TMC (MARINE CONSULTANTS) LTD

Standon House, 21 Mansell Street, London E1 8AA
Telephone: +44 (0)20 7237 2617
info@tmcmarine.com • www.tmcmarine.com

NAVAL ARCHITECTURE • MARINE OPERATIONS • ENGINEERING • OFFSHORE

Date: 28 May 2015

LONDON CITY CRUISE PORT

Statement on Cruise Ship Operational Environmental Issues

TABLE OF CONTENTS

1 INTRODUCTION

1.1 This initial statement has been prepared by TMC (Marine Consultants) Ltd., (TMC). The purpose of the statement is to comment on certain operational environmental issues that have been raised in relation to the proposed London City Cruise port at Enderby Wharf.

1.2 Specific concerns have been raised regarding the following possible areas of environmental impact and these are discussed separately in the report:

- Possible Noise Pollution
- Air Quality and Emissions
- Shore Power and Connections

1.3 TMC is a London based international consultancy, with 35 years of experience, which provides expert advice on a wide range of marine issues, including attendance at a casualty, technical investigation and support during court and arbitration proceedings, consultancy, surveys and audits. TMC acts on behalf of Owners/P&I, Hull and Machinery Underwriters, Charterers, Cargo Interests, Salvage companies, employing Master Mariners, Marine Chief Engineers and Naval Architects. TMC has also acted for the Governments of the United Kingdom, Bahamas and Malta during courts of inquiry and technical investigations. We have also supplied advice to companies on regulatory compliance.

1.4 The author of this report has considerable cruise ship experience. I started my seagoing career in 1974 with the Peninsular and Oriental Steam Navigation Company, spending my entire seagoing career on cruise ships and qualifying as a Master Mariner.

In 1992 I took a shore position with P&O Cruises and promotion led to a number of increasingly senior roles, all relating to marine operations, safety, security and environmental management of cruise ships. My final position was Head of Marine Services for Carnival UK, operating a fleet of ten large cruise ships. I held a corporate position for a number of years which included responsibility for safety and environmental standards across the group. During this period all the ships operated under an environmental compliance plan until 2008 when we successfully introduced ISO 14001, the international environmental standard. This required the ships to operate to a higher standard than just compliance with MARPOL. In 2009 I was responsible for production of Carnival UK's first sustainability report which included reporting on all types of emissions from cruise ships.

In 2011 I joined TMC (Marine Consultants) Ltd. TMC is a worldwide marine consultancy with offices in the UK, Singapore, Shanghai, Australia and the USA. Over the last three years I have had a leading role in dealing with a shipping casualty in the Bay of Plenty in New Zealand where environmental concerns in this sensitive area have been the main driver in dealing with the ship, its cargo and contents.

In addition to the above I have been a representative of the following external bodies:

- International Maritime Organisation - Delegate both at the Maritime Safety Committee and the Marine Environmental Protection Committee.
- United Kingdom Chamber of Shipping – Chair of the Environmental Committee and Main Board Director.
- European Cruise Council – Main Board member specialising in EU legislation on emissions.
- United Kingdom Passenger Shipping Association – Chair of the Safety, Security, Health, Environmental and Welfare Committee.
- Tourism 2023 – A joint government/ industry initiative investigating sustainable tourism
- Nautical Institute – Council member.

1.4 This report has also used the expertise of Tony Grainger, an ex-sea going Chief Engineer who has cruise ship experience and spent many years dealing with passenger vessels. Tony was at sea for over 20 years and spent the last 12 years at sea sailing as Chief Engineer Officer on many different types of passenger vessel, including cruise ships, passenger ferries and high speed craft. He moved ashore in 2007 and became head of projects for a large ferry company and specialised in ship energy efficiency. Tony headed up a vessel new-build programme and was responsible for delivering 8 new vessels from 3 separate shipyards. During the vessel new-builds, Tony led the decision making for the engineering design and engine specification, and introduced many innovations. Tony joined TMC in 2012 and has dealt with many differing cases, including cruise vessel audits, advising on ship energy efficiency, engine failure investigations and numerous vessel new-build issues. Tony is a full member of the Institute of Marine Engineering, Science and Technology.

1.5 TMC client list and cruise ship involvement includes:

- Steamship Mutual P&I
- West of England P&I
- Transport Malta
- Harmony Cruise
- Thomson Cruises
- Louis Cruises
- Royal Caribbean Lines
- V Ships Leisure
- Azamara Cruises

- MSC Cruises
- Costa Cruises
- Fred Olsen Cruises
- Hill Dickinson LLP
- Thomas Cooper LLP

2 POSSIBLE NOISE POLLUTION

2.1 International legislation concerning noise levels on ships only recently come in to force on 1 July 2014. These regulations apply to all ship types built after July 2014. The levels are contained in the IMO "Noise Level Code" and are brought in to force through SOLAS Regulation II-1/3-12. The code states the maximum noise levels to be complied with in different parts of the ship. However these noise levels are primarily intended to protect the hearing of crewmembers on normal commercial shipping such as container ships or tankers. Some of the maximum levels stated for areas outside the machinery spaces would be unacceptably high for a cruise ship. For example the code states that external recreation areas (open decks) should have a maximum noise level of 75dB(A). Such a level (which can be the equivalent of a dishwasher running) would be unacceptable on a cruise ship where the passengers expect a high quality holiday experience and to be able to relax on the open deck and outside areas of the cruise ship in a quiet environment. The dB(A) rating is an average noise level, but should the allowable on-deck design noise level of 75dB be exceeded even briefly on a cruise ship it would be extremely rare and/or accidental.

2.2 By their very nature cruise ships are quiet ships, where noise emissions must be kept to a minimum to protect the amenities of the passengers. This not only applies in internal areas such as cabins and public rooms, but also on the open decks where the spaces are used for leisure activities, or more often relaxation. Indeed cruise lines advertise that the open decks are areas where people can sunbathe and frequently fall asleep. To meet these requirements the noise levels need to be in the region of 50-60dB(A), the equivalent of a quiet office or normal conversation.

2.3 A number of classification societies carry out noise surveys on cruise ships and use a highly successful system of noise classification in the various areas of the cruise ship. Not only do these surveys ensure the contractual noise levels of the ship as built have been met, they also ensure that the ship meets the requirements of the passenger for a quiet and peaceful environment. Det Norske Veritas (DNV) is one of the world's leading classification societies for cruise shipping, and publishes noise levels which passenger ships which have to achieve for them to be designated "comfort class". These noise levels would be considered the norm for cruise ships. Exceeding these noise levels would almost certainly lead to complaints from the on-board passengers.

2.4 To achieve DNV's "comfort class" then open deck areas must achieve an average noise level of 65dB(A), which is the equivalent of normal conversation or laughter. This would include any background noise from air conditioning and generators running. Passengers would expect to be able to converse at a normal level in these areas without having to raise their voice or shout.

2.5 The UK Health and Safety Executive designate 80dB(A) as the level at which monitoring of noise levels must begin to be taken, and 85dB(A) as the level at which action must be taken to reduce the effects on hearing. However noise level rises are not linear, and for every 3dB increase the noise level actually doubles.

2.6 Noise on-board a cruise ship is generally generated from three specific areas:

- Machinery, principally Main Engines or Generators
- Heating, Ventilation and Air Conditioning (HVAC) systems
- Public Address announcements and ships whistle

2.7 On completion of manoeuvring alongside the cruise terminal a cruise ship will not use her main engines and the ship will only run diesel generators to provide sufficient electrical power to satisfy the requirements of the hotel operation. This is commonly referred to in the industry as “hotelling”. It is in the interest of the cruise ship owner to keep this load as low as possible thus reducing the number of generators which will be running and the amount of fuel being used. The cost of the fuel to the shipowner is an important consideration as the generators are running on low sulphur diesel oil which is the most expensive (and cleanest) marine fuel available. The generator provides electrical power to the various electrical motors around the ship, including powering the air conditioning system.

2.8 The number of generators in use will depend on the ship’s design. It can be a number of smaller generators producing around 1000kW each, or a single larger generator producing up to 11000kW. The generators are situated in the machinery spaces (engine room) low down in the ship. The machinery spaces are always well insulated to stop the noise of the machinery being heard and the vessel’s exhaust system contains a sophisticated silencing system to ensure the noise emitted is kept to a minimum. The level of noise produced by the ship’s power plant is especially important on cruise vessels, as passenger comfort is of the highest importance. A diesel generator can generate around 90-105dB(A) when standing next to it. However a passenger cabin situated close to the engine room would normally have a noise level below 50dB(A) which is the equivalent of a refrigerator humming. No matter where the cabin was situated on a cruise ship the passenger would only expect to hear a gentle hum from the refrigerator in their room, or the air supply from the ventilation and air conditioning system. They would not expect to hear the ships generators.

2.9 Based on my extensive experience of ports and terminals where cruise ships are berthed, the noise from ships generators has never been raised as an issue by residents, even when the ship is moored near a residential area. As the passengers are sleeping on-board the vessel it is unlikely that persons in the closest residential area to the cruise

berth would hear anything greater than the existing noises of the city if they had their windows open.

2.10 As the Cruise ships berthed at Enderby Wharf will be at least 150m from the nearest residential properties the noise levels quoted and their effects will be greatly reduced by distance.

2.11 One other area of noise creation is from the ships broadcast system and whistle. Broadcasts over the open decks are equally annoying for passengers as they are for others. For this reason cruise ship operators keep these broadcasts to an absolute minimum. The ships whistle is used for mandatory SOLAS manoeuvring signals, or to signal an emergency. The only occasion when a ships whistle is sounded other than this is the traditional “farewell” to the port when sailing. All these signals are over in a matter of seconds.

2.12 In my experience noise pollution from cruise shipping has rarely been an issue, even when the ship is berthed in or close to a residential area.

3 AIR QUALITY and EMMISIONS

3.1 Ship emissions are governed by International, National and local legislation and rules. For the Port of London, UK legislation brings in to effect the international legislation required by the International Convention for the Prevention of Pollution from Ships (MARPOL) and relevant European Directives. These regulations apply to all cruise ships, regardless of age or type of engines. These regulations and directives mean that the cruise industry is heavily regulated and controlled and this comprehensive legislative framework would apply to all cruise ships that call at Enderby Wharf for their entire duration of their stay. The emission regime in the UK is enforced by the UK Maritime and Coastguard Agency, who visit ships under the Port State Inspection regime. As well as this the ships classification society also monitors and approves compliance with these regulations. Due to their high profile, cruise vessels tend to have a greater focus placed on them for inspection than other types of ships.

3.2 Engine emissions are measured in Nitrogen Oxide (NOx) and Sulphur Oxide (SOx) and these are governed internationally by MARPOL 73/78 Annex VI.

3.3 Annex VI has requirements for the following main issues applicable at the proposed cruise terminal:

- Regulation 12 - Emissions from Ozone depleting substances from refrigerating plants and fire-fighting equipment
- Regulation 13 - Nitrogen Oxide (NOx) emissions from diesel engines
- Regulation 14 - Sulphur Oxide (SOx) emissions from ships
- Regulation 16 - Emissions from shipboard incinerators (cruise ship incinerators are generally not used in port)
- Regulation 18 - Fuel Oil quality.

3.4 On 19 May 2005, Annex VI to MARPOL entered into force, with a revised Annex VI adopted by IMO on 10 October 2008. In this legislation the sulphur oxide (SOx) and particulate matter emissions from ships are controlled by setting a limit on the sulphur content of marine fuel oils as follows. The sulphur content of any fuel oil used on board ships must not exceed the following limits:

- 3.50% m/m on and after 1 January 2012
- 0.50% m/m on and after 1 January 2020

3.5 On the 1st January 2010 the EU implemented its requirement that all ships burn fuel of 0.1 per cent sulphur content or less when they are within EU ports or within EU inland waterways. On the 1st July 2010 this requirement was extended offshore into Emissions Control Areas (ECA) which includes the North Sea and the Baltic Sea. This area includes the Thames and came in to force on 01 January 2015. As the ECA

extends from Falmouth through the entire North Sea to 62° North this means that the cruise ship will have been burning low sulphur diesel well before it approached London and for the entire transit of the Thames.

3.6 Ships that visit the Thames after 1 January 2015 are required to burn fuel of less than 0.1% sulphur content in their generators and boilers whilst in port; realistically this means running the plant on low sulphur diesel oil, rather than heavier grades of fuel. This low sulphur diesel is very similar to automotive diesel and results in much lower sulphur and particulate emissions than the heavy fuel oil that ships used to be allowed to use prior to January of this year. Low sulphur diesel oil is the cleanest fuel available that will run the ships generators and will reduce emissions from the vessel's generators by up to 97% in comparison to the marine fuel oil previously allowed.

3.7 Local rules in the UK are covered by the Environmental Protection Act 1990, which sets out the framework for controlling releases to air, land and water from prescribed process. These processes are listed under the Environmental Protection (Prescribed Processes and Substances) Regulations 1991. In 2009 DEFRA published guidance on Local Air Quality Management (LAQM TG09) which states that SOx is the key pollutant associated with emissions from large ships in port. However it also states that if a ship is using fuels with sulphur content of less than 1%, then it will not be necessary to take an air quality assessment any further. Cruise ships calling at Enderby Wharf will be using fuel with a much lower sulphur level than the 1% stated by DEFRA, specifically fuel oil with a sulphur level of only 0.1%. In addition LAQM TG09 uses a threshold of between 5,000 and 15,000 ship movements a year, which is considerably more than the 55 predicted for Enderby Wharf.

3.8 Other methods of reducing NOx and SOx emissions include:

- Exhaust gas scrubbers to remove SOx emissions.
- Exhaust gas selective catalytic reduction to reduce NOx emissions.
- New technology in 'on engine' emission reductions including; Common rail injection technology; Variable valve timing; and direct water injection systems.

3.9 Cruise ships have two distinctive types of engine power. Either main engines driving the propellers directly (or through gearboxes) for propulsion, accompanied by auxiliary diesel engines linked to electric generators for electrical power, or diesel electric propulsion where the ship has up to six diesel generators supplying electrical power to a main switchboard. If the ship requires propulsion, the propellers are driven by large electric motors. The remainder of the electrical power is used for the hotel operation (hotelling) such as heating, ventilation, air conditioning, lighting and electrical power for galleys. When alongside ships are running a minimum number of auxiliary diesel engines or diesel generators to ensure that the amenities available to the passengers whether inside the ship or on-deck are safeguarded.

3.10 NOx (Nitrogen Oxides) emissions are a source of concern for public health and environmental issues. NOx are produced by the reaction of nitrogen and oxygen during combustion, especially at high temperatures. NOx is known to react with ammonia to form Nitric acid and related particles. There are three levels of allowable NOx emissions from diesel engines, depending on the vessel's keel laying date or the engine installation date. The emission levels are called Tier I (applicable from 1 January 2000), Tier II (applicable from 1 January 2011) and Tier III (applicable from 1 January 2016, ECAs only). The methods of NOx reduction are mentioned in paragraph 3.8 and are becoming more popular with shipping companies (mainly due to cost savings brought about by more efficient fuel combustion).

3.11 A typical medium sized cruise ship with a capacity of approximately 1200 passengers would have an 'in port' electrical load of around 3500KW (depending on area of operation etc.) – Typical generators for this type of vessel (Wartsilla 32 generator sets) burn low sulphur diesel oil fuel at the rate of 200g/Kwh. At a load of 3500Kw, the hourly consumption would be approximately 700 Litres/hr.

3.12 Any ship calling at a port will emit a certain amount of emissions. However the legislation which would be in force at Enderby Wharf requiring low sulphur diesel oil to be used would ensure that these emissions were kept to the minimum possible and complied with the latest environmental standards and were well below the thresholds set out in DEFRA guidance.

4 SHORE POWER AND CONNECTIONS

4.1 Supplying shore power to shipping whilst alongside has a number of terms, the most common terms used being Cold Ironing, Shore Connection, Alternative Maritime Power (AMP), Onshore Power Supply (OPS) or High Voltage Shore Connection (HVSC). It is the process of providing high voltage shoreside electrical power to a ship at berth to allow its main and auxiliary engines to be turned off.

4.2 The International standard regarding shore power was agreed in 2012 as *ISO/IEC/IEEE 80005-1:2012 Utility connections in port Part 1: High Voltage Shore Connection (HVSC) Systems - General requirements,* which describes high voltage shore connection (HVSC) systems, on board the ship and on shore, to supply the ship with electrical power from shore. This standard is applicable to the design, installation and testing of HVSC systems and addresses:

- High Voltage shore distribution systems
- Shore to ship connection and interface equipment
- Transformers/reactors
- Semiconductor/rotating convertors
- Ship distribution systems
- Control, monitoring, interlocking and power management systems

4.3 Using shore power has a number of issues attached to it, namely:

- Very few cruise ships worldwide actually have the ability to link up to shore power. (see 4.4)
- Ships power requirements vary with size of ship. (see 4.5)
- The ships electrical requirements differ from those supplied from the UK national grid. (see 4.6)
- Other than a small number of ports on the West Coast of North America I am only aware of around ten other ports worldwide currently having shore power available, and of those only two offer it at the cruise ship berth. (see 4.7)

4.4 Ships on-board electrical switchboards do not have suitable connections for shore power unless specified by the owner at build. Although vessels generally have shore power connections for very low electrical load requirements in dry dock and lay-up periods they are not equipped with the necessary equipment to facilitate the use of shore supplied power for the full hotel load. The cost of fitting a suitable connection along with required upgrades to the ships on-board electrical distribution system is in the region of US$500,000 per ship. This cost would have to be borne by the shipowner on top of the increased costs of already burning low sulphur diesel oil. Of

those cruise ships targeted for possible calls at Endersby Wharf I believe that fewer than 5% have the facility fitted to enable them to take shore power.

4.5 The larger the ship the larger the power supply, and whilst a small cruise ship may only require 0.5MW, a cruise ship carrying up to 2000 passengers would require up to 4MW or higher. The largest cruise ships in the world can require up to 9.5MW and my understanding is that the highest requirement rate usage would always be charged regardless of actual use.

4.6 One of the major reasons why implementation of OPS is rare is that you cannot simply "plug" a cruise ship in to a shore electrical supply. They typically operate with a three-phase power supply, at a frequency of 60Hz and voltage of 440V (distribution) or 6.6kV for propulsion. Providing shore power at 440v is not attractive because of the high currents required. It would have to be supplied at 6.6kV (or above) and the voltage reduced for the 440v distribution system using a step down transformer. There would also be a need for frequency convertors. Most vessels, including cruise vessels, operate at 60Hz; however the UK national grid is supplied at a frequency of 50Hz. Without this change the ships on-board electrical machinery will not function correctly. Finally, ships switchboards are particularly sensitive to power fluctuations. Excessive variations in power supply will cause the switchboard to "trip" causing a blackout on-board. Electrical power supplied by the ships generators is stable compared to shore power which is liable to much greater fluctuations in power and will cause these blackouts.

4.7 Very few ports are equipped to supply vessels with electricity from the dockside. As well as there being few ships that can make use of such a facility the costs for the shore side infrastructure are generally prohibitive, even for some of the largest ports. Once the infrastructure is fitted the ongoing costs of maintenance and supply have to be considered, and these can be very high. In some cases the cost of the shore electricity supplied to the ship is far greater than the cost of the fuel required to power the ships own generators. When the cost of the shore electricity is greater than that of the fuel the shipowner would be reluctant to use the more expensive option when he is already using low sulphur diesel oil, which itself brings major environmental emission reductions. It is of note that Rotterdam have recently announced they will not be fitting any more shore supply systems to their current berths due to the high costs.

4.8 The requirement for ships to burn a much more environmentally friendly fuel has only been in force for a matter of months and will give far better environmental improvements than providing shore supply to the very small number of ships that can actually accept shore power at the berth.

4.9 To ensure there is full environmental benefit the electricity supply from ashore has to come from a power source which is more environmentally friendly than the ships

generators operating on fuel with a sulphur content of less than 0.1%. This is unlikely to be the case in the UK.

4.10 The cruise ships calling at Enderby Wharf will all be required to comply with the latest strict environmental regulations for emissions within the highly regulated cruise industry. These closely monitored and strictly enforced regulations have only been in force for a number of months and will produce a dramatic reduction in the levels of pollutants released compared to previous fuels allowed to be used. Even if shore supply was available at Enderby Wharf around 95% of the ships calling would be unable to make use of it.

On behalf of **TMC**

Stuart Greenfield
Consultant Master Mariner