FIRST EVER CLASSIFICATION OF A NAVAL SUBMARINE

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ABSTRACT

Navies around the world are increasingly aware of the need to prove to the public and politicians that their submarines are safe – for their crews and the environment. The trouble is that only the world’s biggest navies have the personnel and know-how to test the safety of their submarines in service or any new buildings and check the quality of maintenance work.

The solution is to put the quality assurance process in the hands of a classification society. That is precisely what the South African Navy did. And as a result, Germanischer Lloyd (GL) is proud to announce that the world’s first naval submarine to receive a Certificate of Class is certified by GL. This article will highlight the benefits of classing a naval submarine and report on the experience made with classing the first naval submarines.

Introduction

Germanischer Lloyd has been involved in the submarine business due to its history and location for many decades and has been engaged in the naval sector for more than 30 years. The society established the Navy Project Department for this special purpose and up to now this department has attended plan approval and surveys to a variety of ships, more than 330, in more than 24 navies.

GL attended nearly all post war German export and domestic submarines at least partly and had also its stake in the development of some AIP versions. As outcome GL was in the position to publish “Rules for the Construction and Classification of Submersibles” many years ago. GL also issued the “Guidelines for the Use of Fuel Cells on Ships and Boats”. Due to the fact that no other classification society has such an amount of experience with conventional submarines, GL has a unique position among classification societies.
A quarter of a century ago, classification of Naval Surface Vessels was not at issue at all. Today it’s a fact. In recent times it became obvious, that not only naval surface vessels but also subsurface vessels are vulnerable regarding safety of operation and technology implemented in the submarine. Accidents and technical failures below the ocean surface end more often and more probably deadly than those on surface vessels. As a result the first navy is classing their submarines.

The South African Navy has commissioned Germanischer Lloyd with the classification of three submarines. The order includes the inspection of the construction plans as well as annual technical safety checks. This makes Germanischer Lloyd the first classification society worldwide to be entrusted with the technical support of military submarines.

The conventional class 209 submarines of type 1400 MOD are part of a comprehensive programme to modernise the South African Navy. The vessels were constructed by the German Submarine Consortium, consisting of Howaldtswerke Deutsche Werft AG (HDW), Kiel, Nordseewerke GmbH (NSWE), Emden, and MAN Ferrostaal AG, Essen. The first S101 submarine constructed in Kiel was delivered in March 2006. The second vessel is just about to go into service, while the third is still under construction. The state-of-the-art diesel-electric submarines are approx. 62 m in length. (FIG.1) shows S101 during sea trial.

**Class Rules**

In March 2005, GL published “Preliminary Rules for Sub-Surface Ships”. This rule set is part of “Rules for Classification and Construction: Part III Naval Ships Technology” and hence applicable for naval submarines. Up to now GL is the
only class society which established rules for naval submarines. An update of the rules for naval submarines is planned for the end of 2007.

The Rules consist of:

### III Naval Ship Technology

#### 2 Preliminary Rules for Sub-Surface Ships

1. Submarines
2. Remotely Operated Underwater Vehicles
3. Guidelines for Air Independent Power Systems for Underwater Use

Chapter 1 deals with “Submarines”. Included are, among many others, principles for design and construction, design principles for the pressure hull, piping systems, electrical equipment, automation, fire protection and life support systems.

Chapter 2 covers “Remotely Operated Underwater Vehicles” and its principles for design and construction.

Chapter 3 embraces “Guidelines for Air Independent Power Systems for Underwater Use”.

Germanischer Lloyd provides its rules and guidelines free of charge. They can be downloaded from:


Classification means drawing approval according to these rules and guidelines, construction supervision and survey of the submarines in service.

**Plan Approval**

Plan approval is the first step when classing a naval vessel. It forms the basis for the approval of a naval submarine. During plan approval the construction of all safety relevant systems of the submarines are checked on the basis of the submitted plans. For all information to be sent to GL the principle applies that all documents are required to permit an assessment of the compliance with the rules. The rules themselves include a list of documents as a reference and guidance for the required scope.

The biggest challenge on the one hand during plan approval for this project was the fact that the submarines were constructed before there were any class rules for naval submarines available. The advantage on the other hand was that the submarines were constructed in accordance with the Germany Navy Standard. GL and the Federal Bureau for Technology and Procurement (BWB) signed a cooperation agreement in 1999. Since then GL and BWB are developing the German Navy Standards for submarines and surface vessels together. Thus, a submarine built in accordance with the German Navy Standard can be classed easy and cost-effective by GL.

Over 1000 drawings covering the hull, electrical systems, automation systems, piping systems, stability where send to GL for approval. Within two and a half month a team of 25 engineers checked all safety relevant system of the
submarines. One task during plan approval was to develop project specific checklists for the class surveys.

Class Surveys
Surveys are the second important step when classing a naval submarine. Four different types of survey are carried out for naval submarines in a special time sequence which is illustrated in (FIG.2). The different types of survey are summarised in the following:

• **Initial Survey**
  During this thorough inspection the complete submarine with all safety relevant parts is entirely checked. A test dive is to be conducted, and at the end Germanischer Lloyd will issue a class certificate. This shows to all involved parties that GL is convinced that the vessel is seaworthy and safe for the next 6 years, continuous maintenance presumed.

• **Annual Survey**
  Every year GL makes sure that the vessel’s condition is still in good order. This relatively small survey has mainly the reason to identify smaller defects at an early stage, so that they can be rectified at an early point of time before they would worsen and cause more extensive measures.

• **Intermediate Survey**
  This describes an extended annual survey. It is due at the third annual survey see (FIG.2) below and is more detailed. For instance, tightness tests of all pressurized systems will be carried out. All safety systems would be function checked as well as breathing gas systems etc.

• **Class Renewal Survey**
  Six years after the initial survey – this is meant as the beginning of the next class period – the class renewal survey would be conducted. It covers the same scope as the initial survey, including dry docking, pressure test of the pressure hull etc. After successful conduction, a new class certificate would be issued to the vessel, showing that GL as an independent party is sure that the vessel is fit for the next class period of 6 years.
After plan approval for this project the initial survey will be carried out for the three submarines in South Africa. The initial survey for S101 will start in June 2007 and for S102 in August 2007.

Surveys for naval submarines require experienced personal which must have sufficient security clearance, medial certificates and submarine rescue training. The survey is therefore carried out by specially trained experts from GL head office and not by regular surveyors. This ensures that all the requirements of the navies are met.

Conclusions

The construction and in service phase of submarines is an utmost sophisticated business. Due to the sensitivity of the technology to technical failures, which could frequently end in hazardous situations, thorough technical supervision has to be carried out during construction and throughout the lifecycle. To carry out this task a navy needs to have special expertise which most navies can not effort and which are also not easily available on the market. A classification society can therefore be the ideal partner in supporting the navy with these tasks by classing the naval submarines.

Classification of a submarine means an independent review of the design and the safety during the construction and in service phase which releases the navy from the pressure to prove to the public that their submarines save for the crew and the environment.
CV of Authors

**Dr. Lars Grüntiz** was born 1976, studied at Hamburg University of Technology (Germany) and at the University of Cape Town (South Africa). He graduated with a Master of Science degree in Structural Engineering in 2001. He then joined the department of Ship Structural Design and Analysis at Hamburg University of Technology as a researcher and was awarded Doctor in Engineering in 2004. After working at Howaldtswerke-Deutsche Werft AG as a research and consultant engineer for naval submarines he joined Germanischer Lloyd in 2005 starting in the Advanced Engineering and Strategic Research Division. He then took over his current position as Senior Programme Executive Submarines in the Naval Project Department. He was awarded a Rotary International Scholarship in 1999 and a Scholarship from the Germany Research Foundation in 2000. In 2004 he obtained the Curt-Bartsch-Prize from the German Society for Maritime Technology for his contributions to ship building research.

**Lorenz Petersen** was born on the 1967-02-25 in Flensburg, Germany. He served the Federal German Navy for twelve years starting 1987. He studied “Electrical Engineering” at the University of the Federal Forces in Hamburg and graduated in 1992. Afterwards he was a Communication Officer on a Combat Support Ship and had assignments on other naval vessels and schools. Between 1999 and 2002 he studied “Business Administration” at the University of the Federal Forces in Hamburg and Arizona State University in Phoenix. Since July 2002 he is Head of the Naval Project Department at Germanischer Lloyd. Lorenz Petersen was chairman of the Naval Ship Classification Association NSCA in 2005 and is Fellow of the Royal Institution of Naval Architects.