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Winterization Of Vessels For Polar Navigation

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ABSTRACT

In this project, we will describe the result of an end-of-grade work describing the preparation of a ship and the necessary precautions for its operation in cold and icy waters. In the paper, a brief introduction is made to the regulations in force for this special navigation and the different models of class of ice. Finally, a series of recommendations or proposals for improvement based on the experiences on board of the experienced crews under such conditions will be presented, to conclude with some comments on the future trend of the ice class LNG sector.

1. Introduction and background

We live in an age of technological achievements. Mankind has created extraordinary things pushing the limits of what we think is possible. It is in our nature to explore our world and build ways to do so.

Now we seem to know the face of our planet but this was not always the case. It took great courage and sacrifice to provide us with the map that we studied at school. Commerce routes have evolved over the centuries; we have created artificial canals such as the Suez and Panama Canal to shorten long voyages sailing round the continents. Quite recently, the huge engineering project of building a second and wider Panama Canal has been completed so that even the larger vessel can transit from one ocean to the other. Now with the change of climate, the extension of ice at the poles is reducing. The northeast and west passes are becoming an alternative to the longer routes crossing from the Atlantic to the Pacific Ocean. The benefits of these routes are a significant reduction of distance, time and fees for transiting the canals.

As the ice retreats, more oil and gas is discovered and becomes accessible in the arctic regions causing a big economic interest to the northern countries as the world still depends greatly on hydrocarbons for fuel and energy.

Navigating in ice is no simple task. Even though these routes seem attractive to the shipping industry, we must never forget the risks involved. Never the less thanks to the advances of technology in shipbuilding, we can now build safer and tougher ships to tackle the extreme ice conditions.

The experience of the merchant fleet in extreme ice conditions together with the investigation of the scientific community are making the ice-class ships evolve and improve. (Parnell, 1986).

2. Objectives

The main objective of this work is to highlight the results of the research carried out for the final grade work entitled 'The Preparation of the Vessel for Ice Navigation: Particular Case: The LNG 1A FS Ice-class Vessel' in which describes the preparation of a vessel and the necessary precautions for its operation in a cold climate or frozen waters. Prior to achieving this main objective, the improvement proposals and the results thereof will be detailed

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3. Methodology

The methodology used for the realization of the article has been the compilation of personal experiences of crews aboard ships navigating in polar areas. (ABS, 2010) This work is the result of a final grade paper presented at the University of Cantabria, this article only includes the results of the same.

Regulations

IMO has adopted the International Code for Ships Operating in Polar Waters (Polar Code) to make it mandatory under the International Convention for the Safety of Life at Sea (SOLAS) and the International Convention for the Prevention of Pollution from Ships (MARPOL). The Polar Code is expected to enter into force on 1 January 2017.

The Polar Code and SOLAS amendments were adopted during the 94th session of IMO's Maritime Safety Committee (MSC), in November 2014.

The environmental provisions and MARPOL amendments were adopted during the 68th session of the Marine Environment Protection Committee (MEPC) in May 2015.

The Polar Code covers the full range of design, construction, equipment, operational, training, search and rescue and environmental protection matters relevant to ships operating in the inhospitable waters surrounding the two poles.

This Code consists of Introduction, parts II and I. The Introduction contains mandatory provisions applicable to both parts II and I. Part I is subdivided into part I-A, which contains mandatory provisions on safety measures, and part I-B containing recommendations on safety. Part II is subdivided into part II-A, which contains mandatory provisions on pollution prevention, and part II-B containing recommendations on pollution prevention (Buysse, 2007).

The Code will require ships intending to operate in the defined waters of the Antarctic and Arctic to apply for a Polar Ship Certificate, which would classify the vessel as:

Category A ships: ships designed for operation in polar waters at least in medium first-year ice, which may include old ice.

Category B ships: designed for operation in polar waters in at least thin first-year ice, which may include old ice.

Category C ships: ships designed to operate in open water or in ice conditions less severe than those included in Categories A and B.

The issuance of a certificate would require an assessment, accounting for the anticipated range of operating conditions and hazards the ship may encounter in the polar waters. The assessment would include information on identified operational limitations, and plans or procedures or additional safety equipment necessary to reduce incidents with safety or environmental consequences.

Ships will need to carry a Polar Water Operational Manual, to provide the Owner, Operator, Master and crew with information regarding the ship's operational capabilities and limitations in order to support their decision-making process.

The chapters in the Code cover: ship structure, stability and subdivision, watertight and weather tight integrity, machinery installations, operational safety, fire safety and protection, life-saving appliances and arrangements, safety of navigation, communications, voyage planning, manning and training, prevention of oil pollution, prevention of pollution form from noxious liquid substances from ships, prevention of pollution by sewage from ships, and prevention of pollution by discharge of garbage from ships (International Maritime Organization, 2016).

4. Improvement proposals

Certain elements and equipment of the studied vessel could be improved based on its experience in ice conditions:

Mooring winches

The mooring winches when exposed to cold experienced problems caused by the temperature of the hydraulic oil. The winches are equipped with an oil heater but it was proved to small and inefficient resulting in most of the system being cold. During mooring operations at low temperatures, they were known to occasionally trip.

As a solution, a good insulation or heat tracing could be fitted on the exposed piping sections (Loyd and House, 2010).

The best solution would be to protect the mooring area with some kind of superstructure for the protection of the crew and equipment when mooring in extreme ice conditions.

Deck Service Steam

Steam service valves on deck have to be open continuously to let out steam to prevent it from freezing inside the line. If valves are closed, or opened too little, they freeze and crack. This results in a constant loss of steam.

Another consequence is the formation of ice due to the condensation near the service steam valve. The deck freezes in these areas and is added to the natural ice accretion.

This situation is particularly hazardous at the forecastle deck as it is very exposed to ice formation and many drains and steam service valves are located there. At times, it cannot be approached from the main deck due to the ice cover.

The common practice is to fit the valves with caps with thin bore pipes of 1 to 2 mm of diameter through which the steam keeps on coming out continuously. This keeps the valve from freezing and keeps a continuous flow of steam. At some locations the crew rig old or discarded air hoses for draining the steam over the side of the ship to prevent the additional ice formation but it is a quick and imperfect solution as these hoses deteriorate quickly and get blocked due to the rubber lining inside getting spoilt. This leads to freezing and possible cracking of the valve seat once the valve also freezes (O'Connell, 2010).

The solution could be a relief valve for the steam in the line over the side or a return arrangement for each steam service valve connected to a common line over the side.

Shelters

It would be very useful to provide the ship or create windproof shelters, which can be set-up quickly around small spots like valves to allow personnel to repair and do maintenance on the equipment. When windy it is very difficult to work on valves or electrical parts due to the cold and wind chill factor.

A possible solution could be some light tent like structures easy to mount and secure.

Hydraulic Oil for Valve Operation

Fitting heating or insulation for the hydraulic system of the cargo and ballast valves should be considered. At low temperatures the oil becomes viscous and even when the valves are manipulated often to prevent them jamming they end up becoming slow and giving problems.

A fixed heating arrangement, electric heat tracing and insulation in the passageways and on deck could be a solution to this problem.

Air Whistles: electric and pneumatic

The forward air whistle motor and aft air whistle tank has no heating system, which can lead to the piston mechanism freezing damaging the motor in the case of the electric freezing of moisture inside the air tank of the pneumatic. (OCIMF, 2010)

As possible solutions, an electric heater for the forward whistle and an electric heat tracing system with insulation cover for the air tank on compass deck could be fitted.

Paint Store Heating

Paint Store has no heating facility or insulation. The paint specification is for storage above 0^{o}C. This leads to the deterioration of paints and requests for new to replace them. As a solution, a steam heater could be installed in the paint store and the bulkheads insulated.

Fire Detectors

The cargo motor and compressor room fire detectors sometimes give faults due to proximity of the cold deck-head.

This could be corrected with insulation and preferably heat tracing.

Pipe Duct

The cofferdam bilge-draining pipe is located inside the pipe duct and runs along its entire length. This pipeline often contains water that freezes in cold climates, resulting in busted gaskets and inability to use the cofferdam and bilge pumping arrangement.

A reference should be made in the ships winterization manual, to drain the pipe properly by pumping the water to the main deck discharge and then open the non-return valve to drain the remaining water into the duct keel before entering cold regions.

5. Discussion

Navigating in high latitudes calls for skill and caution. Safety must be the main concern at all times. Ice navigation is tough and demanding. Weather conditions change rapidly and dangerous situations may develop. The worst scenarios are becoming beset, colliding with other vessels or damage to the ship (U.S NATIONAL ICE CENTRE, 2016).

Because of this, the ship and crew must prepare for encountering ice. The vessel must be winterized as best as possible. The bridge team must be familiar with ice navigation and in case an ice pilot is on board follow his instructions closely, the deck and cargo equipment are particularly prone to suffer the worst part, as they are the most exposed parts of the ship after the hull, rudder and propeller. Charterers and owners must provide with the necessary equipment to do so. A ship that lacks adequate stores and provisions will not be able to face such unforgiving conditions.

Small failures of equipment such as heating and heat tracings can finally result in catastrophic consequences. In these special conditions, the lifesaving and firefighting elements must be especially looked after. The main characteristics of the Polar Regions are their remoteness, there is no supporting infrastructure in many miles and aids to navigation are few.

In cold waters, a person will not last long even with an immersion suit. Frostbite, snow blindness and hypothermia are some of the effects of the cold environment on the crew. The ship is home to the crew and a safe location in such harsh conditions. She must be protected at all cost as lives may depend on her operability.

Through the experience of ships and companies trading in icy waters, the societies of classification and the different northern nations can create improved guidelines, requirements and specifications for the new ships being built. It is in everybody?s interest as these guidelines return to the ships and companies improving safety.

The most recent project in LNG shipping is the new buildings of ARC 7 vessels that will be between polar class 3 and 4 allowing them to operate in thick first and second year ice. These ships will be highly winterized. They will be double acting ships with azimuthing pod propellers. The propulsion will be diesel-electric capable of going ahead in thin ice and astern in heavy ice allowing them to operate independently from icebreakers. Some of their other features will be a strengthened hull to operate in temperatures of up to -45^{o}C, a specialized bridge for navigating ahead and astern, covered forecastle and poop deck for protection of the crew and mooring equipment, the deck and cargo equipment will be designed to operate at -50^{o}C and the living quarters will also be specially designed for the cold.

These ships are part of a major project in the Yamal peninsula in the Russian Arctic. Great reserves of gas have been discovered there and production will start in 2017. 10 ARC 7 ships will be delivered before such date to cover the expected production. More and more ships are expected to trade in these high latitudes due to economic trade. The ships must be prepared as well as possible for the challenge.

6. Conclusions

It takes a very long time to train an ice master. Ice navigation requires extensive knowledge on the nature, properties and usual motion of the ice.

The best training is gathered while serving in ice conditions. Although much of the knowledge and skill can be tough in courses or books the true experience comes only with actual onboard experience.

The weakest point of the ship is its crew; they are the ones exposed to the cold and must prepare the vessel for cold weather, carry out maintenance and de-ice the ships decks and surfaces.

Safety must be the main concern when navigating in cold areas. The remoteness of these regions must be taken into account as assistance in case of fire, abandon ship or pollution will take a very long time. The importance of preparing the ship and her maintenance are crucial.

The future of the ice-class vessels are the double acting ships capable of navigating ahead in light ice and astern in heavy ice allowing them to operate without icebreaker assistance.

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