

WHAT CLASSIFICATION RULES FOR THE FUTURE AND WHAT FUTURE FOR CLASSIFICATION?

Summary

Classification rules and international regulations are two pillars contributing to safer ships and cleaner seas. There is a substantial content of return of experience in these rules and regulations as incidents or accidents have been one strong driver for their improvement as much as have been technical developments and innovations based on academic studies or industrial investments.

However, today, three factors have largely impacted classification rules. Firstly, the demand for larger vessels has created a new frontier in ship design where the return of experience is limited or almost inexistent. This is the case for instance of ultra large container vessels or of very large ore carriers. Secondly, the development of goal based standards under the impulse of the IMO has significantly influenced the way new rules are conceived. This has been the case for the IACS common structural rules for bulk carriers and oil tankers. And thirdly, the recognition of alternative designs instead of purely prescriptive ones has driven the need of reliable methodologies for risk based designs. This is the case for instance for fire protection or evacuation of passenger vessels.

The paper will address the response of a classification society in front of these challenges in terms of rules development and in terms of development of software tools enabling to support these rules, be they prescriptive or goal-based. It will conclude on the new roles of a classification becoming more and more a partner of the Maritime industry towards safer and more environmental friendly shipping.

Key words: *ship classification rules development*

1. Introduction

Classification rules and international regulations are today the two pillars contributing to safer ships and cleaner seas.

Historically, the first classification societies were created in the very beginning of the 19th century in order to provide the maritime industry, the maritime insurers and charterers in particular, with an independent evaluation, based on experts assessment, of the ship's "good" and "bad" qualities. This evaluation resulted in a rating that reflected the level of confidence in the ship at the very time and whenever it was visited. It was known as the "character of service" and was published in an annual register the sales of which represented the only resource of the classification society. Then, two major steps in the evolution of the Bureau Veritas classification services have been firstly the introduction, in 1851, of the "character of term", which took into account the time factor together with periodical inspections, and secondly the proposal made to owners to follow the construction of their ships and survey them in service.

This triggered the need for the development of specific classification rules including technical prescriptions. And these first rules came out of the works conducted by the technical committees of Bureau Veritas that were shaped with the active participation of representatives of the maritime community. Bureau Veritas published its first rules for the classification of wooden ships on 1st July 1851, followed in 1858 by its first rules for the classification of iron ships, and then by its rules for the classification of steel ships in 1880. Since then, many other technical documents have been published to cover a much broader spectrum of subjects and of sea going units, making class societies a unique technical actor of the maritime community.

The genesis of the classification rules and of the international regulations takes into account various inputs. Definitely, the state of the art of the naval architecture and naval engineering is one of the most significant inputs. But, given the fact that classification societies can exert their inspection on ships and offshore units in service, there is also a substantial influence of the return of experience. And, as technologies have been continuously developing and sometimes dramatically hanging throughout the shipping history, class societies had to adapt their rules to new technologies. Historically, let's mention the evolution of ship's hulls material from wood to iron and steel, let's mention the switch from wind sailing to propelled ships with steam and Diesel engines and more recently gas engines, and let's also mention the continuous move to increase the size of vessels that took place for all ships, but quite impressively between 1950 and 1975 for crude oil carrier, that peaked at 550,000 tons deadweight, or nowadays for container carriers up to about 14,000 teu so far or for liquefied natural gas carriers up to 270,000m³, whilst the standard size of the large vessels of these types was only half of that 10 years ago.

Today, the extreme development of sophisticated computer simulations for structural or hydrodynamic calculations, the accuracy of risk analysis methodologies and the reliability of the construction of steel structures are such that the industry can certainly rely much more than before on these tools to produce designs with a controlled low level of risk or indetermination. However, there are still incidents and accidents which remind us that we have to stay humble and make sure that the power of our tools is used sensibly with an adequate consideration of all the physical phenomena that can impact a design, in particular when it is an innovative one.

In this respect, we will focus specifically on three factors that have largely impacted classification rules. Firstly, the development of goal based standards under the impulse of the IMO has significantly influenced the way new rules are conceived. This has been the case for the IACS common structural rules for bulk carriers and oil tankers. Secondly, the demand for larger vessels has created a new frontier in ship design where the return of experience is

limited or almost inexistent. This is the case for instance of ultra large container vessels or of very large ore carriers. And thirdly, the recognition of alternative designs instead of purely prescriptive ones has driven the need of reliable methodologies for risk based designs. This is the case for instance for fire protection or evacuation of passenger vessels.

We will explain how a classification society like Bureau Veritas has taken-up these three factors in the development of its rules and software tools and will then try to draw some conclusions, based on the learning from the experience of these three particular cases, on the evolution of the role of a classification society in the years to come.

2. Classification rules supporting goal based standards

For the sake of good order, one shall definitely acknowledge that the classification rules have never been discarding any form of goal setting and that they have always been developed in order to contribute to enhance the safety of ships, of people on board ships, of transported goods and to enhance the protection of the environment.

However, in a wake to rationalize the development of the international regulation started in 2002 at the initiative of some national administrations, the IMO has formalized in 2005 the concept of goal-based standards (GBS) and has laid down the basic principles of this approach on the basis of a 5 tier system as follows:

- Tier I - Goals: high-level objectives to be met.
- Tier II - Functional requirements: criteria to be satisfied in order to conform to the goals.
- Tier III - Verification of conformity: procedures for verifying that the rules and regulations for ship design and construction conform to the goals and functional requirements.
- Tier IV - Rules and regulations for ship design and construction: detailed requirements developed by IMO, national Administrations and/or recognized organizations and applied by national Administrations, and/or recognized organizations acting on their behalf, to the design and construction of a ship in order to conform to the goals and functional requirements.
- Tier V - Industry practices and standards: industry standards, codes of practice and safety and quality systems for shipbuilding, ship operation, maintenance, training, manning, etc., which may be incorporated into, or referenced in, the rules and regulations for the design and construction of a ship.

As it happened that simultaneously, by this time, on the one hand, the IMO had already devised the contents of tiers I and II and, on the other hand, the IACS had almost completed their development work of the new common structural rules (CSR) for tankers and bulk carriers, the IMO and the IACS agreed that these new rules would be used in a pilot project where they would be assessed for their fitness for use under the aforesaid tier III.

As the IMO has now adopted the GBS for oil tankers and bulk carriers at its 87th MSC session on 20 May 2010, the common structural rules for oil tankers and bulk carriers will actually be the first rules formally conforming to functional requirements developed and agreed by the Committee. Therefore, for the first time in its history, thanks also to a very substantial contribution of IACS, the IMO will be setting standards for ship construction.

In practice, the goals set by the IMO for oil tankers and bulk carriers of 150m in length and above have been introduced in the “International goal-based ship construction standards

for bulk carriers and oil tankers” which will enter into force on 1st January 2012 and which stipulates in particular the following goals and functional requirements:

- design life not less than 25 years including fatigue,
- North Atlantic sea condition and long term sea state scatter diagrams,
- design with adequate ultimate strength of the hull girder,
- hull strength assessment based on net scantlings and partial safety factors (reflecting a degree of uncertainty on the physical parameters, e.g. loads, model, fatigue, corrosion, material properties, workmanship,...),
- residual strength in damaged condition resulting from collision, grounding or flooding for instance,
- protection against corrosion and minimum corrosion addition as necessary to
- adequate ergonomics and accessibility for safe operations, inspection and maintenance,
- transparency, accessibility and traceability of design process, construction and survey processes, in-service maintenance and inspection processes,

So, what are the benefits of this approach driven globally by the IMO?

The first one is definitely the definition of the overall level of safety required by the maritime community at an international level.

However, this being achieved, the practical implementation in a uniform manner across the industry of these goals and functional requirements will be quite dependent of the consistency of the rules for design and construction of bulk carriers and oil tankers that may be recognized by the IMO in application of tier III verification scheme. This is precisely where the IACS investment to develop common structural rules for oil tankers and bulk carriers and to have them assessed and validated against tier III requirements will greatly assist the overall process. The present aim of the classification societies is to have the harmonized CSR completed and adopted by IACS in June 2013 for an entry into force in December 2013 and have them submitted for validation by the IMO at that time.

This case illustrates that the historical synergies that have always been existing between the IMO and the class societies in the development of the international regulations (for instance in the development of the international code for the construction and equipment of liquefied gas carriers that was greatly initiated by the leading class societies themselves in the early 70s and then taken-up by the IMO) can be further leveraged by this formal process where the classification society’s rules could contribute to fill the so called tier III. And this will be even more efficient if class societies can manage to work together towards common rules.

On the other hand, it is clear that the maintenance of common rules among classification societies is a very substantial work to be followed-up continuously in order to capture and process the return of experience in service of each of the class societies.

Finally, the success of this approach on the long term will also largely depend on the ability of the entire scheme to offer sufficient flexibility to accommodate the necessary evolution of the rules in a timely manner in order to continuously match the technical and safety challenges of this segment of the maritime industry. This remark brings us to the second example of rule development by class societies.

3. Classification rules for very large vessels

Another aspect of the classification rules development is their ability to address swiftly the new issues raised by technological steps made by the industry. The response should be fast enough, namely not slower than the pace of the technical innovation, in order to serve the maritime community on time.

The recent trends in increasing the size of the container ships (up to more than 14,000 teu and more than 360m in length) or the development of projects of very large ore carriers (up to 600,000 dwt and 425m in length) have raised new hydro structural issues in their design and verification processes, both from ultimate strength and fatigue viewpoints. Some of these issues are related to the hydro-elastic structural responses which become important due to the relatively low structural natural frequencies of these ships, and due to the strong operational requirements (maximum speed around 27 knots in case of container vessels). The combination of the reduced natural frequencies and increased excitation frequencies can lead to forced wave induced hull girder ship vibrations called springing, which might significantly affect the ship fatigue life. In addition to this, the slamming induced transient vibration called whipping can affect both the ultimate strength and fatigue. In any case, the conventional prescriptive rules are reaching their limits for these vessels and should be complemented by a direct calculation approach to validate loads and stresses.

The computer simulation tools now available with classification societies as well as the level of investment in hydrodynamics and hydro-structure interactions achieved by Bureau Veritas over the last decade make it possible to call for time domain simulations including non linear springing and whipping phenomena whenever necessary. The phenomenon of springing was already identified, studied and assessed in the mid 70s, with the calculation means available at that time, when the ULCC of 550,000 dwt were built and classed with BV. But its impact was much less than on the current ultra large container ships. It has also been known since that time that springing could impact ships with open decks, but it was hardly analysed in depth due to the lack of numerical simulation tools then.

Similarly, the fast development of new technologies or of innovative solutions in the maritime industry, such as the use of natural gas as fuel on conventional ships or the increased demand of ships designed to operate in harsh, cold or iced environments, requires that class societies be ready to address new challenges, not only based on a conventional rule approach but also sometimes, and in complement, based on direct calculations with a genuine consideration of first principles, or even based on risk analyses. This brings us to the third example of rule development.

4. Risk based design

Risk based design is not a new methodology. It has been applied for many years in particular in the offshore industry in the aftermath of the Piper Alpha accident in 1988, upon the recommendation of Lord Cullen's report. In the North Sea for instance, the adequacy of the design and of the mitigation measures provided for a particular facility shall be evaluated and confirmed to meet specified safety goals on the basis of a "Formal Safety Assessment" of the risks and of their consequences as identified with comprehensive and dedicated risk analyses. This approach is also well recognized by class societies in their process of classification of offshore units like FSOs, FPSOs, semi-sub, etc., whenever relevant for the classification scheme.

As regards design of sea going vessels, SOLAS II-2/17 for passenger ships admits alternative designs which differ from the prescriptive requirements, in particular relating to

the extension of fire zones, if it can be demonstrated by a risk and engineering analyses conducted with numerical simulation software tools modeling the fire and smoke propagations as well as the evacuation of passengers and crew members that the alternative design is at least as safe as the prescriptive one.

This possibility to justify alternative designs thanks to a risk analysis has also recently been extended by the amendments to SOLAS II-1/55 to the arrangements for machinery and electrical installations and by the amendments to SOLAS III/38 to the arrangements for life-saving appliances. Under this second amendment, life boats able to accommodate up to 370 persons have been approved in lieu of the prescriptive limit of 150 persons. This has to be considered given the fact that the passenger vessels, on board which these alternative life saving appliances will be fitted, are able to carry more than 7,500 persons including passengers and crew. It makes sense to consider how best to balance the number of life boats with their capacity for such a size of vessels in practical terms should they be used.

The acceptance of risk and engineering analyses to substantiate alternative designs definitely provides with the flexibility that is needed to address issues where the prescriptive approach would reach some form of limit given the gigantism of some projects.

5. Conclusions

We have reviewed, along these three examples, how classification societies have to adapt their services, rules and software tools to the rapidly changing environment. In the future, the core mission of classification societies will remain focussed on their contribution to safer and more environmental friendly shipping. They have a key role to play there that, so far, nobody else has been able to play, and this position is based on a couple of essential business drivers as follows:

- class societies are independent organizations serving the maritime community,
- they are concentrating a high level of technical expertise that is made available to the maritime industry through classification services,
- they are maintaining a high level of research and development activities, in particular in hydrodynamics, naval architecture, marine engineering and risk techniques in line with their mission in QHSE matters, that makes it possible for them to rapidly adapt their rules and software tools to the evolution of the technology in a reliable manner,
- they maintain a large international network of exclusive experts and surveyors able to service the shipping and the shipbuilding industries in a consistent manner wherever ships have to be surveyed.

The converging ways that have been initiated respectively by the IMO with the development of the goal based standards and by the classification societies with the development of the IACS common structural rules are expected to finally meet each other successfully by 2013. This dual initiative clearly demonstrates the synergies that can be found between the roles of the IMO, setting the level of safety that the maritime community wants to achieve, and the role of class societies devising the technical means to implement them. As mentioned already, the development of common set of rules for oil tankers and bulk carriers by class societies has incidentally contributed to support the practical enforcement of these synergies.

The position of class societies as service companies for the maritime community is also a strong driver for them to adapt to the permanently moving environment, in terms of

technical content of their services, but also in terms of extent of their services. As regards technical contents of services, it is absolutely necessary for class societies to be able to accompany the technological developments of the maritime industry with the relevant level of understanding, and to propose an adequate response in term of rules and software tools to address any upcoming issue in order to promote safety and environmental friendliness. As regards their extent of service, it is observed that there is a trend for flag administration to increasingly proceed to the delegation of statutory activities to class societies. In this respect, the work of class societies is consequently more and more scrutinized by these administrations and we noted an increase of the external audits we are subjected to by about 25% if we compare years 2009-2010 to the two previous years 2007-2008.

Finally, class societies are one actor of the maritime community on which ship owners, shipyards, flag administrations, charterers, insurers, and, without always being aware of it, the public at large, count to develop and enforce sensible and technically relevant prescriptions, provide software tools to support the implementation of the rules and enable direct analyses whenever useful or necessary, and bring evolution to these rules and software tools to match the technological innovations in a timely manner. In short, we could say that classification societies are the family doctors of the shipping industry.
