On Full-scale Onboard Ship Measurements in Various Ice Conditions, a Review of Existing Database at Aker Arctic Technology

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ABSTRACT

The modern era of ice navigation started in the 1950s as a new generation of icebreakers were designed and built. In the late 1960s it became a practice to arrange full-scale ice trials after the delivery of the vessel. During the past 45 years full scale measurements undertaken by Aker Arctic and its predecessors; namely Wärtsilä Ice Model Basin (WIMB), Wärtsilä Arctic Research Centre (WARC) and Masa-Yards Arctic Research Centre (MARC), consist of a total of 95 different vessels tested on 140 occasions. These tests include:

- vessel performance definitions and verifications
- propulsion load measurements, short and long term
- hull stress measurements, short and long term
- research projects on specific topics
- vessel operations

Simultaneously with these events model tests have also been performed. Together these two form an unique correlation data base, which allows the development of semi-empirical analytical methods.

This paper will summarize and discuss the extent of work performed in full scale testing and two example cases will be discussed in detail. The existing database is so vast that it is planned to publish a series of follow-on papers on each of the main subjects in question.

INTRODUCTION

Full scale measurements onboard real ships are essential for the development of technology and operations. For the designer feedback from real operations are important, as are opportunities for establishing correlation between model tests and full scale tests. Whilst one off tests are useful, continuous data on the behaviour of the vessels is needed to be able to better understand the requirements and to make better products.

In the 1950s and 1960s icebreakers and cargo ships were built using a trial and error method; build something and next time make it stronger. One good example is the 22000 SHP icebreaker Vladivostok built in the mid 1960s, shown in Figure 1.

After delivery, the vessel operated one season in the Russian Arctic and returned for guarantee inspection and repairs, The Master reported that they had some vibration in the propeller shaft lines and expected a propeller blade to be missing.

The truth was revealed after the vessel was dry-docked at Wärtsilä Helsinki Shipyard, as shown in Figure 2: All propellers had damages. The next step was to make stronger propeller blades. However, the next time the vessel returned to the shipyard it had lost the whole propeller and the shaft was broken. After these incidents, it was realized that more information was urgently needed on both the conditions the vessels were operating and how the conditions effect the vessel’s propulsion and hull.

It soon became standard practice to arrange full scale ice trials and measurements with all icebreaking tonnage delivered from Wärtsilä Shipyards (today STX Finland). In 1969 the Wärtsilä Ice Model Basin was opened. Together with testing in full-scale, model tests and new design practices, the performance of icebreakers could be guaranteed even for the most challenging conditions.