

# Cruise survey

*Safety, sustainability and innovation*

A technology report from Bureau Veritas Marine & Offshore

Issue #03 - Spring 2019



**BUREAU  
VERITAS**

## INDEX

04

Introduction



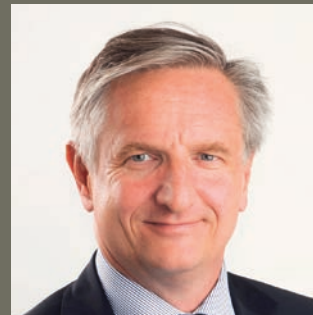
08

Five star adventure:  
a unique travel  
experience



06

Cruise is digital  
technology  
frontrunner, but risks  
need to be addressed



20

Expedition  
Ambition



14

Respect for  
the oceans

Editorial Team

Nick BROWN  
*Communications Director*  
BUREAU VERITAS

Andreas ULLRICH  
*Global Market Leader  
for Passenger Ships & Ferries*  
BUREAU VERITAS

Capucine RIOS  
*Communications & Events Manager*  
BUREAU VERITAS

Artistic Direction  
KAZOAR AGENCY

Cover photos credits: PONANT,  
SunStone, Mystic Cruises, MSC Cruises

18

Exploring  
the high seas with  
Mystic Cruises



# DEAR READERS

**W**elcome to the first issue of a Bureau Veritas Technology Report focused on passenger ships. This year the cruise industry will see the delivery of highest ever number of new ships entering the market. Growth continues in the years ahead as the ships in the current all-time high order-book – with delivery slots ordered as far ahead as 2027.

Cruise operators are offering ever more unique holiday experiences for specific markets - for families, for young couples, entrepreneurs, retirees who could stay afloat forever and, driven by innovation, they are offering new concepts.

Some ships are seen as holiday resorts at sea, others offer luxury and some, especially the smaller ones, are made for guests who like to see new destinations in ever more remote areas of the world like the Antarctic and Arctic.

BV is very proud to classify a significant number of new ships entering the market in 2019: MSC BELLISSIMA, WORLD EXPLORER, SCENIC ECLIPSE, LE BOUGAINVILLE and the GREG MORTIMER will be new names on the world's oceans and seas.

Andreas Ullrich  
Global Market Leader  
for Passenger Ships & Ferries,  
Bureau Veritas



© Baptiste Lajnel

Our commitment to support this sector is based on making safety paramount but also encouraging innovation, meeting or surpassing environmental requirements to introduce alternative fuels, such as LNG, battery and even fuel cell technology to herald the age of hydrogen, perhaps, or fuels and sources of energy still unknown.

Some have been dreaming of clean fuels, dense in energy, for some time. Jules Verne wrote of a “Mysterious Island” where such fuels existed:

**“Water will one day be employed as fuel, that hydrogen and oxygen which constitute it ... will furnish an inexhaustible supply of heat and light ... Water will be the coal of the future”**

Jules Verne, 1874  
*L'Île Mystérieuse / The Mysterious Island*

And a digital future is also here. We expect the cruise sector to undergo major changes over the next decade driven by digital developments. This will present both opportunities and risks.

As a leading classification society in cruise we are continuously challenged to rethink our way of working and to find alternative and better solutions. BV is good at this. But what we know for sure is that what we do well today might not be good enough tomorrow. There can be no standing still and watching. We have to work together to build safer, cleaner, sustainable futures in this exciting sector.

Enjoy your reading and please talk to us about your cruise projects.

# INTRODUCTION



## Overview

The passenger ship sector has seen considerable growth in the last five years and by the end of 2019 berth capacity is forecast to have increased by well over 25% in the five years since 2014.

This growth in demand for passenger ships is keeping us very busy at Bureau Veritas supporting the construction of the full spectrum of new passenger ships being ordered - from megaships to small, specialized expedition class ships capable of operating from the tropics to the poles, as well as everything in between.

Bureau Veritas has always been strong in supporting specialized tonnage. The trends that we are responding to, such as the challenges of 5,000 + berth mega ships, new generations of LNG fueled ships and the smaller specialized ships, will be met by the expertise of our naval architects,

engineers and surveyors. The demand for new technologies, new fuels and new onboard experiences, such as LNG or new underwater viewing windows, requires our technical insight and risk analysis. When a client wants to do something new we are there for them to help find a safe solution.

We have been developing our people to make sure we have the expertise and capacity to meet the demands of the market. Leading for us is Andreas Ullrich, our new Global Technology Leader for Passenger Ships, taking over from Jean-Jacques Juenet, who retired from Bureau Veritas in 2018.



Inspection of the 'Blue Eye' lounge for PONANT - discussion about workmanship of this sophisticated design.

With our new construction surveyors working on passenger ship projects in yards from Norway to China and our ship surveyors working world-wide to support a lifetime of operations, you can be sure that Bureau Veritas will be there to help with a passenger ship project of any scale or sophistication.

## Bureau Veritas: Responding to clients' needs

*Larger ships* - With such a "precious cargo" passenger ship safety must be at the highest level, from designs to reduce the risk of fire, to the evacuation plans for nearly 7,000 passengers and 2,000 crew. We are focused on helping provide our clients with solutions that not only work commercially and operationally but also address all related risks.

*Gas as a fuel* - Both from a regulatory perspective and from a marketing viewpoint, cruise ships need to reduce their environmental impact. Garbage, waste and sewage management are areas where tremendous progress has been made. The next big frontier is air emissions and we are involved in exhaust gas cleaning system installation on new and existing ships and, now, projects for LNG fueled and hybrid ships, like MSC's world class and Ponant's latest order.

### Cruise shipping: worth a lot

Cruise ships represent enormous investment and, today the orderbook - worth USD 64 billion stretches out to 2027 deliveries. The two largest individual cruise ship yards Meyer Werft at Papenburg and Chantier d'Atlantique in St. Nazaire - respectively rank at numbers nine and ten in the total worldwide table of shipyard in terms of the value of ships on order, measured by compensated gross tonnage (cgt). If the cgt of Meyer's Turku yard is added to Papenburg's the combined number would put the group at number five in the world rankings of all shipyards. While the combined Fincantieri yards at Monfalcone and Venice would lie in sixth place.

BV is now the world classification leader in LNG fueled shipping and we are putting this expertise to good use across the gas supply chain, helping to address and reduce risk.

*Expedition class ships* - Demand for travel to ever more adventurous locations is being met by a new generation of cruise ships known as expedition ships. These smaller ships are, perhaps, more like large superyachts and they offer a completely different experience, able to access small harbors and narrower, shallower passages and anchorages accessing wild and remote parts of the world.

*Arctic expertise* - The latest order from French operator PONANT will not only

be gas fueled and hybrid-electric but will also be the first ice-breaking passenger ship enabling autonomous operations in ice-infested waters. Bureau Veritas has considerable expertise in ice class and arctic operations - a notable recent project is the classification of Yamal's series of 15 ice-breaking LNG carriers.

**Growth in passenger ship berths**  
**+ 27%**  
**in five years\***

475,400 (2014) to 607,000 (2019\*)  
 Source - Clarksons

\*Forecast

*LNG fueled: MSC Cruises' World Class cruise ships will feature 2,760 cabins and a maximum occupancy of 6,850 guests, the highest passenger capacity in the global cruise fleet. The first two vessels, which will be delivered in 2022 and 2024 - there are options for two more in 2025 and 2026 - will have a length of 330 metres and 47 metres of beam.*



# CRUISE IS DIGITAL TECHNOLOGY FRONTRUNNER, BUT RISKS NEED TO BE ADDRESSED

Due to the technical complexity of cruise ships and the direct involvement of the cruise business with the general public, which has grown used to digital technology in everyday life, the cruise sector is an early adopter of smart tech in the maritime industry and in many ways leads the way towards maritime 4.0. High speed wifi and evermore sophisticated onboard entertainment systems have become a standard feature on modern cruise ships, as well as advanced weather routing systems making use of real time weather information to ensure passenger comfort and minimize fuel consumption and emissions. Furthermore, onboard systems are increasingly equipped with – remotely accessible – condition monitoring equipment enabling optimized condition based and predictive maintenance schemes.

The sheer number of – computer controlled – systems on board cruise ships requires a high level of automation and integration, ranging from power management to navigation and hotel functions. This allows ships to be operated with a very high level of performance and efficiency, but the associated complexity also entails risk in terms of safety, security and reliability. This manifests itself along three main axes: technology, people and processes.

Cyber-physical systems contain software and are increasingly interconnected to other systems both on board and ashore via remote access. As a consequence a failure in one system could jeopardize the safety of other systems or even the entire ship. In order to ensure an adequate level of cyber safety and reliability a systems engineering approach including risk assessment, system integration testing

and software change management is required. To that end Bureau Veritas has introduced the additional service features **SW-Registry** in the classification rules. The requirements are consistent with IACS URE22 (Rev.2) as applicable to new ships contracted on or after 1 July 2017, which was championed by Bureau Veritas. For ship owners seeking an even higher level of assurance regarding the reliability and dependability of their ship the additional class notation **HWIL** has been introduced, which requires **HardWare in the Loop** testing of complex and integrated systems. This is a “black box” type laboratory testing technique to validate that the tested system is capable to perform its intended functions under all anticipated circumstances, including wrong system input.

Software controlled and connected systems also induce cyber security risk and motivated offenders may consider cruise ships a suitable target – in particular if protection is weak. Experience feedback has amply demonstrated that the human is actually the greatest vulnerability, warranting a focus on training and procedures. In order to support the industry in putting up their defense Bureau Veritas specialists have worked together with industry partners to develop a holistic set of fit-for-purpose class notations and associated requirements. At basic level we have introduced the **CYBER MANAGED** notation, which addresses policy, training and change management. The management process oriented cyber security measures are based on the outcome of a cyber risk analysis, often supported by a maturity assessment of the company and provide a first level of defense against cyber-attacks. Within the scope of the **CYBER MANAGED** notation data transfer between ship

and shore – and vice versa – for remote access and data collection can also be addressed by including additional requirements included in the **SYS-COM** notation dedicated to connected ships. In order to achieve an advanced level of protection the **CYBERSECURE** notation has been introduced. The notation, which is primarily focused on newbuilds, covers ship and equipment security by design, addressing compliance, software registry, inspection/decontamination gates and log recorders. This enables active threat detection at sea for network traffic and systems activity, live status updates of equipment vulnerabilities and local and remote incident response capabilities. The requirements and processes detailed in these class notations are consistent with industry guidelines.

Our specialists can provide ship owners and shipbuilders with awareness training, as well as assistance and support for the selection and implementation of cyber safety and security measures on cruise ships in order to ensure that you are ready to overcome the growing cyber challenges.



Najmeh Massoudi  
Global Technology Leader, Smart Ships,  
Bureau Veritas

# FIVE STAR ADVENTURE: A UNIQUE TRAVEL EXPERIENCE

For more than 25 years, PONANT has been offering marvellous ways of getting away from it all. Sailing on board one of our ships means enjoying exceptional experiences as close as possible to nature, in the heart of virgin territory and in sites that combine dreams and history.

It means discovering other cultures and traditions, and sharing memorable moments with tribes from the other side of the world. It means enjoying the magic of the PONANT Moment.

Bureau Veritas spoke to Jean-Emmanuel Sauvée, CEO of PONANT and one of the company's founders.





## PONANT has a very ambitious newbuilding program – where do you see your company in 15 years?

In 15 years, as far as I can see, the company will have strengthened its development both in terms of turnover and fleet expansion. This development will be supported by our international expansion strategy which will continue to bear fruit thanks to the dynamism of our local teams and the ambitious plan that will result in us having one of the youngest fleets in the world.

However, this dynamic would not have the same value if it were not accompanied by a responsible approach. As we enter this new decade, we will have pursued and intensified PONANT's sustainable development policy.

## You recently ordered a dual fuel, electric-hybrid icebreaking cruise ship – Can you share your ideas behind this order? What's next?

Reaching the North Pole. Crossing the Arctic Ocean. Discovering the far north-east of Greenland... PONANT is imagining the cruise travel of tomorrow with the Commandant Charcot, the first hybrid-electric polar exploration vessel, powered by Liquefied Natural



Christophe Vaes, New Construction Manager, Bureau Veritas Norway, inspecting the steering gear room.

Gas (LNG). From 2021, this latest addition to the PONANT fleet will take passengers in the footsteps of the great polar explorers, in a refined setting and offering luxury services that have never before been available in the extreme regions of the northern and southern hemispheres.

The next step? Commissioning the ship, scheduled for 2021.

The Commandant Charcot will be fitted with the latest environmental protection technology and will have a hybrid liquefied natural gas (LNG) and electric propulsion system. This will

allow a reduction in the ship's emissions of SO<sub>2</sub>, NO<sub>x</sub>, CO<sub>2</sub> and fine particulate matter. There will be silent sailing in sensitive areas: thanks to electric batteries, the ship will be able to sail for 30 minutes without producing any emissions and with a very low noise level. It will be equipped with the latest technology to optimise energy consumption, wastewater treatment and waste processing.

## PONANT operates in the luxury segment going into environmentally sensitive areas. May you share with us what luxury in cruising and being environmentally friendly means to you?

"We protect best what we know best" is the belief of Jean-Emmanuel Sauvé, the CEO and co-founder of the company. For more than 30 years, PONANT has taken its passengers into some of the most secret places on the planet, where nature reigns supreme. This choice brings with it responsibilities with regards to the ecosystems of these places and the communities who live there.

PONANT's ambition is to become a world leader in sustainable development in its sector, the cruise industry. In our profession, luxury is the perfect



Bureau Veritas supporting innovation: PONANT's order for an ice breaking expedition class ship incorporates LNG as fuel for a hybrid electric propulsion system as well as an icebreaking hull.

accompaniment to respect for the environment. Luxury is based on quality, rarity and sustainability.

- **Quality:** Through the way of life, the design, the service or the gastronomy with Ducasse Conseil, you can feel this “French Touch” which is our signature. Our partners are carefully selected and share with us this desire for excellence the French way. PONANT ships offer comfort that is comparable to the leading luxury hotels.
- **Rarity:** exceptional destinations. From the ice of Antarctica to the lagoons of the Pacific, from Mediterranean inlets to the shores of Asia, our experts conceive carefully designed and tailored itineraries, that allow passengers to access the treasures of the Land from the Sea. The intimate size of our ships allows us to offer unusual, quieter ports of call, allowing our passengers to enjoy cruises with an air of exclusivity as well as personalised and attentive service for all.
- **Sustainability:** our activity seeks to ensure sustainability. We are convinced that the preservation of the areas where we sail is primordial. That is why we measure the impacts of our decisions in the long term, rather than seeking rapid returns on investment.

### The governance of a good sailor

Created by sailors, our company has managed to retain the guiding principles of respect for people and for nature. It considers sustainable development to be an integral part of the company’s strategy and cannot be dissociated from it.

In addition, I personally monitor the respect of our commitments and am involved in the supervision of our actions. In addition, I chair the monthly meeting of our Sustainable Development Steering Committee, which brings together representatives of the various departments in the company.

### Well-thought out cruises

Our cruises are very carefully crafted. An environmental impact assessment is made by our experts for cruises in sensitive regions. This allows us to minimise any disturbance of the fragile natural resources. Our passengers are supervised by our onboard guides, who explain to them how to behave with regards to the flora, fauna and local populations.

### Passenger awareness

PONANT passengers are transformed by the cruises, and in turn become

environmental ambassadors. We are very proud when our passengers take more than one PONANT cruise; this means they have gained in awareness.

### Respect for local populations

Our commitment goes beyond environmental aspects. We are also clear about our responsibility towards indigenous populations. We take care to consult them over important decisions and we involve them in the activities on offer during ports of call. We have even been known to provide them with medical support. In this way, we have developed strong partnership with local communities in Greenland, Argentina and also in France.

### The best fuels

Existing ships: from 1<sup>st</sup> January 2019, we decided to definitively stop using HFO and replace it with Low Sulphur Marine Gasoil, LS MGO. This fuel considerably reduces sulphur and fine particulate matter emissions.

As we mentioned earlier, we have chosen LNG for the future Commandant Charcot and we are studying new alternatives such as biodiesel and biogas.

### Cutting-edge technologies

- **Water treatment:** Our ships are equipped with a complete desalinisation system and a wastewater treatment system: a submerged membrane bioreactor. This biodegrading process – free from the use of chemical products – is very reliable. It produces clean water and meets the highest standards of quality. This system is certified according to IMO 2017 regulations and has a GREEN PASSPORT which affirms its respect for the environment. The quality of the water obtained means it does not need chlorination or any other chemical treatment. The pureness of the water produced means it can be used aboard the ship, notably in the laundries.



Insulation - inspection of pins distance for insulation material.



The Ponant, Vard and BV teams with Ponant's captain Jean-Édouard PERROT - discussing next steps.

- Waste processing: we have compactors that are adapted to each type of waste. This allows us to optimise storage volumes and disembarkation operations at ports.
- Navigation aids: PONANT is working on an innovative project using digital navigation. Our ships will be fitted with an electronic assistance system that will ensure optimal fuel consumption.

**Environmental management**

- Waste is sorted aboard ships in accordance with MARPOL regulations for the prevention of marine pollution. PONANT works to optimise the management of its waste when on land. Our aim is to add value to all our packaging. We have put in place a working group dedicated to this subject that includes representatives from all the company's departments.



Le Lapérouse on sea trials.

- Sanitary and waste water are regularly checked to ensure their compliance. Waste water treatment residues are offloaded in ports and given to specialised companies for the appropriate treatment.
- Fuel consumption is monitored aboard ships and at the head office.
- A calculation of our greenhouse gas emissions is made each year.

### External audits

All our ships have received Clean Ship certification from BV. This shows, among other things, that our boats are the most environmentally respectful.

Our ships have also obtained Class 1 certification, which means they produce the lowest levels of noise and vibration. And there are also all the regulatory inspections carried out by the French and foreign authorities.

### Your first vessel is a sailing ship. Can you envisage building a wind powered or wind assisted ship in future?

Introduced as part of the sailing cruise-vessel project Silenseas, launched two

years ago by Chantiers de l'Atlantique, the revolutionary Solid Sail® concept has been tested on Le PONANT since 31 October. Two patents have been filed—in 2009 and 2017—for the new type of sail, made of fibreglass, carbon and epoxy-resin panels in a carbon-slat frame. This new technology will significantly reduce energy consumption from propulsion, and thus considerably reduce the environmental impact.

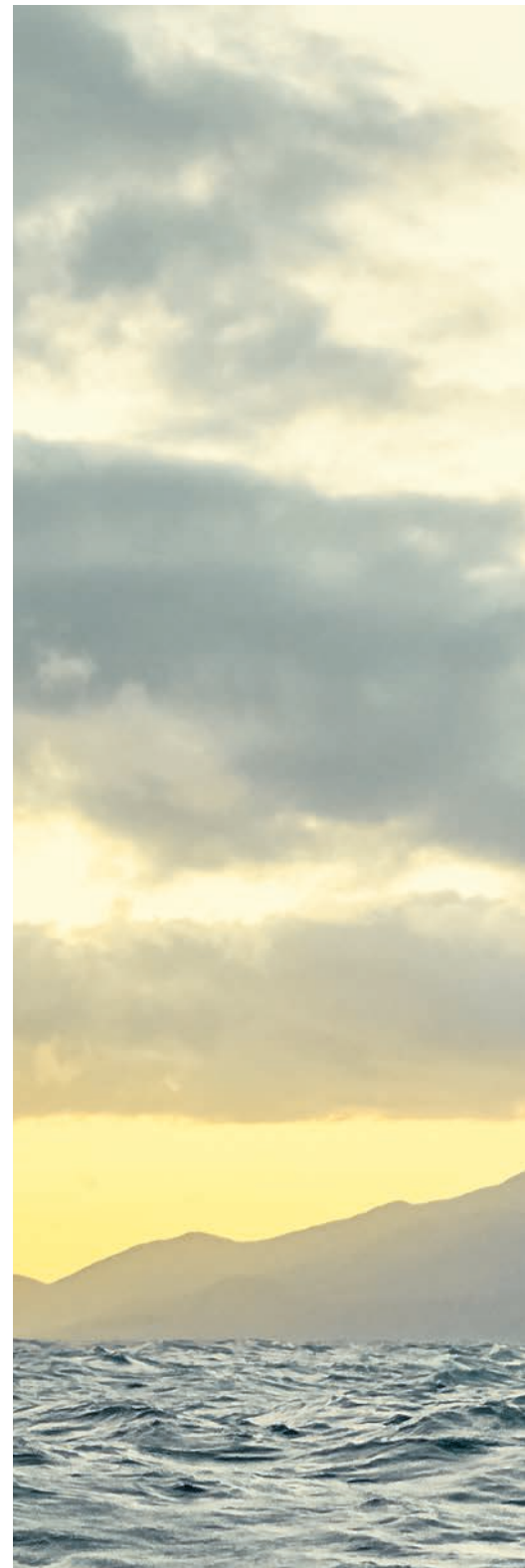
On 25 October 2018, more than 300m<sup>2</sup> of solid sails were installed on Le PONANT during a technical stop in Marseille, France. The three-masted ship set sail for Cape Verde in mid-November before embarking on a transatlantic voyage to Cuba. The prototype, on a 50% scale, will be tested for one year on the company's sailing vessel.

### May you share with us the challenges you envisage when building the icebreaking cruise ship, both related to technology and operation?

This vessel is very innovative for many



Le Laperouse at Taormina, Sicily.



Le PONANT Mindelo.



reasons:

- it is the first Polar Class 2 vessel with icebreaking capabilities that allows the vessel to respect its cruise schedule, cope with any heavy ice conditions and ensure the highest safety level for passengers,
- for the very first time, this vessel will have a hybrid LNG fuel – electric design, which increases the safety level by preventing black outs, further reduces fuel consumption, optimizes LNG fuel use and reduces atmospheric emissions,
- on the operational side, the challenges are to develop new cruise routes that will become accessible with this vessel, as well as develop our skills and procedures in Heavy Polar conditions and the use of LNG as fuel.

**Are there other technologies you are going to consider in future? How do you see class supporting here?**

All green technologies, such as biogas, innovate waste processing, and the sails, are being examined. Class is a partnership that helps us to develop innovative solutions by providing us with expertise and methods.

**How do you see class in the newbuilding process? As referee or coach (or both)?**

BV is a strong partner in the development of all our new projects, from the very beginning of the concept design up to the delivery.

We are launching the procedure to obtain ISO 9001 / 1401 / 4501 certification.

# RESPECT FOR THE OCEANS



**Bud Darr, Executive Vice President, Maritime Policy and Government Affairs, MSC Group shares the MSC vision and describes the company's outlook on the environment, fuels of the future and more.**

## **MSC has very ambitious plans – where do you see your company in 15 years?**

MSC Cruises is the world's largest privately-owned cruise company and the number one cruise line in Europe, South America, South Africa and the Gulf. A relatively young company, MSC Cruises is a game-changer in the industry and has achieved a whopping 800% growth in its first ten years. In just over fifteen years, MSC Cruises successfully built a global reputation as one of the youngest cruise fleets at sea.

Following a first phase of growth, the Company launched an industry-unprecedented EUR 13.6 billion investment plan, spanning a horizon of over ten years, from 2014 through to 2027, for a total of up to 17 next-generation cruise ships. By 2027, MSC Cruises will be the third largest cruise company globally and its fleet will comprise no less than 29 modern cruise ships.

Moving forward, the Company's offer will continue to further enrich its product offer with cutting-edge guest-centric and marine technologies, and will diversify into other market segments, deepening its footprint in the luxury segment. In October 2018, the Company signed a memorandum of agreement for the construction of four dedicated luxury cruise ships which are set to enter into service between 2023 and 2026.

MSC Cruises fits its ships with the latest environmental features and maritime technology. The Company will continue to operate with the greatest respect for the world's oceans and is on an ongoing journey to further develop innovative ways of lowering the environmental impact of its cruise passages, from improving air quality from ship emissions, to advanced wastewater treatment, to comprehensive and coherent waste and garbage management.

We will continue to invest in sustainability solutions to lower the environmental impact of all our ships: those that we are building as well as those that are already part of our fleet. For us at MSC Cruises, sustainability is not an end in itself, but a never-ending journey of continuous improvement.

## You recently ordered very large cruise ships using LNG as fuel. May I ask you to share some of your intentions with us, in terms of the benefits and challenges of using gas ?

As part of a much broader approach to meet its own environmental objectives and greatly limit sulphur and other emissions in ports and in specific operating areas, MSC Cruises is implementing a wide range of measures. One of those measures will be powering many of our future ships with Liquefied Natural Gas (LNG), the cleanest marine fuel available for our use today.

Compared to standard marine fuels, LNG reduces SO<sub>x</sub> emissions by more than 99%, NO<sub>x</sub> emissions by up to 85%, and CO<sub>2</sub> emission by approximately 20%. It also virtually eliminates particulate matter in the exhaust and avoids any cloud from the air emissions during engine start up.

MSC Cruises is investing EUR 5 billion in this specific field of technology and development – and has five ships in its newbuilding pipeline which will all be powered by LNG. The Company's first LNG-powered ship will enter into

service in 2022. Others will follow in 2023, 2024, 2025 and 2027.

## LNG is one way to comply with more stringent environmental regulations. What plans has MSC to reduce even further the company's environmental footprint?

MSC Cruises has a structured and holistic approach to environmental management which meets and exceeds MARPOL regulations. The Company has specific programmes to save energy, improve air quality from ship emissions, preserve water, ensure high-quality and clean wastewater discharges, manage solid waste through state-of-the-art processes and facilities, phase out single-use plastics, etc.

MSC Cruises is already taking a range of measure to meet the upcoming 2020 sulphur cap. To this end, the Company is installing Exhaust Gas Cleaning Systems (EGCS) on its newly-built ships as well as most of its existing fleet. By the end of 2019, 11 of its 17 ships will be equipped with EGCS, and 74% of its total number of berths (i.e. capacity) will be covered by EGCS technology.

Moving forward, MSC Cruises will be equipping its new builds with Selective Catalytic Reduction (SCR) systems. SCR technology helps reduce nitrogen oxide (NO<sub>x</sub>) by converting it into harmless nitrogen (N<sub>2</sub>) and water through advanced active emissions control technology. MSC Grandiosa, which was already afloat in early January 2019 and enters into service later in the year, will be the Company's first ship equipped with SCR technology. The Company currently has three ships under construction that will be fitted with this technology and all following ships will have this capability installed as well.

Another important area of environmental focus is waste water treatment. In 2008, when launching its Fantasia Class of ships, MSC Cruises already started equipping its ships with Advanced Wastewater Treatment Systems. An Advanced Waste Water Treatment System treats waste water to a very high quality by mixing different waste streams together and filtering out the larger components. What comes out on the other end then gets processed even further through very fine filtration and treatment processes, to produce effluent that is of a higher standard than most municipal waste requirements around the world.



MSC Bellissima, the flagship of MSC Cruises' global fleet, in the Port of Southampton

Through these systems, hazardous substances and pollutants are filtered out and digested by bacteria. To avoid risking harm to marine life, the remaining purified wastewater is disinfected by UV processing and never chlorine. We monitor key indicators to ensure any remaining bacteria levels are favourable before discharge.

While the list of environmental measures is extensive, a final element worth mentioning is that by the end of March 2019, MSC Cruises will have effectively phased out an extensive number of plastic items from all ship operations and ashore. All single-use plastic shopping bags, spoons, glasses, stirrers, and other single-use plastic items for which substitution is available will be replaced by environmentally-friendly alternatives. Single-portion items such as butter cups, jams or yoghurts will no longer be individually packaged, rather convenient solutions

will keep waste to a minimum. The Company has already fully replaced plastic straws with 100% compostable and biodegradable substitutes.

### Could you ever envisage building a wind powered, or wind assisted ship?

MSC Cruises explores all the options which provide viable solutions to its energy needs. With wind power, there are scale and physical constraints that limit its application with existing technology, but we continue to consider this as part of our broader efforts.

### Are there other technologies you are going to consider in future? How you see class here?

MSC Cruises' environmental efforts are an ongoing journey. Together with the world's leaders in environmental and maritime technology, the Company is exploring and developing new solutions for its future and existing ships and will be fitting its fleet with more innovative solutions for a lower environmental

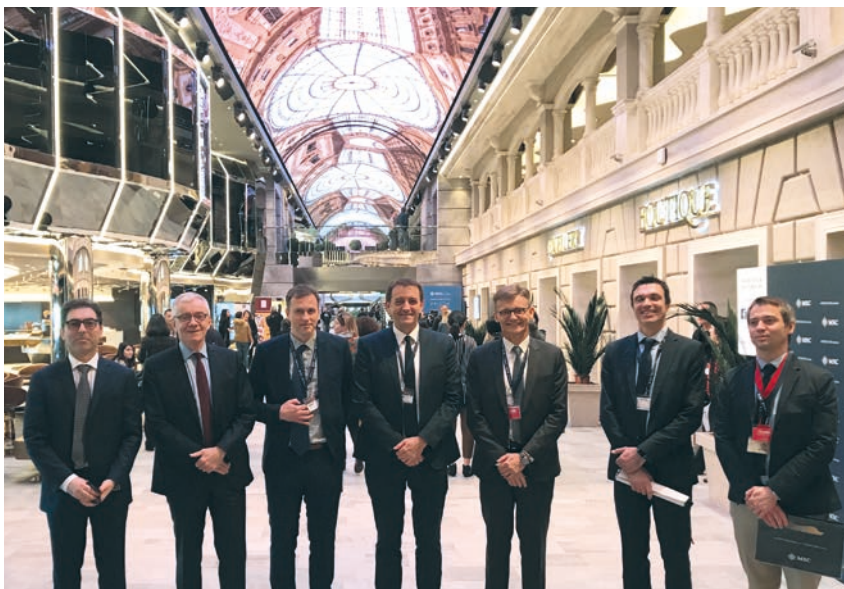
impact. Examples include low carbon alternative fuels, enhanced electronic onboard energy management systems, fine particulate filtration, and new generations of wastewater treatment systems.

A critical challenge for Classification Societies like Bureau Veritas is to understand the significance of new technologies, and what they mean for shipboard operations, crew and the broader environmental framework. A lot of the technology that is being used or developed has a pioneering element to it and takes cruise companies into uncharted waters. It is critically important that Classification Societies evolve their thinking along with our own and adapt to the emerging technology. It is especially important that we work together to not only ensure compliance with existing design and performance standards, but more importantly to ensure equipment is genuinely fit for purpose, throughout its entire service life. The role of the Classification Society is to work with both cruise companies and governments to navigate the complexities of this changing paradigm and continue to allow the industry to stay ahead of the technology curve.



Bud Darr (MSC Group), Philippe Donche-Gay (Bureau Veritas) and the Master of MSC Meraviglia, Captain Mattia Manzi in Marseille, March 2018 on the occasion of the '8 Golden Pearls' award ceremony in recognition of the ship's exceptional sustainability and environmental management practices.





The Bureau Veritas team at the Delivery Ceremony of MSC Bellissima.

**What challenges are you facing with more complex systems installed? Related, perhaps, to crew and maintenance? Fit for purpose? How do you see the role of class here?**

As disruptive as certain new technologies may be, MSC Cruises always makes sure any new technology does not disrupt ship operations or guest experience.

When new technologies are implemented, for instance LNG, the challenge for the Classification Society will be in the inspection and certification of critical equipment, operator programmes and achieving and maintaining performance standards. A critical element in implementing new technology is the delivery of adequate training to crew, or even the creation of new engineering roles. Making sure shipboard systems operate at its best environmental and operational performance, as well as handling and maintaining them with the highest level of care, are key drivers for an efficient and safe ship operation. Classification Societies are instrumental in supporting companies reach those high standards, and making sure the highest level of quality is assured across the details in

the entire chain. (e.g. from the integrity of the LNG bunkering system to the crew members who support the actual bunkering operation).

With any new and complex system, it is imperative that the equipment is genuinely fit for purpose, but it is equally if not more important that the training, procedures, and maintenance are also fully fit for purpose. Any installation of new technology that fails to take the human factor properly into account will ultimately fail. This can compromise

safety and also make it impossible to realize the true value out of these extensive investments.

**May I ask you to share your view on class – referee or coach (or both)?**

I would say that both answers are correct. Classification Societies like Bureau Veritas are instrumental in establishing and maintaining the highest technical standards for the industry. They also typically play an important statutory role in ensuring effective implementation of regulatory requirements on behalf of various governments. Classification Societies have an important refereeing role to make sure operators meet or exceed those standards. They understand the dynamic field in which MSC Cruises operates and are uniquely qualified to fill that role, which also makes them well-suited to serve as a coach. One of the most complex and important roles for class is to ensure compliance, while at the same time encouraging creativity in the evolution of finding the best solutions to meet design, construction, and operational needs for an amazingly innovative cruise industry. The concept of a referee and coach are not mutually exclusive, nor should they be for us to best reach our own safety, security, and environmental goals and to fully meet the expectations of our valued guests.



MSC Meraviglia: the first ship to enter into service in May 2017 under MSC Cruises' unprecedented investment plan.

# EXPLORING THE HIGH SEAS WITH MYSTIC CRUISES



## Mário Ferreira talks about his company's expansion onto the high seas.

Starting very successfully in river cruising, the Mystic group now has 40 ships in operation across its Douro Azul and Nicko Cruises brands operating in Portugal and Germany, making Mystic the world's third largest River Cruise Operator. Now Mystic is expanding into ocean going cruising with its first vessel – a 126m passenger expedition ship, the World Explorer – due to deliver in April 2019 from the WestSea Shipyard in Viana do Castelo, in the north of Portugal.

Mário Ferreira, Founder of Mystic and its Chairman, shared his vision with Bureau Veritas for his company's journey from the rivers to the oceans. "Starting the Ocean Cruise business for us was just like a natural extension of what we have done for the past 26 years", he said from Mystic's base in Porto, Portugal.

"The World Explorer is only the first of a series of vessels we intend to build: World Voyager will be ready in April 2020, 14 blocks are already built and she will be followed by the World Navigator, to be ready April 2021 or a little before."

The ships will take 200 passengers in very large and luxurious accommoda-

tions, it's a number that Mystic are very used to handle in its River Vessels and maintain the tradition of recognizing guests by their names.

*"We expect to be able to give our clients an experience of Exploration Cruises and in some cases and particular parts of the World they will experience our Expedition Cruises. Our main focus will be to base our cruises according to four pillars: cultural destinations, rich architectural locations, scenic landscapes and great food and wines."*

Regarding further orders, Mr. Ferreira says, "We do have large future plans – to be announced soon."

## Portugal – Mystic's home

All Mystic's river, and now, ocean-going, ships are built in Portugal and operate under the Portuguese flag. Mr. Ferreira says that the choice of Portugal for construction is based on a combination of cost management and being able to design and fit out the ships and their interiors to Mystic's strict specifications: "Our ships are being built in Portugal, because WestSea Shipyards gives us the best value for money in the construction of new builds and allows us also to manage a lot of the more specific design and supplies, like all the IT, Entertainment systems, Communications and Interior décor

that is directly supplied and outfitted by us.”

“We have also requested proposals for this model of ship from Germany, Spain and Italy, so far Portugal is still the most competitive to build 10.000 tonnes vessels.”

Regarding the flag he says, “I am Portuguese and while the flag conditions in our country are competitive as other countries are, we will remain with our beautiful Flag.”

## Operating from pole to pole

The World Explorer will spend the northern summer in the Baltic, the Norwegian Fjords, Iceland and Arctic. While, from November, she will operate in the Antarctic for the season, based out of Ushuaia in Tierra del Fuego, Argentina.

“Our guests can expect a five star hotel comfortable feeling when aboard our vessel, the available space per guest will be larger than usual and the guests will be able to experiment with multiple different spaces. The food will be provided by great European chefs while the ship is also equipped with a state of



Cabin interior on the World Explorer.

the art stability system that will help to make the most enjoyable ride.”

## Protecting the environment – reduced impact and a hydrogen fueled future

Mr. Ferreira talks about Mystic’s environmental focus: “We are very concerned about the environment. We will not use any single use plastics on board the World Explorer and the ship

is also equipped with a new technology sewage system. The garbage room is very well equipped - well dimensioned to compact, treat and refrigerate any waste that we have and bring it back to port.”

Regarding alternative fuels: “We do not believe in the LNG for ships of our size and with such an efficient hull. The fuel consumption of the World Explorer is very low when compared with other 10.000 tonnes vessels. Personally I believe that Hydrogen fuel cells could be a great alternative to this type and size vessels in the very near future.”

## Bureau Veritas classification

Bureau Veritas having been chosen as class for Mystic’s newbuildings asked how the company sees class in the process of designing and building his cruise ships:

“We see BV as a very strategic partner for all the vessels we have built in the past and in particular for this one. Since this one is one of the very first generation of expedition vessels to be ready it will not only contain state of the art technologies - and a lot of it - but also because we are building according to the new Polar Code regulations.

The experience of the BV team of engineers has played a huge and important role in the success of this prototype ship accomplishment.”



An impression of the two ships off Mykonos.

# EXPEDITION AMBITION



Niels Erik Lund,  
President and CEO, SunStone Ships

## Niels Erik Lund, President and CEO of SunStone Ships, speaks to the Technology Report.

### The next 10 to 15 years

Since 2004 SunStone's strategy was to expand within the niche market of expedition and small luxury cruise vessels. This will also be the strategy for the next 10-15 years. However, as we do not see any more attractive second hand vessels for acquisition, we are concentrating on new buildings. In 10 years we expect that most of our existing fleet will have been sold. We started that process by selling one ship in 2017, and two ships in 2019. Our fleet is now eight vessels. We anticipate that in 10 years we will have ten new buildings of the INFINITY class vessels and that we might have built two further new series of cruise vessels. One of smaller, warm water, adventure vessels, and another series of larger (up to 300 passengers) expedition and luxury cruise vessels.

### Technology and cruising - are their limitations?

In our niche of smaller cruise vessels, we see no limits to technology adoption, other than the natural limitations due to the size of our vessels.

### Measures to reduce environmental impact

On our new buildings we are having tier III engines installed (to meet No<sub>x</sub> requirements), and we will only be operating with marine gas oil, just like we do with our existing fleet. We have the lowest possible carbon footprint for fuel based engines.

### LNG as fuel and batteries or fuel cells

For Expedition vessels, due to the remoteness of the areas we operate in, we cannot switch to LNG operations. LNG is not available in those areas, and we do not have the space needed for the tanks, due to the range we need for these vessels. We see hybrid vessels as a gimmick. Batteries, which may last for less than for one hour of operation, and require the generators to charge them, will only result in additional pollution.

## Wind power

We have not looked into sailing ships, or sails to add to the power production of the vessels, and at this time we do not see sails being an option in our market niche.

## The role of class

We are very pleased that we have a very close relationship with class, and we see them as a close partner there also help us in the development of our newbuildings, as well as our constant upgrade of our existing fleet.



Niels Erik Lund, center, and participants at the Greg Mortimer steel cutting ceremony at CMHI in June 2018.



Images of the first SunStone ship, the Greg Mortimer, at the CMHI shipyard.

# ELECTRIC SHIPS

**The market for battery and hybrid applications is growing quickly, driven by environmental regulation and performance benefits.**

There is growing use of and demand for marine battery and hybrid energy systems combining energy sources. Many battery manufacturers, principally from the automotive or consumer electronics sectors, are entering or looking at the global shipping market as a huge opportunity.

This growth is supported and enabled by a regulatory framework for battery applications: standards issued in recent years are now generally recognized and used by stakeholders (IEC 62219, IEC 62220) providing confidence to all involved.

The principal battery technology in use is lithium-ion. Lithium-ion is a generic name which covers many types of technologies. Each one with its own advantages and disadvantages. Improved knowledge and understanding of the electrochemical processes have led, and continue to lead, to significant advancements in design.

The selection of one technology over another will depend on the intended use. The most important parameters are the energy density (capacity), power ('C' rate) and number of cycles.

Lithium Iron Phosphate is still used a lot but new chemistries are emerging, notably: Lithium Titanate (LTO), Lithium Nickel Manganese Cobalt Oxide (NMC).



These two technologies represent a good compromise between energy density and power.

## Safety

The safety concerns of lithium-ion batteries are also now well managed. New battery technologies make them ever safer. Battery Management Systems (BMS) are able to detect failures (like thermal runaway) at an early stage and enable the isolation of any faulty battery packs, keeping other packs in operation.

## Charging capacity

Charging capacity has been a major challenge and there are two aspects involved: firstly, for the batteries,

advancements are enabling ships to charge quickly when they touch the quay. Secondly, harbor infrastructure is vital - the amount of electrical energy which can be transferred from shore to ship depends on shore based electric grid capabilities.

## Hybrid power

Batteries were used for a long time on board small ships as a standalone source of power. They are now used in combination with other types of source, on board much bigger vessels and providing an opportunity to harness efficiencies and a route to limiting carbon intensity of operations.

This is hybridization - and it represents huge opportunities for designers and ship operators.

The introduction of batteries enables the selection of smaller engine sizes that can operate at optimal loads for a larger proportion of the time due to additional power being obtained from the batteries when required (peak shaving or load smoothing).

The battery installation also offers other functionalities such as a “zero emission” mode or “power back up” (or a “spinning reserve” in order to provide redundancy).

For now, hybrid electrical ships are mainly based on alternative diesel engine configurations, and battery packages. Other sources such as marine fuel cells and solar panels are developing fast but still don't offer significant power capacity and the return on experience provided by batteries.

Hybridization increases the flexibility of the ship, but also the complexity of the overall installation. Particular attention must be given at the design review, survey and testing stages.

*Energy Observer is the first hydrogen vessel, aiming for energy autonomy, with zero greenhouse gas emissions or fine particles. This former race boat, an outstanding competitor has been fully transformed into a vessel of the future, powered by electric propulsion thanks to a mix of renewable energies and a hydrogen production system that produces carbon-free hydrogen on board using seawater.*



### The role of class is vital in order to help ensure the safety and reliability of installations

BV has issued both “Battery system” and “Electric hybrid” additional class notations. An additional class notation “Electric hybrid prepared” is in preparation and will be issued in the middle of 2019 for ships to be converted to “Electric hybrid”, but for which the installation of batteries might occur at a later date. Battery technology is developing so fast that owners may prefer to postpone the installation of the batteries to a subsequent dry dock. The class notation “Diesel Electric hybrid propulsion” is provided for ships with a hybrid electric / mechanical propulsion system.

# SUSTAINABILITY AND CRUISE: A HAPPY MARRIAGE

Panos Koutsourakis  
Global Technology Leader,  
Sustainable Ships,  
Bureau Veritas



The shipping industry is embarking on a path towards environmental sustainability and de-carbonization. While the initial objective was to control and minimize harmful emissions such as nitrogen oxides (NO<sub>x</sub>), sulphur oxides (SO<sub>x</sub>) and particulate matter (PM), the focus is now shifting towards greenhouse gas (GHG) emissions, as clearly laid down in the initial strategy of the International Maritime Organization (IMO) - adopted in 2018. The cruise sector, which is highly exposed to the public and operates ships in environmentally sensitive areas - including polar waters, is changing course towards cleaner fuels and alternative power systems with the aim of reducing emissions and its environmental footprint.

A key trend in response is uptake of liquid natural gas (LNG) as fuel, which enables compliance with the most stringent IMO emission limits for NO<sub>x</sub> (tier III, except for high pressure 2-stroke engines) and Global Sulphur Cap without additional exhaust gas treatment and provides a first step towards lower GHG emissions (up to 30% lower carbon dioxide (CO<sub>2</sub>) compared to heavy fuel oil, without taking into account methane slip. This makes LNG a suitable transition fuel for the transition to carbon neutral and carbon free fuels. Bureau Veritas is a leader for the classification of LNG fueled ships and LNG bunker vessels, with a market share of around 25% and 65%, respectively.

The LNG capable fleet classed by BV is very diverse and includes large cruise ships, expedition cruise ships and RoPax ferries. Due to our historical involvement in LNG transportation we have a long and well proven track record and can provide in-depth technical support with regard to gas containment technology, propulsion system design, LNG bunkering and safety systems and training. We have developed a wide range of service notations designating and covering LNG and other low flashpoint fuels including liquid petroleum gas (LPG), ethylene and methanol.

For ships with large variations in power demand, batteries - in combination with a direct current (DC) electrical grid, allowing for variable speed engines - can provide optimum energy efficiency and zero emissions operation for a period of time. Tried and proven on ferries - which now shift to fully electric propulsion - and offshore vessels, electric-hybrid power systems could also prove their good use for cruise vessels. Bureau Veritas rules include dedicated **BATTERY SYSTEM** class notations for the safe installation and use of batteries on board and the **ELECTRIC-HYBRID** notation, which covers power management (**PM**), power backup (**PB**) and zero emission (**ZE**) modes. Currently a new **ELECTRIC-HYBRID PREPARED** notation, preparing ships for future installation of batteries, is under development.

Combining clean fuels and electric power storage, French luxury cruise operator PONANT has ordered the world's first dual fuel electric-hybrid expedition cruise ship with VARD Søviknes for delivery in 2021. This technologically highly advanced vessel with high icebreaking capability for accessing ice covered waters is classed by Bureau Veritas and features specially designed membrane tanks for LNG fuel storage and an advanced battery system so that there are no emissions when operating in electric hybrid mode. All together Ponant is setting with this newbuilding a new benchmark in sustainability in the cruise industry.

Looking further ahead Bureau Veritas is engaging with other forward thinking industry partners to develop the technology and regulatory framework for low and zero carbon fuels such as hydrogen and ammonia and advanced power systems such as fuel cells, but also wind assisted propulsion systems including kites and sail systems. The latter may be of particular interest for cruise vessels as it elegantly combines passenger interest with sustainable cruising.

BUREAU VERITAS  
MARINE & OFFSHORE  
8 Cours du Triangle  
92937 Paris-La Défense, France



**BUREAU  
VERITAS**