Certification in Russia of Deep-water Submersible Hulls

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ABSTRACT

The paper presents the basic principles of certification process for deep-waters intended to determine the strength margins of hull structures based on a detailed analytical and experimental analysis of their actual conditions. The main activities and master-plan of certification efforts are considered including the analysis of design solutions, hull structure surveys, assessment of actual service characteristics of s based on refined estimations and experimental verifications. The paper gives a detailed description of the land-based hyperbaric test facilities in the context of their certification test capabilities.

KEY WORDS: Certification; underwater technology; hull; strength; margin; performance.

INTRODUCTION

By present day, Krylov Shipbuilding Research Institute has performed a great scope of work in certifying underwater technology. Certification activities were started after commissioning DK-1000 and DK-600 test rigs. By their goal, these certification activities can be divided into three following groups:
- acceptance certification of the underwater technology for their compliance with the requirements stated in normative and technological documents;
- certification activities designed to define actual strength margin;
- certification activities designed to define residual lifetime after repair/operation.

The available experience of certification and R&D activities performed by the Institute allowed formulating the main principles of certification procedures for the underwater technology based on a detailed analysis of the parameters related to their hull structures, materials used, as well as the analysis of their manufacturing technology and procedures for precise assessment of their strength and performance parameters. These terms will be given below.

GENERAL DATA AND CERTIFICATION LAYOUT

Certification of hulls is a set of industrial operations, analytical and experimental researches, organizational and technical measures whose final goal is to assess strength, residual lifetime and bearing capacity of hull structures and to compile a conclusion defining actual operational (performance) parameters of the object.

Certification is performed by shipbuilding and/or ship repair enterprises, design offices and research institutes in accordance with their specialty.

Key feature of certification technology is application of all basic methods for an estimation of hull structures actual condition with wide use of mathematical modeling on the basis of modern numerical methods. It provides universality of technology regarding listed above solved problems. On the other hand, the complex estimation of hull structures condition along with experience of certification works available for today allows to estimate actual service characteristics of deep-waters in some cases even in conditions of missing of those or other stages of works. The most typical and important example of such incomplete certification scheme are the works which are performed at ship-repair enterprises where it is not obviously possible to execute tests of deep-water hulls for action of external pressure.

The certification process includes generally activities in the following directions:
- examining the condition of pressure hull and robust hull structures;
- analysing design, technological, operational and repair documents;
- generalizing and systematizing the data about theoretical and actual geometry of the hull joints, deviations from the ideal shape of the structural elements occurred during construction, the defects and damage found, methods and results of repair performed;
- developing the layout of mathematical modeling and analytical mathematic models applied to the hulls of specific underwater vehicles;
- developing the layout of mathematical modeling and analytical mathematic models applied to the hulls of specific underwater vehicles; performing (if necessary) experimental studies on test samples of the main metal and welded seams in the hull structures of underwater technology designed to define their physical & mechanical parameters and compare them with data available;
- performing (using mathematical models developed) updated strength calculations considering the factors found, such as structural geometry changes, deviations from the ideal shape of their elements, updated physical & mechanical property values of the materials;
- performing (if necessary) control tests on pressure hulls and robust hull structures of the underwater technology in order to confirm the conclusion about their actual performance parameters compiled basing on the updated calculations.