also remains open. Please contact marketing@sigtto.org if you need further information regarding member stories, the SIGTTO promotional film or the membership survey.

PEOPLE

New Technical Adviser



Yunzhe He (Jack), a ship surveyor with China Classification Society (CCS), joined SIGTTO as Technical Adviser in November 2021. Jack will spend three

years with the Society before returning to CCS. As a result of the new appointment, the SIGTTO Secretariat in London now has 11 members.

On gaining his BSc in naval architecture from Shanghai Jiaotong University in 2012, Jack joined the Shanghai

Branch of CCS and became involved in construction survey work for container ship, bulk carrier and very large crude carrier (VLCC) newbuilding projects.

By 2014, liquefied gas carriers had become the primary focus of Jack's CCS ship survey work. Over the following six years he served as surveyor and project manager for several series of 174,000 m³ LNG carrier newbuildings constructed to CCS class, including vessels for the Yamal and Asia Pacific LNG projects and ships for Mitsui OSK Lines. More recently, Jack has become more involved with CCS survey work on ships in service, including LNG and LPG carriers.

"In my role as a class surveyor over the past 10 years, I have been engaged in various projects involving newbuilding and in-service gas

carriers," comments Jack. "Everyone involved in the design and operation of these vessels has a deep appreciation of the key role played by SIGTTO guidelines in promoting high levels of safety and best practice on board.

"China Classification Society became a new SIGTTO member in 2021, having earlier developed a strong presence in the liquefied gas industry in tandem with China's growing involvement with gas ship construction and fleet development. I am greatly honoured to be joining SIGTTO from CCS as a Technical Adviser and look forward to utilising my knowledge and experience in my new role. It will be a privilege to be contributing to the development of the industry best practice guidance upon which liquefied gas shipping's excellent safety record is built."



Sailing through the Suez Canal on the LPG carrier Hampshire in 1982 as a 20-year old cadet

A man of the sea reflects

On the eve of his departure from the Society to take up a new challenge, *SIGTTO News* took the opportunity to ask Andrew Clifton about his early career and the principal takeaways from his unprecedented nine-year tenure as General Manager.

Q. What made you decide on a seagoing career and how did your long-term commitment to the liquefied gas shipping industry come about?

Like most people's career paths, mine evolved more due to luck and circumstance than any adherence to an early masterplan. With hindsight, I should have stayed at school for A levels and then gone on to university. Instead, I made a somewhat reckless decision to leave school at 16 with just five GCSEs. I had no family or friends who had been to sea but, without knowing exactly why at that tender age, there was something that attracted me about joining the UK Merchant Navy. I was also considering the Royal Navy but the Merchant Navy offered me a job first. Within a few weeks I was on the induction course and then flying out to Los Angeles on my own to join my first ship at 17! It just so happened that the company I did my cadetship with, Bibby Line of Liverpool, was one of the few operators of LPG vessels at the time. Bibby then slowly sold most of their non-LPG ships and I ended up specialising in LPG by default!

Q. How formative were those seagoing days for you?

I joined the Merchant Navy in October

1979 (coincidentally the same month and year that SIGTTO was formed!) and left in September 1998. Early on, when I was a cadet and junior officer, seagoing life was much different to that facing today's newcomers. Ship complements were large, trips were long, leaves were short and there were no rigorous safety management systems and computerised checklists to concern us. Communications with the office were far from instant and on British ships, like most others, there were no alcohol restrictions. The onboard social culture was well established and included the likes of boat races, yards of ale, sea shanties, bar rugby and one ship even had a pyramid of 'full moons' - if you know, you know!

Life aboard ship started to change in the mid-1980s as cost-cutting measures such as flagging out and the introduction of crews of reduced size and mixed nationalities, usually supplied by manning agencies, were implemented. These were followed in the 1990s by the International Safety Management (ISM) Code and Ship Inspection Reports (SIRE) regime.

In these changing circumstances I realised promotion prospects could be enhanced by specialising on a particular type of ship, and I chose to stay on gas carriers. Taking note of some valuable tips and tuition from other senior officers, I became a chief officer with a Class 2 ticket at 26 and a master at 33. My first ever cargo discharge as master was a ship-to-ship (STS) transfer at sea off Hong Kong whilst underway; it was something I'd never done before and for which I'd never received any training! The discharge went reasonably well and I recall the only damage was a bent light fitting! I served at sea with three companies involved in gas shipping - Bibby Line, George Gibson and Dorchester Maritime. I met Chris Clucas for the first time when I was with the latter outfit. Little did I know then the extent to which our paths would cross over the years and that I would be handing over the SIGTTO General Manager role to him more than three decades later.

Q. Why did you decide to leave the sea and work ashore?

When I became master, I had the choice of either staying at sea for another 30 odd years at that same rank or coming ashore and putting my experience to work there. I used to play cricket for the Southampton Master Mariners Club and a couple of well-respected college lecturers there, Ian Bagshaw and Jerry Stanford, gave me some good advice. They said that when coming ashore it would be wise to get a degree first rather than going straight into a desk job. At that time, there were few in the UK below the age of 40 who had both deepsea

command experience and a degree.

Taking Ian and Jerry up on their advice, I left my last ship as master on the Friday in Japan and started as a student the next Monday at Southampton Institute (now Southampton Solent University). While I knew that most of the students would be younger than me, I hadn't considered that several of the lecturers would also be!

I graduated with a first class honours degree in Shipping Operations in 2000 and joined the UK's Marine Accident Investigation Branch (MAIB) as a nautical inspector. Although I investigated a couple of gas vessel incidents while there, my three years at MAIB were the only part of my career spent outside of the gas industry. When an opportunity to join Golar LNG at their head office subsequently arose, I chose to return to the gas shipping sector.

Q. After getting involved with the gas shipping industry ashore, how did you first come into contact with SIGTTO and its work?

I first became aware of SIGTTO in the 1980s, whilst still at sea, through various publications, including Liquefied Gas Handling Principles. Having read the Society's guidance on gas carrier ship/shore links as a chief officer, the information proved most useful when we installed the first-ever ship/shore link (a pendant).

During my time as marine superintendent with Golar LNG, the opportunity of being seconded to SIGTTO as Technical Adviser came up. I will be forever grateful to those at Golar and to James MacHardy, the SIGTTO General Manager at the time, for facilitating this, as it turned out to be a



A year later, in 1983, Andrew sailed on his first voyage as a third officer on the LPG carrier Wiltshire

major influence on my future career path.

Incidentally, the Technical Adviser I took over from at SIGTTO was Chris Snape from Shell. I was a cadet with Chris over 40 years ago at Fleetwood Nautical College and we have kept in touch ever since, Chris is a smart lad who is a long-term supporter of SIGTTO and, in addition, is very good at managing the work/life balance!

Following my time as Technical Adviser, I moved to BP Shipping, first in London and then on to Indonesia as LNG shipping manager for the Tangguh LNG project. I spent over five years in Indonesia where I met my future wife, who herself now has 17 years LNG experience! During my BP days I chaired SIGTTO Panel Meetings for four years, thus maintaining a good connection with the Society. As my time in Indonesia was drawing to a close, Bill Wayne had announced he would be stepping down at the end of 2012 so I, along with 90 others, applied for the soon-to-be-vacant General Manager post. I successfully completed three interviews and the psychometric testing process and commenced in my new role in October 2012.

Q. What do you think are the particular strengths of SIGTTO? Are there any characteristics that set SIGTTO apart from other NGOs?

The liquefied gas industry has built up an excellent safety record over many years, due not least to the soundness of the provisions of the International Gas Carrier (IGC) Code, the main body of regulations governing this shipping sector. The IGC Code is one of the few sets of regulations developed by IMO which were not written as a result of a major incident. The Safety of Life at Sea (SOLAS) Convention came about as a result of the *Titanic* disaster while the groundings of the oil tankers *Torrey Canyon* and, later, *Exxon Valdez* did much to shape the provisions of the Marine Pollution (MARPOL) Convention. And major accidents involving the ro-ro passenger ferries *Scandinavian Star*, *Herald of Free Enterprise* and *Estonia* in the 1980s and 1990s prompted a series of SOLAS amendments, including the introduction of the International Safety Management (ISM) Code, to ensure that disasters of this type did not happen again.

The initial requirements of the IGC Code were based on the design and construction experience of the pioneering gas ship owners, operators, class societies and naval architects, along with some extra safety margins added in, back in the 1960s and 1970s. As an industry, we cannot thank the key prime movers behind these pioneering companies, people like Bob Lakey and Roger Ffooks, enough. The IGC Code-backed safety regime has continued to be refined ever since to reflect experience gained and the emergence of more



Andrew made his first trip as master in 1995

sophisticated risk assessment technologies.

SIGTTO has played a key role in the maintenance of gas shipping's exemplary safety record by sharing lessons learnt, encouraging open dialogue amongst its members and issuing regular industry best practice guidance and recommendations to ensure that the industry operates at a level above the minimum required. Other parts of shipping take note! The Society's Secretariat and membership also played a key role in completing the latest revision of the IGC Code. A major update, it represented the first time IMO had entrusted the revision of a major instrument to a non-governmental organisation (NGO).

Q. What has been the biggest challenge, both for yourself and SIGTTO, during your tenure as General Manager?

I think dragging the Society kicking and screaming into the 21st century! When I started as General Manager some communications, including bank transfers, were still being conducted by fax. The old office premises in the City of London were inadequate, dark and dusty with no desk space for additional staff and not capable of meeting the requirements of our growing membership. Another major challenge for me during my first year was the request by the SIGTTO Board to establish a brand new NGO, the Society for Gas as a Marine Fuel (SGMF), from scratch! This kept me busy for a full year, throughout the time I was familiarising myself with, and carrying out, the duties of my General Manager role. I'm pleased to say that SGMF was up and running and had members within four months of the decision to proceed with this new NGO.

Q. Which of your achievements as SIGTTO General Manager are you proudest of?

Many stand out - our move to a new office, forming SGMF, producing multiple publications and guidance, establishing SIGTTO's first-ever Strategic Plan, the 50 years of LNG and 40 years of SIGTTO

celebrations and forming the Human Element Committee (HEC) and Environmental Sub-committee (ESC). However, I think, most of all, I will look back on what I am leaving compared to when I joined.

Q. What is the most valuable lesson that you've learned during your time as SIGTTO General Manager?

With society and industry moving so quickly, especially with respect to topics like decarbonisation, we need to be very proactive. It's a bit like playing chess or tennis; because the next move is pretty much decided for you, you always need to be looking at least two moves ahead.

Q. In what ways do you think working closely with your SIGTTO colleagues and the membership has improved your own skill sets?

The interaction has been invaluable. Watching colleagues grow and develop in new roles has been very fulfilling. Dealing with the membership can sometimes be challenging as they, in effect, pay the wages and usually each case is different. On occasions, for example, member companies have to be delicately told that what they are requesting is outside of our remit or not possible. But, on the whole, the membership has always been very supportive and proactive.

Q. Looking on the lighter side, can you share with us a memory of a particularly amusing moment during your time as General Manager?

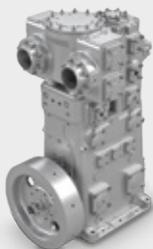
I went shooting once at an indoor range with Dave Ervin following a Regional Forum meeting in Houston. As we were leaving, the manager said "Hope you enjoyed it guys. By the way you're not flying anytime soon, are you?" I told him I was flying to China first thing in the morning. The manager then pointed out that my clothes and shoes were now covered in gunshot residue which would be detected at the airport! As mass panic set in, I went straight into the shower when I returned to the hotel and double-bagged my clothes and shoes in the suitcase!

Q. When the working day is done and when holiday time comes around, what hobbies do you turn to for relaxation?

As many of you know, I am a big cricket fan and, until recently, I had a debenture seat at the Oval. I have been to over a hundred test matches, including several in Australia. In addition, my wife and I made a 'COVID resolution' during the first lockdown to do something completely different together that neither of us had done before and would, hopefully, become a new shared interest. So we bought a tent and all the gear and went camping for a total of 28 nights in different parts of the UK during the summer of 2021. It

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was, to be honest, a bit more like 'glamping', as we had a large luxury tent, Jackery power bank, cool box, chemical toilet and a very comfortable double camp bed! We have now put a deposit down on a caravan!

Q. Building on those early prime mentors, are there any people that have provided a key inspiration to you later in your life and career?

First of all would be my father. He worked for the Atomic Energy Authority in the early days of the UK's nuclear industry and was amongst the team who, along with the pioneering North Sea offshore industry, first developed the 'safety case' in the 1950s and early 1960s. We now know this discipline as risk assessment.

On the maritime front, following on from those inspirational chief officers and masters that I was at sea with, Chris Clucas came along! Then, James MacHardy, who was General Manager at SIGTTO when I became a Technical Adviser, told me to target coming back as General Manager in 15 years. I managed it in seven!

During my tenure as SIGTTO General Manager, I have been inspired by industry veterans like Richard Gilmore, Ray Gillett, Samir Bailouni and Ed Carr. The current SIGTTO President, Steffen Jacobsen, was President when I started as General Manager. Following a short hiatus doing other things, Steffen is now back, by coincidence as I'm finishing. He has been very supportive throughout.

Q. To what extent do you think the work of SIGTTO has contributed to the exemplary safety record established by liquefied gas shipping over the last 60 years? What are the key challenges lying ahead that SIGTTO will need to keep in focus and take an industry lead on?

Without doubt SIGTTO has been a key contributor to the liquefied gas industry's remarkable safety record, not least by bringing virtually our entire industry together to share lessons, drawing up recommendations and guidelines and then ensuring that industry operates to standards above and beyond the minimum. By being proactive and addressing issues before incidents occur adds to our credentials.

Going forward, the biggest challenge will be dealing with the ever-increasing environmental workload that the issue of decarbonisation encompasses. I would argue that the development of environmental protection measures needs to be done in tandem with, not instead of, work on safety. The "green" demands of society and politics are currently moving at a pace faster than the IMO and technology can accommodate, and this is not a healthy situation. This means energy is likely to be far more expensive and less available than we have been used

to in the past. Wise heads, from a number of different disciplines, need to prevail.

I also feel, as mentioned in my General Manager's Message at the beginning of this newsletter, that the current whispers about the merger of SIGTTO and the Oil Companies International Marine Forum (OCIMF) will become louder and louder, with the current relative stagnation of the oil tanker sector and, with it, OCIMF. Gas carrier shipping is a distinct and different discipline from oil tanker shipping and I hope that the SIGTTO Board and membership can resist the call for the merging of the two organisations and retain the Society in its own right, with its unique membership and remit.

Q. What abiding memory of your time with SIGTTO will you take with you?

My memory banks from the last nine years are so full but if I had to zero in on one particular aspect it would have to be meetings and events. The 50 years of LNG celebrations in Livorno in 2014 and the commemoration of SIGTTO's first 40 years in London in 2019 were very memorable. Another very special event was the Witherbys-hosted General Purposes Committee (GPC) dinner onboard the royal yacht *Britannia* in Leith just outside Edinburgh, complete

with bagpipers on the quay.

The venues of several SIGTTO Board meetings, along with the accompanying proceedings, have also been notable, not least at the top of a mountain in Oslo by a ski jump, in Bermuda in 2012, the UK House of Commons visit and dinner in 2013, Boston 2016 and the river Seine dinner cruise in Paris. Finally, I have been to over 50 SIGTTO Regional Forums as General Manager and, amongst these, the amazingly well-attended South American ones in Buenos Aires, superbly hosted by Marta and her team at YPF, will live long in the memory.

Thank you SIGTTO for all the memories and I wish you well in the future!



Andrew is welcomed aboard as SIGTTO General Manager in 2012 by the Society's then President Steffen Jacobsen

Chris Clucas takes on transition role



SIGTTO has appointed Chris Clucas as Interim General Manager. He is expected to serve in this role for 4-6 months, until a permanent replacement for

Andrew Clifton can be recruited.

"The Society is pleased to welcome Chris as a very experienced pair of hands to coordinate the transitional period until we find the right permanent candidate to serve as our next General Manager," states SIGTTO President Steffen Jacobsen. "Chris has not only enjoyed a long and distinguished career in liquefied gas shipping but also chaired many a SIGTTO meeting over the years."

"I am honoured to be taking over the helm at SIGTTO during these very interesting times of change," replies Chris Clucas.

"The key will be to ensure that the Society responds to this fast-developing landscape, and continues the excellent support for its members in the journey ahead - while never losing sight of our excellent safety record."

Currently principal at Liquefied Gas Consultancy Ltd, Chris holds degrees in chemistry (BSc) and cryogenics (MSc). He began his career at the International Chamber of Shipping (ICS), working there

between 1973 and 1978 on the original International Gas Carrier (IGC) Code and the gas training syllabus of the Standards of Training Certification and Watchkeeping (STCW) Convention. Chris also compiled the ICS Tanker Safety Guide (Liquefied Gas).

After achieving his cryogenics degree, Chris Clucas worked with British Gas on LNG plant design before joining Kosan Tankers, first as superintendent and then with the company's Isle of Man LPG operation.

In 1990 Chris returned to shipping with Dorchester Maritime, taking on responsibility for cargo system design, newbuildings, upgrades and operations for the company's owned and managed fleets of LPG, LNG and liquefied ethylene gas (LEG) gas carriers. He was appointed to the Dorchester board in 2008.

Chris has run LGC Ltd since 2018, providing training courses for ship and shore gas staff, 'expert witness' advice and design and operational consultancy services.

In 2013 he was elected founder president of the Society for Gas as a Marine Fuel (SGMF) and is that body's current secretary. He is the immediate past chair of SIGTTO's General Purposes Committee (GPC) as well past chair of the Society's Panel Meetings. Chris Clucas has also resumed his role as co-chair of the Gastech conference, taking over from Andrew Clifton in that position, and remains a member of the Gastech governing body.

FROM THE ARCHIVES



A model of Bridgestone Maru on display at the Nagasaki yard of Mitsubishi Heavy Industries

Diamond jubilee for fully refrigerated LPG carriers

Sixty years ago, on 31 January 1962, the 28,837 m³ *Bridgestone Maru*, the world's first purpose-built, fully refrigerated LPG carrier (FRLPGC), was delivered by Japan's Mitsubishi Heavy Industries (MHI). The ship's design proved eminently suitable for moving large quantities of LPG on deepsea routes and gave rise to a growing fleet of fully refrigerated vessels. Today's very large gas carriers (VLGCs), i.e. FRLPGCs of over 70,000 m³, or three times the size of *Bridgestone Maru*, are direct descendants, having been built to designs not markedly different from that utilised on this pioneering vessel. VLGCs are currently one of the most dynamic growth sectors in shipping.

Bridgestone Maru was built for the Bridgestone LPG Company Ltd, a joint venture established by Japan's Bridgestone Tire Co Ltd and Phillips Petroleum of the US to investigate the import of refrigerated LPG into the country from the Middle East. The seaborne transport of LPG would help meet the growing demand for the product as a household fuel in Japan and reduce the flaring of gas associated with the Middle East's burgeoning crude oil production.

In May 1959 Bridgestone concluded a technical assistance agreement with Conch International Methane, a company then working on the design of ships able to transport LNG to meet the UK's growing need for clean energy. Bridgestone followed its Conch contract with a BP deal involving the transport of Kuwait propane and butane to an LPG import terminal it had constructed at Kawasaki. *Bridgestone Maru* was jointly owned by Bridgestone and NYK Line and NYK was responsible for the ship's operation.

Conch nominated JJ Henry, a New York naval architect firm with which it was working on LNGC construction, to cooperate with MHI on the development of the *Bridgestone Maru* design. Bearing in mind that the first international gas carrier design and construction code would not be developed and implemented for another 14 years, the *Bridgestone Maru* design partners erred on the side of caution. The ship's four independent prismatic cargo tanks were constructed of 3.5 per cent nickel steel while the inner hull, effectively the secondary cargo containment barrier, utilised 2.25 per cent nickel steel. The cargo tanks were separated by transverse cofferdams and the double bottom and double wing tanks were utilised for water ballast. *Bridgestone Maru* served successfully on the Middle East/Japan route for 25 years and was sent for recycling in 1987.

Despite some experimentation with different designs for FRLPGCs in Europe later in the 1960s, including trunk arrangements above the main deck, the design of modern VLGCs are not markedly different from that of *Bridgestone Maru*. By the late 1960s naval architects realised that FRLPGCs with a flush deck, longitudinally framed sloping upper and lower wing ballast tanks at the sides and a transversely framed hull constituting the secondary cargo containment barrier offered the best way forward, and today's VLGCs conform to this arrangement.

The prismatic shape of the tanks in FRLPGCs enable the cargo-carrying space on the ship to be optimised. Tanks on FRLPGCs are able to accommodate a minimum design cargo temperature of -48°C, a little lower than the boiling point of propane, and a maximum design pressure 0.25 kg/cm² greater than atmospheric pressure. The introduction of the *Code for the Construction and Equipment of Ships Carrying Liquefied Gases* for new ships in 1976 necessitated

only minor changes to the design parameters of FRLPGCs already in service.

The average size of the early FRLPGCs quickly increased in order to take advantage of the economies of scale, MHI delivering the first 50,000 m³ vessel in 1967 and Kawasaki Heavy Industries the inaugural 70,000 m³ ship in 1969. Although three 100,000 m³ FRLPGCs were built in the 1970s, the majority of vessels of this type constructed since then have been in the 75-85,000 m³ size range. Built to carry the 40-45,000-tonne deepsea cargoes that LPG sellers were geared up to providing and buyers were geared up to accommodating, these ships constitute the core of today's VLGC fleet.

For many years the Middle East Gulf was the principal LPG export zone and Japan the leading importer. Since the start of the millennium, however, the deepsea trade in LPG has been subject to some notable changes. Over the past two decades export volumes from the Middle East have grown relatively slowly, with new output from Qatar more than compensating for dwindling shipments from Saudi Arabia, as that nation has sought to utilise more of its gas resources in the production of downstream derivatives.

More recently, over the past decade, the US has rapidly emerged as the leading exporter of LPG, on the back of its shale gas boom. The top of the LPG buyers league table has also changed, with China and India rising to the fore as the two leading importers. The growing use of LPG as a petrochemical feedstock, particularly in China, and as a fuel and in the household, transport and agricultural sectors, as evidenced in India, has underpinned a major expansion of that sector of the LPG trade served by VLGCs in recent years.

Although the US did not begin to export LPG in any sizeable quantities until 2012, by 2015 the country's overseas shipments had reached the 20 million tonnes per annum (mta) level, a volume that has continued to climb robustly since then. Predictions published late in 2021, after statistics for first three quarters of the year had been logged, stated that US LPG seaborne exports for 2021 would reach 52.2 million tonnes (mt), well above the year's export figure of 36.5 mt for the Middle East as a whole. The leading LPG import nations in 2021 were China with 24.5 mt, a 24.6 per cent year-on-year climb, and India with 17 mt, a 19 per cent rise. Worldwide seaborne movements of LPG reached 109.9 mt in 2021, more than double the 2005 level of 50.4 mt.

As of late 2007 the world VLGC fleet numbered only 106 ships but the orderbook stood at a healthy 58 vessels, on the promise of rising LPG output from Qatar and several West African nations. By mid-2016, with US output having reached the 20 mta level and rising, the VLGC fleet numbered 221 ships and the still-healthy orderbook

stood at 59 ships. As of 31 December 2021, following the commissioning of 20 such vessels during the year, the VLGC fleet stood at 323 ships, while there were 69 gas carriers of this type on order.

The cargo-carrying capacities of the latest VLGCs to be contracted have been inching up, into the low 90,000 m³ range in some cases. Another innovation is the introduction of a cargo segregation system that enables a new generation of VLGCs to simultaneously carry LPG and ammonia cargoes.

However, the most notable recent design



Vessels powered by LPG, both retrofits and newbuildings, are a growing part of today's VLGC fleet

change for these vessels has been the use of dual-fuel engines able to burn LPG. BW LPG, for example, has carried out retrofit projects on 15 of the VLGCs in its fleet to enable their engines to also burn LPG. When the conversion work on the first of these vessels, the 84,000 m³ *BW Gemini*, was completed in December 2020, the vessel became the world's first dual-fuel LPG carrier. The first purpose-built, dual-fuel VLGC newbuilding to enter service was Exmar's 88,000 m³ *Flanders Harmony*, in July 2021, and the majority of FRLPGC newbuilding orders that owners have placed over the past year have been specified with dual-fuel engines to enable them to realise the environmental and economic benefits that can accrue.

LPG, like LNG, has been recognised as a bridging option in the drive towards the goal of net-zero carbon fuels, to the extent that it is a virtually a de facto propulsion system solution for new orders for FRLPGCs. The LPG dual-fuel option is also now being specified for smaller LPG carriers with pressure tanks and, in addition, its use is being promoted for other ship types that are not LPG carriers.

Note: "Fully Refrigerated LPG Carriers" by Syd Harris and published by Witherbys in 2004 was a helpful source of information on the *Bridgestone Maru* design.

NEW PUBLICATIONS

Information Papers (2022)

The Society's latest publication is an updated compendium of SIGTTO *Information Papers*. Compiled for the guidance of industry members, *Information Papers (2022)* contains all the SIGTTO Information Papers that are in force for 2022. The new edition, which replaces the SIGTTO *Consolidated Information Papers (2019)*, includes the following new publications from the Society:

- *ESD Systems - Recommendations for Emergency Shutdown and Related Safety Systems, Second Edition*
- *Guidance on Gas Carrier and Terminal Gangway Interface*
- *Recommendations for Management of Cargo Alarm Systems*
- *Recommendations for Designing Cargo Control Rooms*
- *Recommendations for Cargo Control Room HMI.*

ESD Systems updates the previous edition, *ESD Arrangements & Linked Ship/Shore Systems for Liquefied Gas Carriers (2009)*.



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Amongst LNG carriers, older ships powered by steam turbines face the stiffest challenges in complying with the tightening IMO regime governing the reduction of greenhouse gas emissions

Revised IGC Code under review

The following paragraphs detail the most recent decisions impacting gas carriers taken by the International Maritime Organization's (IMO) two principal committees, i.e. the Marine Environment Protection Committee (MEPC) and the Maritime Safety Committee (MSC).

Marine Environment Protection Committee (MEPC)

IMO's Marine Environment Protection Committee met for its 77th Session (MEPC 77) in November 2021. The primary focus at the meeting was on the IMO's greenhouse gas (GHG) strategy and mid-term GHG reduction measures.

IMO GHG strategy

MEPC 77 considered a proposal for a resolution revising the GHG target to a 50 per cent reduction by 2050. While the proposal did not find consensus, the Committee did agree to initiate the strategy review anticipated by the original strategy resolution. Following discussions at the MEPC 76 in June 2021, and the support expressed by many delegations, the "50 per cent by 2050" target is likely to be a core tenet of these GHG strategy discussions at future sessions.

Short-term GHG reduction measures

Building on the success of the earlier Energy Efficiency Design Index (EEDI) and Ship Energy Efficiency Management Plan (SEEMP) initiatives, delegates attending MEPC 76 in June 2021 adopted the Energy Efficiency Existing Ship Index (EEXI) and Carbon Intensity Indicator (CII).

Work continues in a correspondence group (CG) on guidelines for the

implementation of CII, including potential correction factors, and a new Part III to the SEEMP on the Ship Operational Carbon Intensity Plan. The CG will report to MEPC 78, in June this year, where the guidelines on short-term reduction measures will need to be finalised ready for implementation in 2023.

Mid- and long-term GHG reduction measures

IMO's work plan for the development of mid- and long- term GHG reduction measures consists of the following three phases:

- Phase I – Collation and initial consideration of proposals for measures
- Phase II – Assessment and selection of measures(s) to further develop
- Phase III – Development of (a) measure(s) to be finalised within (an) agreed target date(s).

The aim is to complete Phase I by spring 2022 and Phase II by spring 2023. The time to complete the development of a selected measure is not specified and would depend on the complexity and type of measure.

Also discussed at MEPC 77 were proposals, including market-based measures, in line with Phase I of the work plan "collation of proposals". No concrete decisions were taken at this time – Phase II of the plan will assess proposals next year.

Energy Efficiency Design Index (EEDI)

Also approved at MEPC 77 was MEPC.1/Circular 896 2021 *Guidance on Treatment of Innovative Energy Efficiency Technologies for Calculation and Verification of the Attained EEDI and EEXI*. The circular provides updated guidance on the application of innovative energy efficiency technologies, including air lubrication systems; wind-assisted propulsion systems; waste heat recovery systems for the generation of electricity; and

photovoltaic power generation systems. This new circular replaces MEPC.1/Circular 815.

Protecting the Arctic from black carbon emissions from ships

Noting the IMO's ongoing work to establish appropriate control measures to reduce the impact on the Arctic of black carbon emissions from international shipping, MEPC 77 adopted Resolution MEPC.342(77) which recognises that black carbon is a short-lived contributor to climate warming, and that a switch to distillate fuel reduces an engine's black carbon emissions. The Resolution urges IMO member states and ship operators to voluntarily use distillate or other cleaner alternative fuels or methods of propulsion that are safe for ships and could contribute to the reduction of black carbon emissions from ships when operating in or near the Arctic.

Maritime Safety Committee (MSC)

Discussions on gas carrier design, construction and equipment matters at the most recent session of IMO's Maritime Safety Committee, MSC 104 in October 2021, were limited to the adoption of a small amendment to the International Gas Carrier (IGC) Code on watertight doors (paragraph 2.7.1.1).

However, gas carriers will come much more into focus for MSC and its sub-committees in 2022. For a start, the revision of *Guidelines for the approval of fixed dry chemical powder fire-extinguishing systems for the protection of ships carrying liquefied gases in bulk (MSC.1/Circ.1315)* will be further considered at the 8th Session of the Sub-committee on Ship Systems and Equipment (SSE 8) in March 2022.

Proposed by SIGTTO, the Marshall Islands and the International Association of Classification Societies (IACS), the *Review of the IGC Code* was adopted as a new Committee agenda item at MSC 103 in May 2021. The possibility of revising and updating the Code will first be considered at the 8th Session of the Sub-committee on Carriage of Cargoes and Containers (CCC 8) in September 2022. Deliberations are scheduled to take two sessions, i.e. CCC 8 and CCC 9, but may be extended. It is anticipated there will be a correspondence group between sessions to progress the work.

The aim of the IGC Code review is to clarify areas of ambiguity while maintaining the levels of safety and integrity inherent in the IGC Code. Areas that are the subject of Unified Interpretations (UIs) and issues that have been raised at IMO but not resolved will no doubt be considered. In addition, given that the scope of the

review is unlimited, SIGTTO anticipates numerous other submissions on possible Code revisions in the months ahead.

Another new agenda item, *Revision of the Revised recommendations for entering enclosed spaces aboard ships (Resolution A.1050(27))*, will also be considered at CCC 8 in September 2022.

Exceptional bravery nominations

IMO's Secretary-General is inviting nominations for candidates for the 2022 IMO Award for Exceptional Bravery at Sea through 15 April 2022. All nominations should be submitted to ero@imo.org and/or addressed to the Secretary-General, International Maritime Organization, 4 Albert Embankment, London SE1 7SR, UK.

Nominees will be judged on the basis of actions performed between 1 March 2021 and 28 February 2022. Those proposing candidates will be asked to complete a questionnaire to provide an Assessment Panel and a Panel of Judges with sufficient information to decide on the merit of a nomination.



Spreading the good word

"Students on our BSc Energy Management course had the privilege of hearing a brilliant guest talk from SIGTTO's General Manager Andrew Clifton on 8 February 2022," states Ann-Marie Laffey, head of the Energy Management curriculum at CU London. "We were brought right up to date on the dynamic nature of today's gas carrier industry and the great work being done by SIGTTO in the field of gas ship safety. Entitled *Gas Shipping in the 21st Century*, Andrew's presentation certainly piqued our students' interest and stirred wide-ranging feedback." Part of the Coventry University Group, the CU London campus is in North Greenwich.

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MEMBER PROFILE

CCS makes great gas ship progress

Founded in 1956 and headquartered in Beijing, China Classification Society (CCS) is a member of the International Association of Classification Societies (IACS). The Society now has more than 120 offices and 5,000 employees across the globe as well as over 30,000 merchant vessels on its register.

Thanks to the continuing surge of China's demand for LNG imports and the rapid development of the Chinese shipbuilding industry, CCS has quickly developed its capabilities as an efficient and specialised service provider for gas carriers. The Society entered the field of large LNG carrier construction in 2003 and in 2008 the first such CCS-classed vessel, the 147,000 m³ *Dapeng Sun*, was completed.

CCS has now classed 115 gas carriers, including 26 large LNG carriers, and this overall fleet is expanding at a brisk pace. As part of its commitment to the LNGC field, CCS has developed a comprehensive set of rules which covers a full range of containment systems, including membrane tanks and independent tanks of the IMO A, B and C types.

Over the past two decades CCS has, in tandem with the development of its expertise and service capabilities, established and maintained good cooperation with a number of major energy companies, shipowners and operators worldwide active in the LNG sector, including COSCO Shipping, CNOOC, CNPC, CMES, BP, MOL and Teekay.

As an integral part of its gas carrier rule development work, and in parallel with China's steadily increasing LNG import volumes, CCS has also been broadening its involvement with gas ships beyond large LNGCs. When completed in 2015, the CCS-classed 31,043 m³ *Hai Yang Shi You 301* became the largest LNGC with Type C cargo tanks yet built. Propelled by dual-fuel diesel-electric (DFDE) engines, the ship was awarded the Society's Green Ship Notation on delivery.

The current orderbook of CCS-classed ships further illustrates the Society's expanding gas carrier project portfolio. The newbuildings under construction include a fourth-generation 79,960 m³ vessel which is the world's largest shallow water, river-sea LNG carrier; the fifth-generation large LNGCs being built by the Hudong-Zhonghua shipyard, known as the *Chang Heng* series; and a 99,000 m³ gas ship which will be the biggest very large ethane carrier (VLEC) in the world on delivery.

To date CCS has granted Approvals in Principle (AIP) to 24 membrane tank designs, including those for a 147,000



A CCS surveyor verifies the integrity of an LNG carrier newbuilding's GTT NO 96 membrane containment system

m³ VLEC, a 175,000 m³ Arc7 icebreaking LNG carrier and a 12,000-18,600 m³ ballast-free LNG bunkering vessel. The AIPs cover a range of GTT containment systems, including the new NO 96 Super+ and Mark III Flex membrane designs.

In 2010 CCS extended its liquefied gas commitment to encompass research and development work on the use of LNG as marine fuel. The Society's engineers and naval architects have been focussing on not only LNG bunker vessels (LNGBVs) but also ships other than gas carriers fuelled by liquefied gases. Amongst its work, CCS took the lead in developing ISO 21593. Entitled *Ships and marine technology – Technical requirements for dry-disconnect/connect couplings for bunkering liquefied natural gas*, this international standard was published in July 2019.

Based on over 40 sets of internally developed rules, guidelines and research papers relating to LNG, CCS provides a broad range of technical services for LNG bunkering to ensure the safety of using LNG as marine fuel. These services cover the approval of LNGBV ship types and LNG bunkering systems as well as the compatibility and risk assessment of ship-to-ship (STS) LNG bunkering arrangements. In a notable development in this sector, the 20,000 m³, Type C tank *Hai Gang Wei Lai*, the world's largest LNGBV, has recently joined CCS class.

"As a new SIGTTO member, CCS participated in two virtual meetings of the organisation in 2021 and looks forward to engaging in many more of the organisation's activities going forward," states Mr Fan Qiang, CCS vice president. "CCS is well aware of the significant role played by SIGTTO in the liquefied gas industry's achievement of

such an exemplary safety record. It is only through exchanging technical knowledge and sharing experiences and best practices that industry members can maintain this safety record and tackle the greenhouse gas emissions challenge efficiently, and CCS looks forward to being part of this process through its SIGTTO membership."

In addition to its affiliation with SIGTTO, CCS is also a member of the Society for Gas as a Marine Fuel (SGMF) and has been a proactive participant in the work of SGMF's committees and working groups.

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