

Analysis of the Safety of Ship Hull for Antarctic Operations with Different Ice Classes

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Shipping in ice covered Polar waters such as Antarctica is increasing and new ice classed ships are built to replace older ice strengthened fleet. Selection of suitable ice class for ships operation is an important but not simple task. The process of selecting an appropriate ice class is of high importance both from a safety as well as an economical perspective, but the selection process is still based on accumulated experience and traditions within the areas of existing operations. The increased exploitation of the Polar waters, both seasonal periods and geographical areas, as well as the introduction of new international design standards, reduces the relevancy of using existing experience as basis for the selection, and new methods and knowledge have to be developed.

To gather experience of the load levels experienced by the ships navigating in Antarctic waters, the research vessel of Agulhas II built in Finland for South African Ministry of Environment was instrument during 2012 for hull and propulsion loads measurements. In addition an advanced new stereo camera system was developed to monitor the ice conditions. Now during four full scale voyages from Cape Town to Antarctica on the years 2012-2016, detail data of the prevailing ice conditions and encountered ice induced loads and vibrations onboard the vessel have been gathered. The paper will summarize the main findings during the measured period. Great variation on both the ice conditions and operation principles of the vessel has been observed causing high scatter on the measured ice load and vibration level onboard the vessel. The gathered data base gives good background to determine the statistical estimates for the long term loads experienced by the ship hull, which can form sound basis for the design of future safe ship hulls for these operations.

In addition, based on the full scale measurements of ice loads during summers 2013-2014 in the Antarctica, the structural strength of the South African research vessel S.A. Agulhas II has been evaluated to assess the suitability of the chosen ice class of the vessel. The new polar code and especially the new Polar Operational Limit Assessment Risk Indexing System (POLARIS) is applied on this vessel to evaluate the suitable ice class. It is found the PC 3 is the most suitable ice class for ships navigating in harsh Antarctic ice conditions.