Canadian Ice Regime System Database

G. W. Timco and I. Morin
Canadian Hydraulics Centre, National Research Council of Canada
Ottawa, Canada

ABSTRACT
Transport Canada has proposed extensive revisions to the Canadian Arctic Shipping Pollution Prevention Regulations (ASPR 1989). In part, these changes make use of actual ice conditions, and define the conditions in which vessels can navigate in ice-covered waters. The system is based on the quantity of hazardous ice. Transport Canada approached the Canadian Hydraulics Centre of the National Research Council to assist them in developing a scientific basis for the Ice Regime System, which is at present based on operational experience. A seven-step approach was developed to do this. A major part of this process was the development of a comprehensive database that would relate ship damage to ice conditions and environmental factors. This paper describes the development, design and format of the database. It also includes a few examples of the types of queries that can be performed with the information in the database.

KEYWORDS: Ice regime, ASPPR, ships, damage, safety, database.

INTRODUCTION
Navigation in Canadian waters north of 60°N latitude is regulated by Shipping Safety Control Zones. At the present time, a "Zone/Date" matrix gives entry and exit dates for various ship types and classes. It is a rigid system with little room for exceptions. It is based on the premise that nature consistently follows a regular pattern year after year. Transport Canada, in consultation with stakeholders, has proposed extensive revisions to the Canadian Arctic Shipping Pollution Prevention Regulations (ASPR 1989; TC-RIAS 1996; AIRSS 1996). The changes are designed to reduce the risk of structural damage in ships which could lead to the release of pollution into the environment, but provide the necessary flexibility to ship owners by making use of actual ice conditions, as seen by the Master. In this new system, an "Ice Regime", which is a region of generally consistent ice conditions, is defined at the time the vessel enters that specific geographic region, or it is defined in advance for planning and design purposes. The Arctic Ice Regime Shipping System (AIRSS) is based on a simple arithmetic calculation that produces an "Ice Numeral" that combines the ice regime and the vessel's ability to navigate safely in that region. The Ice Numeral (IN) is based on the quantity of hazardous ice with respect to the ASPPR classification of the vessel (see Table 1) and is calculated from Equation 1.

[Equation 1.] \[ IN = \sum_{i=1}^{n} M_i F_i \]

In Equation 1, \( F_i \) represents the fraction (in \( 10^8 \)) of ice of a certain type and \( M_i \) the Ice Multiplier for that ice type and a given ship category as shown in Table 2. The values of the Ice Multipliers are then adjusted to take into account the decay or ridging of the ice by adding or subtracting a correction of 1 to the multiplier, respectively.

The Regulation deals with both vessels that are designed to operate in extreme ice conditions for both transit and IceBreaking (CAC class) as well as vessels designed to operate in more moderate first-year ice conditions (Type vessels). The System determines whether or not a given vessel should proceed through that particular ice regime. If the Ice Numeral is negative, the ship is not allowed to proceed. However, if the Ice Numeral is zero or positive, the ship is allowed to proceed into the ice regime. Responsibility to plan the route, identify the ice, and carry out this numeric calculation rests with the Navigation Officer in charge of the bridge watch. Due care and attention of the mariner, including avoidance of hazards, such as growlers and multi-year ice, is vital to the successful application of the Ice Regime System. Authority by the Regulator to direct ships in danger, or during an emergency, remains unchanged.

Credibility of the new system has wide implications, not only for ship safety and pollution prevention, but also in lowering ship insurance rates and predicting ship performance. Therefore, there is a need to establish a scientific basis for the system. To this end, Transport Canada approached the National Research Council of Canada in Ottawa to assist them in developing a