Operational Monitoring of Vessel’s Vibration Parameters When Operating in Ice

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ABSTRACT

Monitoring is a continuous registration of vessel’s vibration parameters simultaneously with registration of its movement and navigation parameters and also severity of ice conditions. In this paper the monitoring system main features and main principles of its installation on vessel are presented. The experience of practical use of monitoring system is presented by data obtained on research ice-going vessel which had ice class Arc7. On basis of obtained data there were determined statistical characteristics of vibration parameters depending on travelling regimes and ice severity conditions. In this paper it is proposed to characterize the severity of ice conditions by total power on shafts and vessel speed ratio. These results could be used for developing statistical attitudes to principle of vibration rates for ice-going ships.

KEY WORDS: Vibration; ice; monitoring; propeller; shaft.

INTRODUCTION

One of the problems emerging on ice-going ships is increasing its vibration when operated in ice. This vibration increasing is due to hull and ice interaction and propeller blades with ice floes. It can lead to equipment failure and also create non-favorable habitation conditions for crew. Mechanical stress in hull structures induced by vibration in ice is considerably lower yield stress of steels used in shipbuilding. That’s why fatigue failure is typical of hull structures. Nowadays the problem of hull structures durability when operated in ice requires obtaining more data consisting of vibrational loads, its values and longitudes during exploitation of different kinds of vessels.

It should be noted that in worldwide practice ratings restricting vibration limits of ice going vessels when operated in ice do not exist. The actual ratings of the world-leading classification societies, such as (ABS, 2001), (Bureau Veritas, 2005), (DNV, 2003), (Germanischer Lloyd's, 2004), (Lloyd's Register, 2004), (RMRS, 2011) are formulated for vessels operated in open water. It is necessary to obtain rather large bulk of field data containing hull vibration parameters of vessels with different ice categories to formulate scientifically based rating criteria for hull vibration for ice operating conditions. Vessel vibration parameters during its operating in ice depend on a large number of factors such as thickness and closeness of ice, vessel operation parameters (forward or backward travelling, ramming icebreaking, velocity, main engines power) and others. Their quantitative regularity cannot be described by determinated parameters. That’s why analysis and estimation of these vibration parameters should be performed on basis of probabilistic approaches. In spite of the existing experience of performing vibration research of ice-going vessels operated in ice (Belov, Spiridonov, 2012), the amount of collected vibration parameters data is not enough to perform its statistical analysis. In order to solve this problem it is necessary to do ice going vessels vibration parameters monitoring during their operation in ice conditions.

DATA-MEASURING SYSTEM FOR OPERATIONAL MONITORING

‘Operational monitoring’ is a persistent control of vessel’s main operational parameters, the vibration parameters among them. The vibration parameters monitoring is performed simultaneously with registration of main vessel’s operational parameters such as its ground speed, shaft rotational speed, torque and total power on shafts. In addition to the above mentioned parameters it would be useful to get data from vessel navigation system, such as under-keel clearance, rudder angle, draught etc.

The accelerometers measuring hull vibration are to be set in places mostly subjected to vibration. These places should be chosen according to the vessel’s function and its constructional peculiarities. Most preferable places are forepeak bulkhead, which is subjected to vibration induced by hull and ice interaction, afterpeak bulkhead or transom which are subjected to vibration induced by propellers and ice floes interaction, and superstructure forepeak bulkhead. In addition to above mentioned points accelerometers should be set on foundations of rudder propeller units if the vessel have them.