EFFECTIVE SIMULATOR TRAINING IN PREPARATION FOR ICEBREAKING OPERATIONS AND ICE MANAGEMENT ASSESSMENT

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Abstract: It is estimated that as much as 13 per cent of the world's undiscovered conventional oil resources are located in The Arctic (the region located north of the Arctic Circle) [1]. As a result, future prospecting and drilling operations in this area will be of uttermost importance for guaranteeing a continuous supply of crude oil. To meet the demand of nautical officers with icebreaking competence, the Transatlantic Ice Academy (TIA) was established in 2008. The Ice Academy is a co-operation between Kalmar Maritime Academy, AB Transatlantic, the simulator manufacturer Kongsberg A/S and the Swedish Maritime Administration, and aims to educate and prepare nautical officers for the extreme conditions ice exerts on a crew. This paper describes two of the courses that TIA offers, the way that TIA has set up effective simulator exercises and how they will prepare the officer for upcoming challenges.

1. INTRODUCTION

The Transatlantic Ice Academy offers a great variety of ice courses; however, the two most frequent courses are custom-made simulator training for oil companies preparing for prospecting in the arctic region, and courses for deck officers who plan to work onboard Swedish icebreakers in the Baltic Sea. This paper will give a brief description of both courses.

A vessel or rig engaged in drilling in arctic waters will have to be prepared for tough ice conditions. The concept of ice management is that such a unit is supported by one or more icebreakers. Through radar surveillance and ice reconnaissance, heavy ice will be discovered at an early stage. An assessment of the ice will then determine if it is manageable or not. Following that decision, the icebreakers will either manage the ice before it reaches the drill unit, or the drilling will be suspended and the unit removed. TIA has planned and performed custom made training courses in ice management for a number of large oil companies.

Icebreaking is a necessity for keeping many harbours in the Baltic Sea and the Gulf of Bothnia open during winter. For this purpose TIA has set up a course to train potential icebreaking officers. Up until the present date, TIA has educated approximately 50 officers in the art of icebreaking. Given that TIA was established in December 2008, it is still too early to conduct any extensive follow-up evaluation of the course. Nonetheless, the general opinion of the course participants is that it is of great value and an excellent way to prepare the officers for their upcoming tasks.

2. BACKGROUND

Sweden has an extensive history of icebreaking; it goes all the way back to the late 19th century. Since 1926 the government has been responsible for the icebreaking service in Sweden, and today the planning of the service is executed by the

Swedish Maritime Administration (SMA) [2]. The icebreaking season starts in January and ends in late May. The goal is to keep all Swedish ports open all year around, and to manage this, up to ten icebreakers can be needed.

From 1926 up until 2000, the icebreakers were manned and operated by the Swedish navy. In 1999 an investigation concluded that a civil management of the icebreakers would be more cost efficient, so from 2000 the management has been contracted for a number of years at a time [3].

Having naval manning of the icebreakers had the positive effect that the supply of well trained officers was secured. With conscripts onboard, the interest for icebreaking was cultivated from an early age, the right recruits were signed and once an officer, chances were that he or she was to stay within the icebreaking fleet for the remains of his or her career. When the manning became civilian many naval officers decided to proceed to the new manning company and stay within the icebreaking business. However, today the supply chain of well trained nautical officers with competence of icebreaking is not as steady as it was before. As within the entire shipping cluster, the average age of sailors is increasing and within a few years a great amount of sea going personnel will retire.

Today, the path to becoming a skilled icebreaking officer is not as straight as it was under the naval supervision. To solve this, the Swedish Maritime Administration has stipulated the requirements to be met by every nautical officer in charge of a bridge watch onboard a Swedish icebreaker. These requirements include both theoretical and practical skills.

3. ICEBREAKING IN THE BALTIC SEA

3.1 Ice endorsement

The officer of the watch (OOW) onboard a Swedish icebreaker must hold an ice endorsement issued by the SMA. To obtain this endorsement, the applicant must complete training covering four areas: theoretical knowledge, simulator exercises, practical icebreaking experience and finally a number of written examinations.

The training starts with a one-week course designed to give the student general knowledge, covering areas such as the history and organisation of icebreaking, weather and ice conditions affecting the operation, and common icebreaking techniques. The latter basically involves ship handling and manoeuvring in ice. The student is also introduced to a special computer based communication program used onboard all Swedish and Finish icebreakers, called IB-bridge and IB-Net. During the initial week, the theoretical studies are mixed with simulator exercises. This way, whatever theories the student has acquired during the day is soon to be practiced in the simulator. At the end of the week the student has to pass a written examination, guaranteeing that all students reach a certain level of competence. This week is organised by Kalmar Maritime Academy (KMA) and TIA, and the training takes place at the academy in Kalmar, Sweden.

Following the week of studies at KMA, the deck officers must then complete a training program onboard one or more of the icebreakers. During this period, the student is under the supervision of an ice officer (an officer holding an ice endorsement), monitoring and practicing icebreaking operations. All frequently used techniques have to be practiced; therefore, the time onboard icebreakers varies greatly depending on the area and season. Usually, the time needed to complete this program varies from one month to one season, but can be even more extensive. During the onboard training the student also has to pass two written examinations, covering the geographical properties of the Northern Baltic Sea and the Gulf of Bothnia. The reason for this is simply so that the officer will be familiar with the area in which he or she will be operating as an icebreaking officer.

3.2 Simulator exercises

As with most simulator training, the purpose of this course is to prepare the student for real life situations. Therefore, the simulations have to be as real as possible and focus on the elements that the student will encounter onboard the icebreaker.

In general, there are three elements that are of great importance for becoming a skilled ice officer: correct techniques for handling the icebreaker, strict and uniform communication, and experience. The former two are easily practiced in a simulator while the latter is learnt over time. However, it is important to bear in mind that the simulator training does not claim to produce expertly skilled officers, but rather to prepare them for the upcoming onboard training. Expert knowledge is acquired gradually over time.

During the course the participants run approximately ten different exercises. Each bridge team consists of two students, one acting as officer in charge (manoeuvring officer) and the other as co-officer. Usually, each bridge team is supported by an ice advisor, who is an experienced ice officer. The ice advisor offers instant support and continuous feedback. Below, the most important exercises are described with their main objective, general scenario and planned result.

3.2.1 Assisting a vessel that is stuck in ice

This exercise is run a number of times with only slightly different settings. As breaking free a vessel that is stuck in ice is one of the most common procedures for an icebreaker in the Baltic Sea, this is a very important exercise and can easily be repeated three or four times.

Scenario. The exercise takes place in an area that is completely covered with 0.4-0.6 metres of ice. There, a merchant vessel is stuck in the ice and has called the icebreaker for assistance. The icebreaker is approximately 1 nautical mile (NM) from the vessel. The weather is fair with good visibility and day-light.

As the vessel that is to be assisted is being approach, communication has to be established between the two vessels. The merchant vessel has to be informed about the icebreaker's intentions, and the merchant vessel has to provide information such as ship's heading, engine status, ice conditions around the vessel etc. At the same time the officer in charge of the manoeuvring has to assess the ice and determine, with regard to the wind, on which side to pass the vessel that is to be assisted. Another factor that has to be taken into consideration when deciding how close the icebreaker can pass the vessel is whether or not there is a substantial open wake around the vessel's stern. If the icebreaker gets too close to this area of open water it could sheer away, possibly resulting in a collision. When the icebreaker passes the assisted vessel, the latter one is given the order *full ahead*. If the vessel gets loose, it will then follow the icebreaker towards weaker ice or open water.

This exercise is repeated a couple of times. The students get to try to approach the merchant vessel both from ahead and astern, and in both good and bad visibility.

Result. The outcome of this first exercise is almost always the same. The students focus too much on the icebreaking and too little on communication with the other vessel. They try to be polite in their speech and do not use the standard marine communication phrases (SMCP). This results in too much talking but not enough information being communicated.

Furthermore, at this stage the bridge team onboard the icebreaker is usually very individualistic. The officer in charge tries to manage both the manoeuvring and the communication, delegating neither task to the co-officer.

3.2.2 Assisting a vessel in the stern notch

Another commonly used technique is when the icebreaker takes the assisted vessel into the stern notch to pass through an area with heavy ice or ridges. This can be done with or without connect-

ing a towing wire. When assisting many vessels in a convoy it might be useful to have the weakest vessel in the stern notch with a wire connected. However, if a convoy gets stuck in a difficult area, the icebreaker could assist one vessel at a time in the stern notch without connecting a wire. This is done quickly, and when all vessels are through the heavy ice the convoy can proceed.

Scenario. The exercise takes place in an area that is completely covered with 0.6-1.0 metres of ice. A merchant vessel is stuck in a heavy ice ridge, which makes it difficult for the icebreaker to simply pass closely by the side.

The icebreaker will have to approach the vessel from ahead, slowly reversing until the two vessels are touching, with the vessel's bow in the stern notch of the icebreaker (see figure 1). Depending on the situation, the officer in charge may decide that a wire is to be connected or not. No matter what is decided, the following actions apply to both situations. The icebreaker will give the order *full/half ahead*, while still reversing its own engine. The reason for this is that the vessels have to be in contact at all times. When the composite unit is slowly moving ahead, the icebreaker will also go ahead.

This exercise is usually done at least twice, with and without connecting a wire.

Result. Communication is of uttermost importance in this scenario, as well as that the officer in charge of manoeuvring the icebreaker really takes charge of the situation. What often happens, both in a real situation and in the simulator, is that the assisted vessel is having trouble steering correctly after the icebreaker. In the simulator this is easily achieved by the instructor who is in command of the merchant vessel. If the assisted vessel does not steer straight after the icebreaker, the unit will easily fold, which in turn can break the wire and result in damage to the vessels.

Figure 1 shows no folding effect when the assisted vessel manages to steer straight after the icebreaker.

Fig. 1 No folding effect

If the composite unit starts to fold, the manoeuvring officer immediately has to give the correct rudder order to the assisted vessel, to counteract the folding effect. The correct rudder orders on both the icebreaker and the assisted vessel are shown in figure 2.

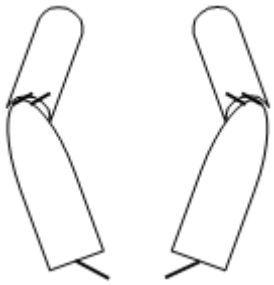

Fig. 2 Units folding to starboard and port

The main objective of this exercise is achieved when the students realise that they must, and have the right, to take charge of the situation and give strict orders to the assisted vessel.

3.2.3 Changing convoys

With many vessels travelling in the same area, icebreakers try to direct the vessels through certain waypoints. This is done mainly to keep the vessels in the area with the least problematic ice and within reach when assistance is needed. However, another positive aspect is that when many vessels travel in the same ice tracks, the tracks stay open longer, and with fewer tracks in the ice, they are easily identified. This is also the reason why, when two icebreakers with convoys meet, they pass each other and enter each other's tracks.

Scenario. The exercise takes place in an area

that is completely covered with 0.3-0.5 metres of ice. The weather, visibility and light settings can vary.

Two icebreakers with convoys are travelling towards each other. The vessels in the convoy are operated by the instructor, but the students have to maintain proper communication with the convoy. Depending on the ice conditions, there are two ways to change convoys. The icebreakers could pass each other, enter the other track and when the vessels have reached the new track, the icebreaker turns around and catches up with the other convoy, thus proceeding in the opposite direction (see figure 3).

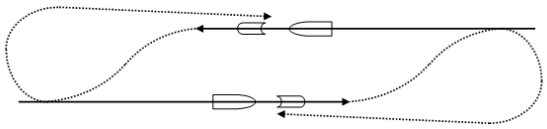

Fig. 3 Changing convoys

The above method imposes a minimal risk, since the icebreakers can pass each other on a safe distance. If the ice condition is not too harsh and the visibility is good, another method can be employed. By increasing the distance to the first vessel in the convoy, the icebreakers can turn simultaneously, making a 180° turn and enter in front of the other convoy, thus travelling in the opposite direction (see figure 4). This method is quicker but requires that all involved are perfectly aware of the correct procedure.

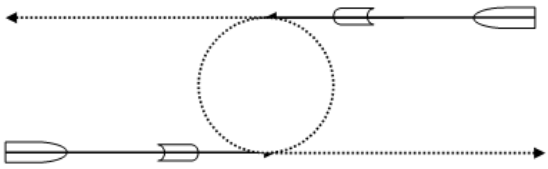

Fig. 4 180° simultaneous turn

Result. Changing convoys is a standard procedure that icebreaking officers must master. The main objectives of this exercise are for the students to get a feeling of the ice and from that determine how to best change convoys, and also to practice communication. This exercise is performed at least twice, and the students are encouraged to try the 180° turn. However, sometimes the instructor can change the ice conditions, making it too difficult to perform such a manoeuvre. It is then up to the students to realise this and make the (sometimes difficult) decision to abort or change plans. Approximately half the time this advanced manoeuvre is carried out. If not, then the students can discuss during a debriefing why it did not work, and then the exercise can be run one more time.

3.2.4 Handing over a convoy to another icebreaker

During a normal winter with average ice coverage, there might be up to fifteen Swedish and Finish icebreakers operating simultaneously in the northern Baltic Sea and Gulf of Bothnia. For easy organisation, each icebreaker is assigned an area in which they will monitor the traffic and assist when needed. Therefore, it is common practice that when two icebreakers meet in between two areas, a convoy is handed over from one icebreaker to the other. In that way, several icebreakers might assist a vessel or convoy through long passages of ice.

Scenario. The exercise takes place in an area that is completely covered with approximately 0.4 metres of ice. The weather is fair with good visibility and time of day could be either dusk or night-time.

Two icebreakers are approaching each other on opposite courses, one of them assisting a number of vessels in a convoy. The one taking over the convoy turns around and manoeuvres into a position in front of the other icebreaker, adjusting the speed until it is situated roughly 0.1-0.2 NM ahead. With the relieving icebreaker in position, the former one breaks out of the channel and the relieving icebreaker takes over.

Result. At this stage of the simulator training, the students have started to grasp the importance of good communication. The communication between the icebreakers usually runs smoothly, and

the information to the vessels in the convoy has become brief and strict. The students do not feel the need to be overly polite and use elaborate sentences any more.

As a result, this quick exercise can easily be repeated with different weather and light settings, and the outcome is nearly always successful.

4. ICE MANAGEMENT

Depending on in what area an ice management operation will take place, the procedure and training will have to be different. During the past years, Kalmar Maritime Academy and TIA has planned and performed a number of courses for both seagoing crew and onshore personnel, in preparation for ice management operations. These courses have been put together in accordance with the customers' specifications. Below, a typical ice management simulator exercise is described with its main objective, general scenario and planned result.

4.1 Ice management simulator exercise

The main objective of this exercise is for the onboard crew to practise assessing the manageability of the ice, and to communicate the situation to the onshore personnel. After the ice has been assessed, proper actions have to be taken according to the situation.

Scenario. The exercise takes place in an area with open water. There is a drill rig anchored to the sea bed and one icebreaker with anchor handling capacity nearby. 10 NM further away there is another icebreaker standing by. Approximately 20 NM NNE of the rig there is a floe of ice, with some ice ridges. Satellite images (provided by the instructor) show fairly accurately the size and characteristics of the floe (see figure 5). Note that figure 5 is not made in scale.

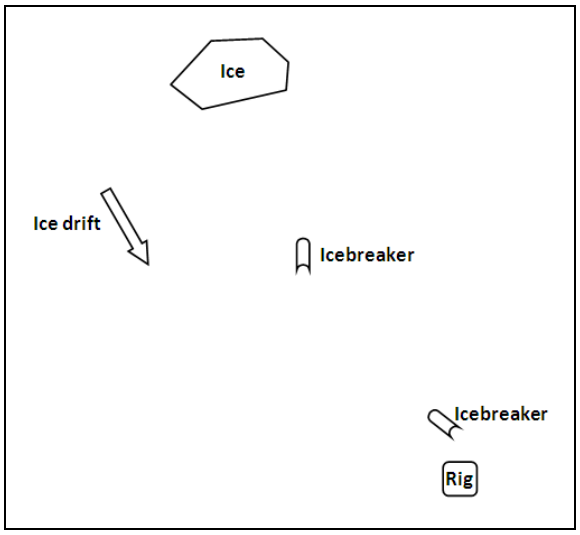

Fig. 5 Ice management operation

One icebreaker will then approach and enter into the ice, to estimate the ice thickness and ice drift. With the help from a weather forecast (also provided by the instructor) the crew has to estimate how long it will take the ice to reach the drill rig, thus estimating whether or not the ice is manageable.

Following that decision, the icebreaker will either start to break the ice into smaller pieces, creating ice that is non-hazardous, or prepare for a rig move.

Result. Depending on the ice conditions the outcome of this exercise varies from time to time. Usually the same exercise is run a number of times with an increasing level of difficulty.

Often the participants are already fairly familiar with the concept of ice management. They might be crew members with many years of ice experience, or operational managers who have spent many months compiling an ice management plan. In these cases, it is not so much the icebreaking techniques that are being practiced, but an operational plan that is being tested. The communication between the involved parties generally runs smoothly. For many participants, the new experience of being and working in a state-of-the-art simulator is a real eye-opener. Most of the time, this simulator exercise proves that the pre-existing ice management plan will work satisfactorily, possibly with only minor adjustments.

5. CONCLUSION

For quite some years, Kalmar Maritime Academy has offered a course in ice navigation which has focused on navigation and ship handling from a merchant vessel's perspective. The demand for this course has been bleak; only two courses have been given during the past three years. However, since the formation of the Transatlantic Ice Academy in late 2008, and with a change of focus from the merchant fleet to specific areas of icebreaking, the interest for ice courses has boomed. There are a number of reasons for this.

Firstly, TIA is a collaboration of four parties which bring together expertise from four different areas, all striving towards the same goal: Transatlantic with its field experience, Kongsberg with its constant support and updates of the software, the Swedish Maritime Administration that continuously validates the quality of the training, and finally KMA with its pedagogical and skilled instructors, well developed simulators and an ongoing dialogue with the shipping cluster, enabling KMA to be attentive to the needs of the market. This partnership lets everyone focus on what they are best at, making sure that the end product is the very best it can be.

Secondly, TIA strives towards training that is as realistic as possible. This is achieved through an ongoing dialogue between KMA and Kongsberg, where programming errors and unrealistic features are reported and attended to hastily. Furthermore, the ship model used in the simulator is an exact replica of a Transatlantic icebreaker, and some 200-300 hours of work have been put into finalising and testing the model.

Finally, planning and hosting seminars and simulator training in ice management is a great way for KMA and TIA to acquire new knowledge. During an ice management seminar, most participants have sound knowledge of this area. Even though we set up and guide the participants through a number of exercises, we as instructors listen to and reflect on their comments and feedback. At a recent seminar in May 2010, a group of 25 participants had a total experience of approximately 850 years at sea, of which 250 years were from ice experience. In a group like that, information and skills flourish. This knowledge is of course of great value to the individual instructor. But at the same time, that same knowledge is also invested into future students, thus continuously improving the standard of the training, which in the long run gives Kalmar Maritime Academy a solid and reputable trademark.

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AUTHOR'S BIOGRAPHY

Magnus Boström is a Master Mariner with experience from both the merchant fleet and the role of deck officer, as well as from being a master and instructor in the Amphibious Corps of the Royal Swedish Navy. Since 2009 he is a lecturer at Kalmar Maritime Academy at the Linnaeus University, Sweden. Apart from teaching at the Master Mariner's Program, he also plans and holds courses in icebreaking and ice management at the Transatlantic Ice Academy.

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