



Martech Polar

Ice Navigation in the Northwest Passage

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Abstract

The role of the ice navigator has become an important component in safe shipping operations in the Arctic. New standards and governance initiatives by IMO and various governments will impact the shipping industry in the future. This paper will provide an overview of the role of the ice navigator, the need for pilotage in the NWP and how it may be structured. It will include an overview of the ice typically encountered and how these and the accuracy of navigational charts affect transit. From a pilotage perspective, the paper will also address other operational issues including the prospect of remote assistance in higher latitudes (mechanical, medical and environmental emergencies).

The Northwest Passage

To many, the Northwest Passage remains as mysterious today as it was in the 19th century in the hey day of Britain's quest for its elusive attainment. The name itself conjures images of cold bleakness in the minds of most people. But to those that regularly traverse its length today, it is for the most part simply another navigational challenge. The route is known, reasonable charts exist, and passage is now relatively frequent. If one does not count transits by Canadian Coast Guard icebreakers, on the average, about 6 complete transits and numerous partial transits occur every year. At any given time the NORDREG traffic lists may include several dozen commercial vessels reporting within the zones of the Canadian Arctic. None the less, the Northwest Passage is a navigational challenge that requires skill sets and knowledge additional to what the average navigator or ship's officer may possess.

It is not so much the typical navigational challenges of unknown or little known routes where the services of a local knowledge pilot may aid the Master of a vessel in transit, but the knowledge of the weather and ice conditions that can combine to thwart the best laid passage plans of an unprepared navigator. Even in the best of years, ice conditions can pose a formidable barrier to even a purpose built icebreaker. During the summer 2005 navigational season, even the 18.0 MW Swedish icebreaker Oden encountered difficult conditions transiting Peel Sound, encountering 9 plus tenths ice, peppered with multi-year floes. A recent paper published by Dr. Humfrey Melling of the Institute of Ocean Sciences in Sidney BC, indicated that though subsurface moorings placed through out the arctic to monitor sea ice conditions did indicate a minimal decreasing trend in sea ice thickness, ice concentration or overall coverage seemed to be increasing, at least in the Beaufort Sea. Global Climate Change aside, for the foreseeable future, sea ice through out the Northwest Passage will remain a potential barrier to passage and a challenge to the navigator.

Specialized Skills

That specialized skills are necessary to navigate in ice conditions has been recognized since the first forays into Arctic waters. Whaling Captain William Scoresby stated in his 1820 *The Arctic Regions and the Northern Whale Fishery*:

“the navigation of the Polar seas, which is peculiar, requires in a particular manner, an extensive knowledge of the nature, properties and usual motions of the ice, and it can only be performed to the best advantage by those who have long experience with working a ship in icy conditions.”

Early sailing vessels often included in their crews Ice Masters, more often culled from the ranks of the whaling ships that frequented Baffin Bay and Davis Strait. These supernumerary officers provided the skill and knowledge of ice conditions that exploring Royal Naval officers did not possess. Even Sir John Franklin’s ill-fated ships HMS Erebus and Terror had Ice Masters onboard, James Reid and Thomas Blanky respectively.

It is no less true today. In the September 1st 2005 issue of Fairplay, Stena’s Ulf Ryder recognized the years of development necessary to train an officer to handle a ship in ice, recognizing “it takes as long to train an Ice Master as it does a brain surgeon.”

By nature of their specialized work, the crews of modern icebreakers are well trained and skilled in the assessment of ice conditions en route and the execution of a passage. Just as Scoresby wrote almost 200 years ago, these skills are honed over years and many miles of transit in ice regimes that challenge their growing skill. The average mariner however, rarely challenged by the extreme conditions within an ice passage, does not have the opportunity to gain from experience, to add to his or her knowledge base and therefore make appropriate decisions when faced with the ever changing and challenging ice conditions of the Northwest Passage. For this reason ship owners and regulators acknowledge the need for onboard specialists to assist and advise the bridge team when it comes to passage through ice regimes. However, unlike coastal, harbour or river pilots, ice pilotage has remained unique in its status and though recognized as required had until recently remained industry driven for the most part.

Modern Requirements for Specialized Skills

In the 1970’s with the advent of petroleum exploration and potential exploitation, particularly in the western arctic, Transport Canada recognized the need to regulate marine traffic within Canadian Arctic waters in order to protect the fragile environment. The Arctic Waters Pollution Prevention Act and Regulations came into force in an effort to put in place regulations that would achieve that protection. In the mid nineties Transport Canada took another step, researching what skills and knowledge should be required of a bridge navigation officer when transiting arctic ice regimes. Due to the

presence of heavier multi-year ice in the arctic, it was felt that even skills developed in more benign first year only ice conditions was not sufficient.

The research, conducted for Transport Canada by Canarctic Shipping Company, with subcontract to the Marine Institute to develop model instruction modules based on the skill sets, resulted in the International Ice Navigator Course Development position paper. This paper would be presented to IMO and become an integral foundation for what would become the Polar Code, and then eventually the IMO Guidelines for Ships Operating in Arctic Ice Covered Waters.

As lead author of the position paper, I was heartened to find that globally, there was a common agreement that the challenges faced by navigators while transiting arctic ice regimes were often beyond the scope of present or even future expectations of average mariner training and experience. Though many of the new skills and knowledge could be taught in well developed courses, the true skill came only with actual onboard experience. As predicted by Scoresby many years before and echoed by Ryder so recently, the final paper confirmed that specialized skills and knowledge were required of navigators onboard vessels transiting arctic ice regimes, detailed those skills and knowledge, presented model courses for training and recommended minimum experience onboard vessels engaged in navigation within arctic ice regimes for both junior watchkeeping officers and the Master. Endorsements to Certificates of Competency in two levels were recommended, one for Officers of the Watch that would be based on a syllabus of training and a second higher for the Master or at least one senior watchkeeper requiring quantified experience in arctic ice regimes.

The position paper identified the broad array of additional skills and knowledge required to safely navigate within the multi-year ice regimes of the Northwest Passage. The Ice Navigator must fully understand ice physics, and be able to identify ice types and forms, with particular attention to the more dangerous glacial and multi-year ice that may be encountered. This includes the ability to visually interpret conditions all around the vessel and the signs of ice in the vicinity as well as be able to interpret the various ice imagery, charts and reports that are available. He or she must understand the interaction of weather conditions, currents and ice, along with the prevailing conditions that should be expected at particular periods of transit. The Ice Navigator must be able to combine that knowledge with the more traditional aspects of passage planning in order to develop the most effective and safe routing under, at times, very dynamic conditions. Full knowledge of the limitations of ships based on ice class (or lack there of), due to hull strengthening, power and manoeuvrability are necessary to approach and enter an arctic ice regime safely and successfully direct a vessel through even the most innocuous ice regimes. He or she must be skilled at avoiding potential besetment, and if forced into that unenviable position, must be skilled at methods to free the ship and handling a damaged ship were that to occur. The Ice Navigator must have complete understanding of operations with icebreakers, the requirements and communications necessary.

The immediate result of the position paper was a change to Canada's Arctic Shipping Pollution Prevention Regulations.

Today, section 26. (1) of the regulations requires any tanker transiting Canadian Arctic waters to carry an Ice Navigator at all times, and vessels other than tankers to carry an Ice Navigator if they intend to transit zones that would otherwise be closed to their vessel by virtue of the zone/date system of CASPPR by instituting the option to utilize the Arctic Ice Regime Shipping System. AIRSS permits an experienced ice navigator to make subjective assessments of present ice conditions, enter a calculation based on those assessments with a factor based on the vessel's ice class, then determine a go no go decision.

The Ice Navigator shall:

- (a) be qualified to act as a master or person in charge of the deck watch in accordance with regulations made pursuant to the Canada Shipping Act; and
- (b) have served on a ship in the capacity of master or person in charge of the deck watch for a total period of at least 50 days, of which 30 days must have been served in Arctic waters while the ship was in ice conditions that required the ship to be assisted by an ice-breaker or to make manoeuvres to avoid concentrations of ice that might have endangered the ship.

The 2002 IMO Guidelines, though not compulsory, recommend a similar specialized skilled individual onboard vessels operating in Arctic ice covered waters, section 1.2.1 stating "all ships operating in Arctic ice-covered water should carry at least one Ice Navigator qualified in accordance with chapter 14." Chapter 14 requires an Ice Navigator to "have documentary evidence of having satisfactorily completed an approved training program in ice navigation." The original Polar Code required documented service in Arctic ice conditions. As yet neither IMO nor Canada has seen necessary to accept the recommendations of the position paper to pursue the concept of an Ice Navigator endorsement on Certificates of Competency.

Ice Advisor Model

The requirement of the special skill set and knowledge is also recognised in the East Coast waters of Canada during the winter ice navigation season. Though not affected by multi-year ice conditions, the Gulf experiences heavy ridging due to the dynamic current and wind effects. Here, the Joint Industry – Coast Guard Guidelines for the Control of Oil Tankers and Bulk Chemical Carriers in Ice Control Zones of Eastern Canada, otherwise known as JIGs, recognizes that most commercial vessels do not transit ice regimes with sufficient regularity to maintain ice navigation skills, and require the presence onboard of a person experienced in navigating an active Ice Control Zone. For many ships this person is the contracted "Ice Advisor". The person "must have a

certificate of competency valid in Canadian waters, be medically fit and have sailed as Master or Senior Watchkeeping Officer or Ice Advisor during the last five year period, while making at least 6 one way trips, totalling a minimum 15 days experience navigating ice covered waters that required the ship to make extraordinary manoeuvres or to be assisted by an icebreaker.”

The Shipping Federation of Canada annually publishes a list of recommended Ice Advisors for the use of member shipping companies. Accepted individuals must prove that they meet the requirements of the JIGs before they are listed. Ice Advisors contracted by the shipping company will board vessels inbound before the vessels enter ice and provide professional advise to the Master and Bridge team through out an ice transit. Outbound, the Ice Advisor will depart once the ship is clear of ice. Many companies, such as Fednav have their own list of accepted Ice Advisors.

The many years of experience requiring Ice Advisors in the Gulf of St. Lawrence has proven that the concept of adding supernumerary especially skilled personnel to regular bridge teams during ice regime transits is workable, efficient and economical. Shipping and Ship Management Companies, rather than attempt to maintain high level skills required of Ice Navigators onboard ships where ice transits are few, can augment regular crew skill with experienced and effective advisors only when required. This same process is generally followed on most other non-icebreaking ships transiting the Northwest Passage today, fully in compliance with the intent of the Arctic Shipping Pollution Prevention Regulations and the IMO Guidelines.

Effective Model

The ice advisor model is effective. The combination of National regulations, IMO guidelines, and insurance requirements work together to ensure that vessels that transit the ice infested waters of the Northwest Passage carry onboard mariners who possess the necessary skill and knowledge to ensure safe transit. Employing an Ice Advisor only when required, without the expensive proposition of trying to train or maintain skills of navigators that rarely transit the ice is the most economical method of meeting Ice Navigator requirements for most shipping companies.

The skilled Ice Advisor will board the vessel as a supernumerary officer prior to entering ice infested waters armed with latest ice information combining it with their specialized knowledge to interpret ice imagery and information, recommend both strategic and tactical routing and even advise the vessel’s management team on cold weather precautions not directly related to navigation. With the full understanding of the physics of sea ice formation and degradation, the effects of wind and current combined with the local knowledge of the maze of passages within the Canadian Arctic Archipelago, the Ice Advisor provides daily and hourly recommendations to the Bridge Team. Often one of the greatest challenges is in educating the Bridge Team to raise them to a higher

operational skill level in ice navigation. A more safe and efficient transit of ice covered waters results.

Training and maintaining skills and knowledge in crews that less frequently transit ice infested waters can be time consuming, costly and less effective than hiring and placing onboard skilled Ice Advisors only during periods when these specialized skills are necessary.

Skill Development

Where do these advisors gain their skills? Many have gained their experience as watchkeeping officers on vessels that more regularly transit Arctic ice regimes. Companies such as Groupe Desgagnés, Nunavut Eastern Arctic Shipping and Northern Transportation Company and the Canadian Coast Guard have contributed to the ranks, their officers having built their skills with their regular presence in Arctic waters. A great deal of experience has also come from the petroleum exploration boom in the Western Arctic in the 1970's, 1980's and early 1990's. In the Beaufort Sea, bridge teams learned by trial and error what worked and what didn't.

Modern courses as envisaged by the Ice Navigator Position Paper do provide a valuable background, but as yet none of the practical skill development. Meriturva Training Institute in Finland, the Netherlands William Barentsz Institute and Argentina have conducted classroom training.

In the future, simulators may provide valuable skill development opportunities. Transas has developed simulation programs and suites in conjunction with Russia's Arctic and Antarctic Research Institute that provide excellent visual representation. Enfotec Technical Services of Ottawa in conjunction with PhiloSoft has developed a PC based instructional Ice Navigation Training Module. The Marine Institute in St John's conducts their Fundamentals of Ice Navigation which utilizes their full motion simulator in an attempt to provide skill development on top of knowledge accumulation. Missing thus far in all of these simulators however, is the realistic interaction between ship and ice as represented in the visual simulations.

Continuing Challenges in the Northwest Passage

Even with the broad array of skills and knowledge that an effective Ice Navigator develops over years of arctic experience, the Northwest Passage will still provide challenge.

Though glacial ice forms are only encountered in the eastern arctic, multi-year ice occurs though out the passage. Even during periods of least ice cover, choke points

exist that must be transited with utmost care. Peel Sound and McClintock Channel, the latter more often choked with multi-year ice; guard the eastern entrance to the central Arctic. Though generally more open than McClintock Channel, the route through Simpson Strait and James Ross Strait to the east of King William Island is draft restricted. McClure Strait is generally heavily choked with old ice, blocking access to Prince of Wales Strait. Dolphin and Union Strait at the western entrance to the central Arctic can be a challenging choke point in the early part of the navigational season. And finally, the polar pack may choke off the western entrance into the Canadian Arctic if it sets down along the coastline during the navigational season.

Charting of the Canadian Arctic remains a challenge. Just as many other Canadian federal agencies, the Canadian Hydrographic Service (CHS) has been forced to deal with budget issues that have restricted updating of the suite of charts that cover the Northwest Passage. Adjoining charts may often have different datum standards; in some cases such as *Chart 7725 Requisite Channel and Approaches*, datum is unknown; and some surveys dating to the 1800s. Visual or radar range and bearing positions can shift a vessel hundreds of metres in latitude and longitude when changing charts in some areas. Bridge teams can not risk lackadaisical acceptance of charts and positions without due care and attention. Soundings themselves are often sporadic, and in many cases are the result of track soundings of transiting Canadian Coast Guard icebreakers that intrepidly yet cautiously sailed through the Archipelago. Chart projections such as Polar Gnomonic still exist in the waters of the Northwest Passage, though new charts are being issued in the more comfortable Mercator projection. As funding allows, CHS has gradually been updating bathymetric data, datums and chart projections and issuing new charts. To be fair, the primary routes are sufficiently well covered to enable safe navigation, even if an extra level of diligence is required.

One of the greatest challenges facing the navigation team and the Ice Advisor onboard vessels transiting the Northwest Passage is its remoteness. Unlike the Baltic or Gulf of St. Lawrence, surrounded by population and resources, the Northwest Passage offers little support to a transiting ship. Canadian Arctic communities are small villages, few and far between providing virtually no infrastructure to support anything but the smallest vessels. Though the communities provide scenic and historical backdrops for transiting adventurers and pocket cruise vessels, only anchorages are available except at the two ore berths that once served Nanisivik and Polaris mines. A vessel in transit must ensure that all its needs with respect to fuel, provisions and spares are met prior to entry into the Canadian Arctic. Only limited and costly opportunities exist for restoring or obtaining spare parts, and fuel is almost impossible to obtain except in an emergency basis. Arrangements may be possible for advance fuel orders from barges coming down the Mackenzie River. Overall, the bridge team must consider that the transit is a “come as you are” affair unless specific and costly deliveries are planned well in advance.

The remoteness also factors in emergency response. There are no salvage tugs waiting for calls for assistance, few nearby helicopters waiting to leap to medevac

injured crew or passengers to state of the art medical facilities. There are no Commercial pollution response corporation vessels or equipment in the Canadian Arctic, though all Coast Guard vessels carry rudimentary oil spill response equipment and some equipment is pre-positioned. In the Arctic, the Coast Guard takes the role of the pollution response companies that mariners are familiar with on the Pacific and Atlantic Coasts. Though there may be up to half a dozen Coast Guard vessels operating in the area of the Northwest Passage for the bulk of the navigation season, there is never a guarantee that one is within immediate response range unless the transiting vessel is already in company with the icebreaker due to ice conditions. Almost all the icebreakers are helicopter equipped and all carry at least a nurse along with the regular ships rescue specialists.

Conclusions

In conclusion, several points stand out:

- The Northwest Passage will continue to remain a navigational challenge for the foreseeable future.
- The skills necessary to ensure a safe and efficient transit take years to develop over numerous encounters with polar ice conditions.
- Modern simulators are gaining in capability, but as yet cannot replace actual time in ice covered waters.
- Transiting of the Northwest Passage is a “come as you are” voyage, as support facilities are virtually nonexistent.
- The Ice Advisor Model, where mariners that possess the skills and experience necessary to ensure safe navigation through the Northwest Passage are brought onboard when required is the most economical way to achieve safe and efficient transit.