DNV·GL

CLASS GUIDELINE

DNVGL-CG-0053 Edition April 2016

Approval and certification of the software of loading computer systems

DNV GL AS

FOREWORD

DNV GL class guidelines contain methods, technical requirements, principles and acceptance criteria related to classed objects as referred to from the rules.

Any comments may be sent by e-mail to *rules@dnvgl.com*

CHANGES – CURRENT

This is a new document.

CONTENTS

SECTION 1 INTRODUCTION

1 Objective

This class guideline is intended as guidance for the approval and certification of a loading computer system for a specific ship, and may be used by software manufacturers or yards.

2 Scope

Included in this document is more detailed information on some of the requirements provided by the rules. It is also included an "approval request form" which shall be filled in by the manufacturer, giving a structured format for providing the information needed for the approval of the installation for the specific vessel.

3 Application

Requirements for loading computer systems for specific ships are given in rules for classification RU SHIP Pt.6 Ch.4 Sec.7. The rules cover the requirements given in IACS UR L5 *Onboard Computers for Stability calculations*. Requirements for installation of loading computers are provided in RU SHIP Pt.3 Ch.1 Sec.5 [3], RU SHIP Pt.3 Ch.15 Sec.1 [3.4] and CSR Pt.1 Ch.1 Sec.5 [3].

This class guideline may also be used as guidance for those manufacturers who want to have their software type approved.

SECTION 2 APPROVAL OF LOADING COMPUTER SYSTEMS

1 Loading computer system

A loading computer system is a computer based system for calculation and control of loading conditions for compliance with the applicable stability, longitudinal and local strength requirements.

The loading computer system consists of software (calculation program) and the computer (hardware) on which it runs. Also refer to rules for classification RU SHIP Pt.6 Ch.4 Sec.7 [1.8].

2 Approval and certification for a specific vessel

Approval of software means that the Society approves the software for a specific installation onboard a specific vessel. The approval is based on a review and acceptance of design, calculation method, and verification of stored data and test calculations for the specific vessel.

Approval of the software shall be carried out for each specific vessel where the software shall be installed.

Approval of the software results in approved test conditions.

If the software is type approved, the review and acceptance of software design is not necessary for each specific vessel. Only a verification of the user's manual (if "tailor made" for the vessel), stored data and test calculations for the specific vessel will then be carried out.

Installation testing and certification is carried out to ensure that the loading computer system works properly onboard the specific vessel, and to ensure that the correct approved version of the software has been installed. Certification shall be carried out for each vessel for which a loading computer system has been installed.

A loading computer certificate, DNV GL form no. 60.00a, will be issued by the attending surveyor.

Mandatory class notation **LCS** will be assigned to a vessel with installed loading computer, built according to the rules.

3 Optional class notation LCS(DC)

This optional class notation applies to integrated systems developed to assist the master as a decision aid when the ship has been subjected to damage and consequent flooding. Requirements are outlined in DNV GL rules for classification RU SHIP Pt.6 Ch.4 Sec.7 [4].

4 Type approval

Type approval means that the Society has approved the software design, methods and specifications of the software in general. The type approval certificate will be issued based on a review and acceptance of design, calculation methods and documented test results for at least two test vessels.

In the type approval certificate it will be stated what kind of calculations the type approval covers. The type approval will be included in the DNV GL register of type approved products, file no. 780.90.

In connection with approval for a specific ship with type approved software, less documentation will be required, and less fee will be charged.

For more information on type approval, also refer to the general type approval scheme described in DNVGL CP 0338.

SECTION 3 LOADING COMPUTER FUNCTIONS

1 General

The loading computer may have different functions related to calculation of strength and stability, depending on the type of vessel it is installed on. This section includes additional information on how these functions can be handled by the loading computer. Please also refer to the approval request forms in App.A and App.B, as well as the explanatory part in App.C, which also contains information on other issues related to the loading computer functions.

2 Warning messages in the loading computer

According to the rules, the loading computer shall display warnings if certain loading limitations are exceeded for the prepared loading condition. The general requirements for warnings are given in the rules RU SHIP Pt.6 Ch.4 Sec.7 [1.10]. Additional information on warnings and limitations are given below.

3 Display of warnings

The rules do not specify how a warning shall be displayed, and different types will be accepted as long as they are clearly visible and unambiguous for the user. Typical warning methods used are "pop up" windows, special message field or change of colour/font size if the limits are not met. In general, both the required and the attained value should be visible on the screen. The warnings should also be visible on the printout of the loading condition (e.g. on the printed test conditions).

If the loading limitations are not visible on the test conditions presented to class for approval (e.g. warning only appears if a limit is exceeded), the software maker should still document that the limits are correctly implemented. This can be done by inserting screen shots of the limits, or make additional test conditions not complying with the limits for this purpose alone. All pre-stored limits and warning functions shall also be demonstrated to the attending surveyor during the on-board test.

4 Loading limitations and warnings

Regarding the loading limitation specified by the rules, some additional advice and information on background is given below.

Note:

Not all types of limits are included below, so please refer to the text of the rules as well.

---e-n-d---o-f---n-o-t-e---

4.1 Maximum draught midship

All vessels will have a maximum allowable draught midship. This should normally be calculated and checked at LBP/2, or at the load line mark position. Checking only the equivalent draught (i.e. at LCF) is not acceptable.

The loading computer shall check the maximum draught, and give a warning if the draught is exceeded. The loading computer may also check the draught limits for the seasonal load line marks (winter, summer, fresh water, tropical, tropical fresh). If this is an option, there should normally be an input for the "season" for the specific loading condition, so that the correct mark/draught is selected. For special consideration for timber load line see [6.6]. The same also applies for other special marks on the ship side, like ICE (maximum draught in ice infested water) or other condition based draught limitation (mode of vessel, reduced number of passenger).

For vessels with permanent thrusters or skegs below the normal base line draught, the draught at the lowest part of these shall also be displayed.

For vessels equipped with retractable appendages such as thrusters or sonars, there should be a function for displaying the draught at these when applied in their deepest position. For this function, it is proposed to discuss with the owners on how this function shall work and be displayed.

4.2 Minimum draught midship

Minimum draught midship is introduced in the new IACS common structure rules (CSR) for tankers and bulk carriers. Minimum draught may also be applicable for some LNG carriers.

If applicable for the vessel in question, the loading computer shall display a warning if the draught is lower than the limit.

4.3 Minimum draught forward (bottom slamming)

Most cargo vessels will have a restriction on minimum draught forward, to reduce the probability of bottom slamming in heavy weather. The minimum draught forward is based on ballast conditions, and generally, the minimum draught forward is based on the assumption that ballast tank(s) in forebody is(are) empty. However, for larger cargo vessels, yards may have optimized the design using a minimum draught forward based on the assumption that ballast tank(s) in forebody is(are) full. Normally, a definition of what is regarded as "full" or "filled" will be given (e.g. more than 95% full).

The loading computer shall check minimum draught forward, and give a warning if the draught is not complied with. In case the vessel has the minimum draught forward "dependent" on the filling of ballast tank(s) in the fore end, the computer should be able to determine the filling of the relevant tanks, and automatically select the correct limiting draught.

4.4 Draught limits for navigation in ice infested waters

Vessels designed to operate in ice infested waters will be reinforced (a so called "ice belt") in parts of the ship sides.

The loading computer shall give a warning if a loading condition planned for ice-infested waters have draughts outside this ice belt. To avoid warnings being displayed for normal loading conditions not planned for ice, there should preferably be a function within the loading condition for selecting "Ice infested waters" (or similar expression), for which these limits will be activated and checked.

4.5 Minimum draught aft and propeller immersion

Except for some design conditions, there are no rule requirements for minimum propeller immersion in operation. It is however advisable that the loading computer at least provides a warning when the propeller is not fully immersed, as this will influence the operation of the vessel (speed and vibration).

There are normally two ways of describing propeller immersion; one is showing a propeller immersion of 100% when the top of the propeller blades is just immersed, whereas the other method is showing 50% for a fully immersed propeller. To avoid confusion for the user, the loading computer should generally use the method applied in the loading manual/stability booklet.

4.6 Trim limits

Limits on trim are implemented for many vessels. There are generally two types of trim limits:

i) Limit curves (maximum VCG/minimum GM) that are specifically given for different trim values. The trim limits in this case will be the maximum aft and maximum forward trim applied in the curves. Limit can be interpolated between the different curves, but not outside the trim range. This will typically be the case for pure intact stability limit curves, or for damage stability requirements, such as old SOLAS passenger rules (pre 2006 amendments), old SPS rules (IMO Res. A.534), offshore supply vessels rules (IMO Res A.469/IMO Res. MSC.235(82)/IMO Res.MSC.335(90)), or ship shaped mobile offshore units (IMO MODU code or special flag state rules).

ii) Direct trim limits. This is mainly a result of the SOLAS 2006 amendments (also called SOLAS 2009). Typically, this can be draught independent constant values for maximum forward and maximum aft trim, but could also in some cases be a curve varying with draught (piecewise linear type).

The applicable trim limits shall be implemented in the loading computer, and a clear warning shall be given when the trim limits are exceeded.

4.7 Visibility – SOLAS requirement

SOLAS Ch.V, Reg. 22 requires that the "blind zone" in front of the vessel (experienced from the steering position in wheel house) shall be less than 2 * Loa, measured from the fore end of the vessel.

The rules do not require that this is checked by the loading computer, but it is recommended for the easy reference for the crew. If the item restricting the forward view is a variable deck cargo (e.g. containers or timber deck load), a function for choosing the correct "view obstacle position" (longitudinal position and height) should also be included. This should preferably be an automatic selection based on the computer's loading tool.

If included, this will be subject to approval, and the relevant stored data (conning position and obstacle positions) shall be included in the vessel's stored data, and the results should be visible on the test conditions (both on the screen and on the report).

4.8 Filling limitation, tankers with high density load

Product tankers are normally designed for a maximum weight in each tank corresponding to the tank fully filled with sea water (S.G. = 1.025 t/m^3). In some cases, these vessels may also be allowed to load a higher density load, provided that the filling height is reduced. Most often, this is simplified with the following equations:

Max filling (%) = (1.025 / (S.G of load)) * 100%

In addition there will be a maximum density.

Example: For a load of specific gravity of 1.53 t/m^3, the maximum filling level is (1.025/1.53)*100% = 67%.

This checking shall be performed by the loading computer, and a warning displayed if the filling limit is exceeded.

4.9 Filling limitation – sloshing

For some vessels, in particular LNG vessels, and bulk carriers which use a cargo hold for ballast water in the "emergency" ballast condition, there will be a loading restriction in order to reduce the probability of sloshing. This will normally be given as restricted filling height (minimum and maximum), which can be converted to filling percentage.

The loading computer shall check this, and give a warning if the filling level is within the restricted area.

4.10 Filling restrictions, gas carriers (loading of ballast below empty tanks)

Some gas carriers, in particular LNG vessels, will be optimized in the design in such a way that in case a cargo tank is empty, certain ballast tanks below this tank have to be filled.

The loading computer should check this automatically, and give warning if this is not complied with.

4.11 Filling limitations, IMO chemical type 2 vessels (< 3000 m^3)

According to the IMO chemical code, the maximum filling of cargo tanks for chemicals categorized as "Type 2" cargo is 3000 m^3.

Some combination product and chemical tankers, primarily intended for type 3 cargos may also be designed for transporting type 2 cargoes. Such vessels will often have tanks larger than 3000 m^3, however, the maximum filling limit for type 2 shall be complied with. In that case, the above limit will apply.

The loading computer should give a warning if the maximum filling limit is exceeded. For such vessels, there should be an input parameter to indicate if the cargo is of type 2 or type 3 (or oil).

5 Separate "mode" for IMO chemical type 2 and type 3

In relation to [4], for loading computers that calculate damage stability, there may also be a different pre-stored damage group for type 2 loads, compared to type 3 loads.

The loading computer shall have the possibility for the selection of the "mode" related to type of chemical load (type 2 or 3), and the pre-stored damage group shall be linked to the correct load type "mode".

6 Special considerations – ships intended to carry dry cargo in bulk

6.1 Loading limitations for cargo holds (hold mass diagrams)

Bulk carriers will generally have limitation to load/mass for each cargo hold and each two adjacent cargo holds (hold mass diagrams or hold mass curves). These diagrams are often presented as a function for cargo mass vs. draught.

These diagrams shall be included in the loading computer, and a warning shall be given if limitations are exceeded.

6.2 Strength for flooded cargo hold

For bulk carriers, the loading conditions shall comply with longitudinal strength limits with each cargo hold flooded one by one in all seagoing loading conditions (included in CSR rules, and previously known as IACS UR S17).

Loading computers shall have implemented the function for check according to the above.

6.3 SOLAS Reg. XII/ 4 – Damage stability with single hold flooded

Bulk carriers with L > 150 m, with ordinary B-freeboard shall comply with the damage stability requirements as given in SOLAS Reg. XII/4. This implies compliance with damage stability with a single hold flooded.

The loading computer shall be able to check this (for ships contracted after July 2005). If the yard have made limit curves (e.g. max trim curves) in this respect, this may be used. If not, direct calculations are required.

Note that SOLAS Reg. XII/4 is not applicable for vessels with reduced freeboard (so called B-60 or B-100 freeboard), since damage calculation has been checked and concluded on the design stage for these vessels.

6.4 Shear force correction

Shear force correction is applicable for most bulk carriers. Note that there will be some difference in the method of correction for older versions of the class rules, compared to the later versions referring to IACS common structural rules (CSR). For some older vessels (pre CSR) originally built to other class societies' rules, shear force correction may not be applicable.

Hence, for preparation of a loading computer for an older vessel in operation, it is important to check which issue of the hull rules that is applicable for the design, so that the correct shear force correction method is applied.

Upon type approval or renewal of type approval (if applicable), the method/rule for shear force correction will be listed on the type approval certificate.

6.5 Grain stability calculation

For bulk carriers and general cargo vessels designed for carriage of grain contracted after July 2005, the loading computer intended for stability check shall also have the function for checking grain loading conditions for compliance with the grain stability requirements. This can be done by incorporating the allowable grain heeling moment tables produced by the yard in the loading computer, as well as the grain heeling moment values for filled holds (trimmed and untrimmed) and partial filled holds. Clear warnings shall be displayed if the allowable grain heeling moment is exceeded. Direct calculation of grain stability criteria is also an acceptable method of checking.

6.6 Timber on deck – additional draught limits and stability limit curves

Bulk carriers and general cargo vessels may have a timber freeboard/draught which is different from the ordinary assigned freeboard/draught. In addition, there may be different stability limit curves for conditions with timber on deck, compared to those without deck load, due to contribution from the buoyancy of the timber on deck. The loading computer should have a function allowing the user to select the mode of operation in this respect (i.e. "Timber on deck" and "No deck load" or similar), and the correct draught limit and stability limit curves shall be selected automatically based on this input. Default should be "No deck load".

7 Special considerations – tankers

7.1 Shear force correction – tankers

Shear force correction is applicable for oil tankers built according to the DNV rules prior to the IACS common structural rules (CSR) for tankers (introduced in 2006).

For the tankers built according to the rules prior to the CSR rules, note that there are several different methods, depending on single skin/double skin and number of longitudinal bulkheads. It is thus important to check out the relevant applied rule prior to implementing the shear force correction in the loading computer.

For tankers with length above 150 m built according to the CSR rules, incorporated in all class rule issues since 2006, the assumed result of shear force correction is incorporated in the shear force stillwater limits, and it is hence not applicable to check this for the planned loading conditions.

SECTION 4 HOW TO OBTAIN APPROVAL AND CERTIFICATION FOR A SPECIFIC VESSEL

1 General procedure

The following stepwise procedure applies:

a) The approval request form shall be submitted.

b) For type approved software, use the form "Approval request form for type approved loading computer software", as given in App.A. For not type approved software, use the form "Approval request form for loading computer software", as given in App.B. It shall be clearly stated for what parts of the software the approval is requested.

c) Upon receipt of the filled in form, the Society will indicate the fee for the approval and certification. Fees of approval are dependent on the applications to be approved. These fees are reduced for type approved software and they are reduced for sister vessels.

d) Documentation as listed in rules for classification RU SHIP Pt.3 Ch1 Sec.3 Table 1 shall be submitted for approval.

e) When the submitted data has been checked and found in order, the approved test conditions will be returned.

f) When the software has been approved for the specific vessel, certification shall be carried out as described in rules for classification: RU SHIP Pt.6 Ch.4 Sec.7 [3].

g) Class notation **LCS(DC)**; additional documentation as listed in rules for classification RU SHIP Pt.6 Ch.4 Sec.7 [4] shall be submitted for approval. Note that this notation also requires additional draught and compartment sensors installed on the vessel.

SECTION 5 HOW TO OBTAIN TYPE APPROVAL

1 General procedure

The following stepwise procedure applies:

a) The form "Approval request form for loading computer software", as given in App.B, shall be filled in and submitted to the Society. It shall be clearly stated for what parts of the software the type approval is requested.
b) Upon receipt of the completed form, the Society will indicate the fee for type approval.
c) Manufacturer and the Society shall agree on applicable test vessels. The test vessels can either be standard test vessels provided by the Society or other vessels in DNV GL class preferred by the manufacturer. The latter can be ships in operation or newbuildings, as suitable. The test vessels shall be for at least two different ship types. For calculation programs based on the input of hull form data, test data should be provided for three different ship types.
d) If the DNV GL standard test ships are applied, the necessary ship data (ship lines, description of compartments, light ship data etc.) will be supplied by the Society.
e) For each of the test vessels, documentation as required in above 3. d) shall be submitted. I.e. documentation as for specific approval for each of the test vessels. Often it is practical to combine the type approval with specific approval for each of the test vessels.
f) If the DNV GL standard test ships are applied, the calculations required will be described in the data supplied by the Society; definition of cargo and supplies in the test conditions, if relevant, damage cases etc.
g) When the submitted data has been checked and found in order, type approval will be given. A type approval certificate will be issued.

Limitations:

The type approval is valid only for the calculation results. I.e. the type approval is a confirmation that the software is able to give correct results provided that the stored characteristic data of the vessel and the user's input is correct.

Renewal:

The type approval is valid only for an identified, specific version of the software. Whenever the software is revised, the type approval is no longer valid. In order to get a renewal of the type approval, the manufacturer shall submit the details of the revision and the Society will decide the extent of testing required.

The type approval certificate will remain valid for a period of four years. The certificate will be renewed upon confirmation from the manufacturers of the calculation program that the calculation algorithms remain unchanged. Renewal validity can be either two or four years, depending on maker's preference.

APPENDIX A APPROVAL REQUEST FORM FOR TYPE APPROVED LOADING COMPUTER SOFTWARE

1 Form to be filled in by manufacturer

	To be filled in:
Ship name and DNV GL ID. No.:	
Name of shipyard:	
Shipyard building no.:	
Software manufacturer Name and address:	
Software name:	
Software version no.:	
Software version date:	
Type approval certificate no.:	
Type approval expiring date:	
Responsible for invoice:	

It should be noted that not all items in the following form are required. Some of the items are meant for information while others may not be applicable to the software or the ship in question. For required information see rules for classification RU SHIP Pt.6 Ch.4 Sec.7 [1.10] *General software requirements*.

		To be ticked off, "X":		
No.	*Software Description*	*Yes*	*No*	*N/A*
1.	*General information*			
1.1	The type approval covers all the strength and stability applications as calculated for this actual vessel			
1.5	The approval is with respect to strength			
1.5.1	Provided that the strength limits are agreed upon			
1.6	Approval is with respect to stability limit curves			
1.6.1	The limit curves cover the following stability regulations:			
1.7	Approval is with respect to intact stability calculation including evaluation of criteria against GZ curve			
1.7.1	Intact stability regulation			
1.8	Approval is with respect to damage stability calculation including evaluation of criteria against GZ curve			
1.8.1	Damage stability regulations:			

		To be ticked off, "X":		
No.	*Software Description*	*Yes*	*No*	*N/A*
1.9	Approval is with respect to grain stability			
1.9.1	Grain stability for untrimmed ends			
1.9.2	Maximum grain heeling moment			
1.9.3	Evaluation of GZ curves			
1.10	Approval is with respect to other applications and regulations:			
1.11	Approval includes requirements for class notation **LCS(DC)**			
2.	*General software specifications*			
2.12	Loading limitations are included and the values are included in the stored characteristic data:			
2.12.1	Minimum draft forward due to slamming:			
2.12.2	Maximum draft (load line draft):			
2.12.3	Minimum draft midship (if applicable for vessel):			
2.12.4	Maximum GM to limit sloshing in slack tanks:			
2.12.5	Minimum GM / Maximum KG due to stability:			
2.12.6	Maximum trim due to range of trim covered by stored hydrostatic data, cross curves, limit curves or others:			
2.12.7	Cargo tanks and ballast filling (strength/stability), for example when ballast tanks surrounding empty cargo compartments shall be kept full etc.:			
2.12.8	Cargo tank filling height as a function of cargo density (strength):			
2.12.9	Cargo compatibility: with respect to type of cargo in adjacent compartments:			
2.12.10	Limits to distribute loads on deck: the weights on a given deck shall be limited by strength for which the deck is approved.			
2.12.11	For vessels with ice class: a clear warning is given if the ice draughts (UIWL and LIWL) are included:			
2.12.12	Clear warning is given if the loading limitations 1.6, 1.7, 1.8, 1.9 and 2.12 are not fulfilled:			
2.13	Calculation of tank capacities and centre of gravity is included with trim correction			
2.14	**LCS(DC)**: The software is able to operate in two modes; surveillance and simulation mode:			
2.15	**LCS(DC)**: Continuous monitoring of the flooding situation:			
2.16	**LCS(DC)**: Clear warning in case of discrepancies between calculated draughts and remote draught readings:			

		To be ticked off, "X":		
No.	*Software Description*	*Yes*	*No*	*N/A*
2.17	**LCS(DC)**: Manual input for compartment fillings possible in surveillance mode if failure of one or more sensors:			
2.18	**LCS(DC)**: Manual input for permeability possible			
2.18.1	Compartments with altered permeability clearly indicated on the screen			
2.19	**LCS(DC)**: Check of longitudinal strength after damage included			
3.	*Longitudinal strength*			
3.1	Control of stillwater shear forces against limit values			
3.2	Correction of shear forces for bulk carriers			
3.3	Correction of shear forces for tankers			
3.4	Control of stillwater bending moment against limit values			
3.5	Control of stillwater stresses, including torsion,			
4.	*Local strength*			
4.1	Limits for maximum mass in any hold as a function of draft			
4.2	Limits for maximum mass in any two adjacent holds as a function of draft			
4.3	Limits to filling heights in tanks as a function of cargo density			
4.4	Limits to distributed loads on decks			
5.	*Stability*			
5.1	Free surface correction to initial GM is included			
5.2	Free surface effect as correction to GZ values is included			
5.3	Calculation of GZ included			
5.4	Calculation with respect to intact stability criteria included			
5.5	If calculation and evaluation of severe wind and rolling criteria are included, both the hull above the water line, the structure on deck and all deck cargo are included in the windage area			
5.6	If relevant, calculation of other external heeling moments is included and presented:			
5.7	Graphical presentation of GZ curve is included			
6.	*Grain stability*			
6.1	Effect of vertical shift of grain is included			
6.2	If untrimmed ends are included, this can only be calculated for 100% filled holds			
7.	*Damage stability*			

		To be ticked off, "X":		
No.	*Software Description*	*Yes*	*No*	*N/A*
7.5	A default list of damage cases is included			
7.7	Calculation of equilibrium position after damage is included (draft, trim, and heel)			
7.8	Calculation of GZ curve is included			
7.9	Unprotected openings are included and taken into account in the program			
7.10	Weathertight openings are included and taken it account in the program			
7.12	Evaluation with respect to all actual damage stability criteria is included			
7.14	Calculation of intermediate stages of flooding			
7.15	Graphical presentation of equilibrium position and GZ residual curve			
7.16	Warning displayed if loading condition is updated without re-calculation of damage stability			
8.	*Documentation to submit*			
8.1	User manual (if "tailor made" for the vessel)			
8.3	Test conditions			
8.3.1	Light ship condition			
8.3.2	Ballast or partly loaded condition			
8.3.32	Fully loaded condition			
8.3.43	Extreme condition (anticipated worst condition for strength as founded in the manual)			
8.3.54	5 test damage cases for **LCS(DC)**. Not required in case damage stability calculations are included for rule check (Y on 1.8).			
8.4	Stored characteristic data			
8.4.1	Hydrostatic data			
8.4.2	Cross curves (KN data)			
8.4.3	Tank data: maximum volume, max.VCG, TCG, LCG and maximum free surface moment (FSM)			
8.4.4	List of unprotected openings/margin line/flooding angle (if installed in the program, weathertight openings			
8.4.5	List of limit values (KG GM)			
8.4.6	List of grain data; table of volumetric heeling moment for partly filled holds, tables pertaining to cargo holds filled with ends untrimmed, tables of maximum permissible grain heeling moment			
8.4.7	Group of damage cases			

		To be ticked off, "X":		
No.	*Software Description*	*Yes*	*No*	*N/A*
8.4.8	Other data as; container data, timber loading data (cross curves), data for calculation of severe wind and rolling criteria			
8.4.9	Associated limits to still water shear force, bending moments and torque, as applicable for seagoing, harbour and flooded conditions.			
8.5	The documentation is in accordance with the approved onboard Loading and stability documentation			
9.	*Alterations to the software*			
9.1	Are alterations affecting the results carried out [1)]			

N/A: Not applicable

"*No.*" refers to App.C *Guidance for filling in Approval request form for loading computer software*.

1) A new version of the software should be given when significant software alterations affecting the results are carried out. If changes affecting the results are made to the software, description of the changes shall be submitted and the type approval might have to be renewed.

2) Some items are left out because not applicable for type approved software.

	To be filled in:
Place:	
Date:	
On behalf of software manufacturer:	
Name:	
Position:	
Signature:	

APPENDIX B APPROVAL REQUEST FORM FOR NON-TYPE APPROVED LOADING COMPUTER SOFTWARE

1 Form to be filled in by manufacturer

This approval request form shall be used for specific ships when the software is not type approved. It can also be used for application for type approval.

Reference is made to rules for classification RU SHIP Pt.6 Ch.4 Sec.7 [1.10] *General software requirements*.

	To be filled in:
Ship name [1]:	
Name of shipyard [1]:	
Shipyard building no. [1]:	
Software manufacturer Name and address:	
Software name:	
Software version no.:	
Software version date:	
Computer operating system:	
Requirements for hardware:	
Responsible for invoice:	

1) To be filled in when the approval is for a specific ship, usually not relevant to be filled in if the approval request is in connection with general request for type approval.

It should be noted that not all items in the following form are required. Some of the items are meant for information while others may not be applicable to the software or the ship in question. For required information see rules for classification RU SHIP Pt.6 Ch.4 Sec.7 [1.10] *General software requirements*.

		To be ticked off, "X":			
No.	*Software description*	*Yes*	*No*	*N/A*	*Ref./Page #*
1.	*General information*				
1.1	Approval is requested in connection with initial type approval				
1.2	Approval is requested in connection with approval for a specific ship				
1.3	Approval is requested for calculations for mono-hull ships only				
1.4	Approval is requested for calculations for arbitrary floating structures				
1.5	The approval is with respect to strength				
1.5.1	It is provided that the strength limits are agreed upon				
1.6	Approval is with respect to stability limit curves				

		To be ticked off, "X":			
No.	*Software description*	*Yes*	*No*	*N/A*	*Ref./Page #*
1.6.1	The limit curves cover the following stability regulations: ……				
1.7	Approval is with respect to intact stability calculation including evaluation of criteria against GZ curve				
1.7.1	Intact stability regulations: ……				
1.8	Approval is with respect to damage stability calculation including evaluation of criteria against GZ curve				
1.8.1	Damage stability regulations: ……				
1.9	Approval is with respect to grain stability				
1.9.1	Grain stability for untrimmed ends				
1.9.2	Approval is with respect to maximum grain heeling moment				
1.9.3	Approval is with respect to calculation of criteria directly on the GZ curves				
1.10	Approval is with respect to other applications and regulations: ……				
1.11	Approval includes requirements for class notation **LCS(DC)**				
1.12	Approval includes on-line interface				
1.12.1	Readings used as on-line input: ……				
1.13	Quality assurance system applied for development and testing: ……				
1.14	Approval given by other authorities or classification societies: ……				
2.	*General software specifications*				
2.1	On-line user's task help is provided				
2.2	Lightship weight and lightship weight distribution and associated centres of gravity are protected, i.e. cannot be changed by user				
2.3	The Society's imposed structural limitations are protected, i.e. cannot be changed by user				
2.4	If included, geometric hull form data are protected, i.e. cannot be changed by user				

		To be ticked off, "X":			
No.	*Software description*	*Yes*	*No*	*N/A*	*Ref./Page #*
2.5	Hydrostatic data are protected, i.e. cannot be changed by user				
2.6	If included, cross curves are protected, i.e. cannot be changed by user				
2.7	Compartment definitions including frame spacing, and centres of volume, together with capacity tables (sounding/ullage tables), if appropriate are protected, i.e. cannot be changed by user				
2.8	If included, limit curves (KG, GM) are protected, i.e. cannot be changed by user				
2.9	Where relevant, default group of damage cases are protected, i.e. cannot be changed by user				
2.10	Safeguarding against erroneous input such as overfilling of tanks, filling same tanks twice, etc.				
2.11	The following data are presented for each loading condition:				
2.11.1	Clear deadweight definition				
2.11.2	Light ship data				
2.11.3	Displacement and centre of gravity (VCG, LCG, TCG)				
2.11.4	Draughts at the perpendiculars and at midship.				
2.11.5	Forward, midship and aft draughts, at the actual position of the ship's draught marks				
2.11.6	Provision made available for the introduction of a longitudinal deflection				
2.11.7	Trim, clearly referring to a reference length				
2.11.8	Transversal metacentric height KM				
2.11.9	Initial metacentric height GM				
2.11.10	Free surface moment from slack tanks				
2.11.11	Free surface correction on the initial metacentric height				
2.11.12	Free surface correction on the GZ curve				
2.11.13	Flooding angle presented and included in the stability criteria control				
2.11.14	Listing of all relevant stability criteria: description of the criteria, the limit values and the obtained values				
2.11.15	Where applicable, effect of external heeling moments				
2.11.16	Shear forces, bending moments, torque and local strength as well as the limiting values for those parameters				

		To be ticked off, "X":			
No.	*Software description*	*Yes*	*No*	*N/A*	*Ref./Page #*
2.11.17	Loading condition results of strength and stability calculation are included				
2.11.18	Judgement of each loading condition with respect to all actual strength and stability criteria is clearly shown				
2.11.19	Clear warning is given if any of the actual strength and / or stability criteria are not fulfilled: ……				
2.12	Loading limitations are included (values to be included in stored characteristic data):				
2.12.1	Minimum draft forward due to slamming:				
2.12.2	Minimum draft midship (if applicable for vessel)				
2.12.3	Maximum draft (load line draft):				
2.12.4	Maximum GM to limit sloshing in slack tanks:				
2.12.5	Minimum GM / Maximum KG due to stability:				
2.12.6	Maximum trim due to range of trim covered by stored hydrostatic data, cross curves, limit curves or others:				
2.12.7	Cargo tanks and ballast filling (strength/stability), e.g. when ballast tanks surrounding empty cargo compartments shall be kept full etc.:				
2.12.8	Cargo tank filling height as a function of cargo density (strength):				
2.12.9	Cargo compatibility: with respect to type of cargo in adjacent compartments:				
2.12.10	For vessels with ice class: a clear warning is given if the ice draughts (UIWL and LIWL) are included:				
2.12.11	Limits to distribute loads on deck: the weights on a given deck shall be limited by strength for which the deck is approved:				
2.12.12	Clear warning is given if the loading limitations in 1.6, 1.7, 1.8, 1.9 and 2.12 are not fulfilled:				
2.13	Calculation of tank capacities and centre of gravity is included with trim correction				
2.14	**LCS(DC)**: The software is able to operate in two modes; surveillance and simulation mode:				
2.15	**LCS(DC)**: Continuous monitoring of the flooding situation:				
2.16	**LCS(DC)**: Clear warning in case of discrepancies between calculated draughts and remote draught readings:				

		To be ticked off, "X":			
No.	*Software description*	*Yes*	*No*	*N/A*	*Ref./Page #*
2.17	**LCS(DC)**: Manual input for compartment fillings possible in surveillance mode if failure of one or more sensors:				
2.18	**LCS(DC)**: Manual input for permeability possible				
2.18.1	Compartments with altered permeability clearly indicated on the screen				
2.19	**LCS(DC)**: Check of longitudinal strength after damage included				
2.20	Graphical presentation of loading conditions is included				
2.21	Integration and interpolation method and limitations				
2.22	Iteration limits: ……				
2.23	If on-line interface, possibility is provided for manual input				
3.	*Longitudinal strength*				
3.1	Control of stillwater shear force against limit values				
3.2	Correction of shear forces for bulk carriers				
3.3	Correction of shear forces for tankers				
3.4	Control of stillwater bending moment against limit values				
3.5	Control of stillwater stresses, including torsion				
4.	*Local strength*				
4.1	Limits for maximum mass in any hold as a function of draft				
4.2	Limits for maximum mass in any two adjacent holds as a function of draft				
4.3	Limits to filling heights in tanks as a function of cargo density				
4.4	Limits to distributed loads on decks				
5.	*Intact stability*				
5.1	Free surface effect as correction to initial GM is included				
5.2	Free surface effect as correction to GZ values is included				
5.3	Calculation of GZ curves included				
5.4	Calculation with respect to intact stability criteria is included				

		To be ticked off, "X":			
No.	*Software description*	*Yes*	*No*	*N/A*	*Ref./Page #*
5.5	If calculation and evaluation of severe wind and rolling criteria are included, both the hull above the water line, the structure on deck and all deck cargo are included in the windage area				
5.6	If relevant, calculation of other external heeling moments is included and presented: ……				
5.7	Graphical presentation of GZ curve is included				
6.	*Grain stability*				
6.1	Effect of vertical shift of grain is included				
6.2	If untrimmed ends are included, this can only be calculated for 100% filled holds.				
7.	*Damage stability*				
7.1	Damage stability calculation is based on lost buoyancy method				
7.2	Damage stability calculation is based on added weight method				
7.3	Free surface effect as a correction to GZ values is included				
7.4	Correction for initial contents of damaged tanks is included				
7.5	A default list of damage cases is included				
7.6	Possibility of defining damage cases is included				
7.7	Calculation of equilibrium position after damage is included (draft, trim and heel)				
7.8	Calculation of GZ curve is included				
7.9	Unprotected openings are included and taken into account in the program				
7.10	Weathertight openings are included and taken into account in the program				
7.11	If relevant, internal openings (openings between sections or compartments inside the ship) are included and taken into account in the program				
7.12	Evaluation with respect to all actual damage stability criteria is included				
7.13	Where relevant, calculation of external heeling moments is included				
7.14	Calculation of intermediate stages of flooding				

		To be ticked off, "X":			
No.	*Software description*	*Yes*	*No*	*N/A*	*Ref./Page #*
7.15	Graphical presentation of equilibrium position and GZ residual curve				
7.16	Warning displayed if loading condition is updated without re-calculation of damage stability				
8.	*Documentation to submit*				
8.1	User's manual				
8.2	Program description				
8.3	Test conditions				
8.3.1	Lightship condition				
8.3.2	Ballast or partly loaded condition				
8.3.3	Fully loaded condition				
8.3.4	Extreme condition (anticipated worst condition for strength as founded in the manual)				
8.3.5	5 test damage cases for **LCS-DCLCS(DC)**. Not required in case damage stability calculations are included for rule check (Y on 1.8).				
8.3.6	Test conditions demonstrating exceedance of limits and displayed warnings for strength, stability, draughts or other general loading limitations				
8.4	Stored characteristic data				
8.4.1	Hydrostatic data for range of trim ……				
8.4.2	Cross cCurves (KN data) for range of trim ……				
8.4.3	Tank data: maximum volume, max.VCG, TCG, LCG and maximum free surface moment (FSM)				
8.4.4	Weathertight & unprotected openings, margin line, flooding angle				
8.4.5	List of limit values KG/GM for range of trim ……				
8.4.6	List of grain data; table of volumetric heeling moment for partly filled holds, tables pertaining to cargo holds filled with ends untrimmed, tables of maximum permissible grain heeling moment				
8.4.7	Groups of damage cases (if damage included)				
8.4.8	Other data as: container data, timber loading data (cross curves), data for calculation of severe wind and rolling criteria				

		To be ticked off, "X":			
No.	*Software description*	*Yes*	*No*	*N/A*	*Ref./Page #*
8.4.9	Associated limits to still water shear force, bending moments and torque, as applicable for seagoing, harbour and flooded conditions.				
8.5	The documentation is in accordance with the approved onboard loading and stability documentation				
9.	*Alterations to the software*				
9.1	Are alterations affecting the results carried out [1)]				

N/A: Not applicable
"*No.*" refers to App.C *Guidance for filling in Approval request form for loading computer software.*

Ref./Page #: Answer to each question should be commented separately and enclosed, alternatively reference could be made to actual pages in User's Manual or Program Description.

	To be filled in:
Place:	
Date:	
On behalf of software manufacturer:	
Name:	
Position:	
Signature:	

APPENDIX C GUIDANCE FOR FILLING IN "APPROVAL REQUEST FORM FOR LOADING COMPUTER SOFTWARE"

It should be noted that not all items in the form are requirements. Some of the items are meant for information which may be used in connection with the software approval or the implementation to a specific ship. Some other items may not be applicable to the software in question. Reference is made to the rules for classification: RU SHIP Pt.6 Ch.4 Sec.7 [1.10] *General software requirements*.

In the column "Ref./Page No.", reference to the description of how the particular item is handled by the software should be given. The description may be given on a separate sheet or reference could be made to actual pages in the user's manual or program description.

The following should be used as guidance when filling in the approval request form.

1 Software description

1.1 General information

1.1 Initial type-approval is applicable in connection with the first time DNV GL type approval of the software is applied for. The type approval is valid for four years from the type approval date or to a new version of the software is produced. A new version of the software should be given when significant software alterations affecting the results are carried out. Type approval of stability and longitudinal strength software is rendered on a voluntary basis. Such type approval will make the approval process for a specific ship easier and reduces cost. Less documentation will be required and lower fees will be charged.

1.2 Software shall be approved for each ship where it is installed.

1.3 The approval of the software is valid for mono-hull ships only.

1.4 If the approval is requested for arbitrary floating structures a special agreement on testing will have to be made. The software shall have possibility to calculate stability about any arbitrary axis.

1.5 Approval with respect to longitudinal strength, means that the software calculates the longitudinal strength of given loading conditions, in terms of shear forces and bending moments, and torsional moments where applicable, and checks these against approved limit curves defined in the software.

1.6 Approval with respect to stability limit curves, means the software calculates the stability of given loading conditions, in terms of KG or GM, and checks these against approved limit curves defined in the software.

1.7 Approval with respect to intact stability calculations indicates the software can perform intact stability calculations, in terms of a GZ curve, evaluate and judge the results with respect to the applicable intact stability criteria.

1.7.1 The intact stability rules/regulations, which the software can evaluate and judge with respect to, should be listed, for example IMO *2008 IS Code*, A 2.2.

1.8 Approval with respect to damage stability calculations indicates that the software can perform damage stability calculations, evaluate and judge the results with respect to the applicable damage stability criteria.

1.8.1 The damage stability rules/regulations, which the software can evaluate and judge with respect to, should be listed, for example *MARPOL 73/78* Annex I regulation 4/28.

1.9 Approval with respect to grain stability calculations indicates the software can perform grain stability calculations to be compared with the applicable grain stability criteria.

1.9.1 The software can take into account grain heeling moments from untrimmed ends.

1.10 DNV GL towing criteria or others; please specify.

1.11 Optional class notation **LCS(DC)** applies to integrated systems developed to assist the Master as a decision aid when the ship has been subjected to damage and consequent flooding. The requirements are outlined in the rules for classification: RU SHIP Pt.6 Ch.4 Sec.7 [4.3] Some of the documentation shall be provided by the yard, and some by the software manufacturer.

1.12 This is in cases where on-line remote reading of tank soundings or drafts can be entered automatically into the program.

1.13 It should be stated which quality assurance system has been used for development and testing of the software, for example ISO 9000-3. It is important that the software manufacturer has implemented a quality assurance system in connection with the development and testing of the software.

1.14 Reference to approvals granted by authorities and other classification societies should be given.

2 Software specifications

2.1 General software specifications

2.1 On-line user's task help means that the software system provides on line help for input, output, printing etc. to perform these functions and evaluate the results.

2.2 Stored lightweight data shall be reasonably protected from accidental alterations. A special procedure should be established if alterations of these data are necessary.

2.3-2.8: Stored geometry characteristic data, i.e. hull definition, compartment definition, openings and hydrostatic tables, stability curves etc. shall be reasonably protected from accidental alterations. A special procedure should be established if alterations of these data are necessary.

2.9 A group of damage cases corresponding to the damage cases in the approved stability documentation. This information is not to be changed after approval.

2.10 The software design should be such that it limits possible input errors by the user. For example, it should not be possible to input a volume in a tank that exceeds the tank's total volume, or it should not be possible to change the position of the compartments when positioning (solid) weights related to a given compartments such as stores or swimming pools.

2.11 Relevant data to be presented for each loading condition.

2.12 It should be described whether the software takes into account applicable loading limitations such as:

- Maximum draft: not to exceed freeboard marks
- Minimum draft forward: due to strength considerations (slamming)
- Minimum draft midship, if applicable for certain vessel types
- Draft limits for operation in ice
- Maximum trim: in cases where limit curves are approved for specified/limited trim, or specific trim limits exists
- Minimum GM: to satisfy the applicable stability requirements
- Maximum GM: to limit sloshing in slack tanks
- Limits on cargo tanks or ballast tanks filling: due to strength or stability considerations, for example when ballast tanks surrounding empty cargo compartments shall be kept full etc.
- Maximum tank filling as a function of liquid cargo density: as approved with respect to strength and stability
- Cargo compatibility: with respect to types of cargo in adjacent compartments
- Limits to distributed loads on deck: the weights on a given deck shall be limited by the strength for which the deck is approved.

A warning should be given if any loading limitation is exceeded. See also Sec.3 of this class guideline.

2.13 It should be stated whether the software calculates liquid contents taking trim into account. If not, a note should be made in the user's manual to draw the attention to possible correction for loading conditions with significant trim.

2.14 The software shall be able to operate in two modes, a surveillance mode which reflects the actual situation of the ship and a simulation mode where the operator can simulate corrective actions. The two modes shall be clearly marked on the computer screen so that there is no doubt about in which mode the computer is operated. In both modes it shall be clearly indicated whether the stability margins are adequate for both the actual condition and the simulated condition.

2.15 The software should enable continuously monitoring of the flooding situation and record or plot those compartments where a change in content is registered after the flooding.

2.16 The software shall give a clear warning in case there is a discrepancy between calculated draughts and the remote draught readings.

2.17 It should be possible to give manually input for compartment fillings in those cases where it becomes evident that a failure has occurred influencing the accuracy of one or more sensors.

2.18 It should be possible to manually enter an estimated value for permeability for any compartment assumed to be reflecting the actual situation in lieu of those set forth by the rules. Those compartments which permeability has been altered should be clearly indicated on the computer screen.

2.19 Calculation of longitudinal strength after damage is an optional loading computer function that may be added.

2.20 The software should provide the possibility of graphical presentation of the loading condition in order to verify input of loads.

2.21 The integration and interpolation method and limitations should be described. The number of intervals should be sufficient to provide accurate integration and interpolation.

2.22 The iteration out-off limits should not exceed 1% of the reverting value for on-board software. These limits can be obtained by comparing results from the latest two iterations. The number of iterations should be limited to avoid infinite loops. If the obtained results are not within the above limits, a warning should be given.

2.23 For systems with on-line interface it should also be possible to enter data manually, for planning of load conditions. In case of failure of an on-line interface an error message should be given.

3 Longitudinal strength

3.1 The software shall be capable of comparing calculated, corrected still water shear forces with limit values for seagoing- and harbour conditions as relevant and show the utilisation of the limit values. This control may be performed continuously along the ship's length or alternatively related to specified check point. A warning should be given if the limit values are exceeded.

3.2 For correction of shear forces for bulk carriers reference is made to rules for classification: CSR IACS common structural rules.

3.3 For correction of shear forces for tankers, which is only applicable to tankers constructed before the IACS CSR rules for tankers were released in 2006, reference is made to the relevant class rules for the vessel in question (prior to the January 2006 issue). Please also refer to existing loading manuals for the vessel.

3.4 The software shall be capable of comparing calculated still water bending moments with limit values for seagoing- and harbour conditions as relevant and show the utilisation of the limit values. Reduced limits for bulk carriers in alternate loading conditions should be available.

The control may be performed continuously along the ship's length or alternatively related to specific check points as given in the loading manual. If specific check points are used the software should also control the bending moment maxima between the check points. A warning should be given if the limit values are exceeded.

3.5 The software should have the possibility of controlling longitudinal stresses, including torsion and show the utilisation of the allowable values. A warning should be given if the limits are exceeded.

4 Local strength

4.1 Where applicable, the software should be capable of including and storing approved limits for maximum mass in any hold as a function of draught and show utilisation of limit values. A warning should be given if limits are exceeded.

4.2 The software should be capable of including and storing approved limits for maximum mass in any two adjacent holds as a function of draught, and show utilisation of limit values. A warning should be given if limits are exceeded.

4.3 The software should be capable of including and storing approved limits to maximum filling height in any tank as a function of cargo density and show utilisation of limit values. A warning should be given if limits are exceeded.

4.4 The software should be capable of including and storing approved limits to distributed loads on decks and show utilisation of limit values. A warning should be given if limits are exceeded.

5 Intact stability

5.1 The method by which initial GM is corrected for free surface effect of slack tanks should be described. The lower and upper limits of tank level for calculating the free surface effect shall be given.

A correction based on a virtual increase of KG based on maximum moment of inertia of slack tanks may be accepted.

The method by which initial GM is corrected for free surface effect of 98% full tanks should be described.

A correction based on a virtual increase of KG based on moment of inertia at 98% tank level may be accepted,

or;

by applying the vertical centre gravity of full tank.

The latter method is not recommended for very wide tanks, as the free surface effect can be underestimated.

As a default, the loading computer shall show the "real" free surface according to tank filling for each tank. A function for applying maximum free surface for selected tanks for voyage planning may also be available, but the tanks for which this function is applied should be clearly identified on the screen and in the condition reports/printout.

5.2 The method for which GZ values in intact condition are corrected for free surface effect of slack tanks shall be described.

Normally, a virtual increase of KG is assumed based on maximum moment of inertia of slack tanks,

or;

GZ is corrected based on the actual heeling moment due to shifting of liquid,

or;

GZ is corrected based on a heeling moment due to shifting of liquid calculated according to the *2008 IS Code*, B 3.1.

5.3 The software should calculate the righting lever (GZ) curve in intact condition including correction for the free surface effect at intervals of heeling angles not exceeding 5 degrees, up to at least 40 degrees.

5.4 The software should calculate intact stability based on the righting lever GZ curve, including correction for the free surface effect such as area under GZ curve between 0-30 degrees, 0-40 degrees, 30-40 degrees, angle of maximum GZ, value of maximum GZ between 30-40 degrees (or down flooding angle if this is less than 40 degrees) as well as value of initial GM.

5.5-5.6 External heeling moments should be calculated as in the onboard stability booklet or according to applicable rules.

External moments may be moments due to wind, passenger heeling, towing or others.

5.7 The software should provide for graphical presentation of GZ curve in intact condition.

6 Grain stability

6.1-6.2 To be same as in the approved grain loading manual.

7 Damage stability (need not to be completed if the software checks against damage stability limit curves only)

7.1 It should be stated whether the damage stability calculations are based on 'lost buoyancy method'. This method is preferable.

7.2 It should be stated whether the damage stability calculations are based on 'added weight method'.

7.3 The method by which GZ values in damaged condition are corrected for free surface effect of slack tanks should be described.

Normally, GZ is corrected based on the actual heeling moment due to shifting of liquid,

or;

GZ is corrected based on an assumed heeling moment due to shifting of liquid at 5 degrees (MARPOL),

or;

a virtual increase of initial KG is assumed based on maximum moment of inertia of slack tanks.

7.4 If damaged tanks contain liquids before the assumed damage, the software should take this into account by assuming such initial liquid contents flow out before filling the damaged compartment with sea water.

7.5 For checking damage stability of a planned loading condition, a default list of damage cases should be stored so that the user can run damage stability calculations applying these predefined damage cases.

7.6 For checking damage stability of a current or planned loading condition the user may define other certain damage cases to run damage stability calculations for those defined damage cases.

7.7 Calculation of equilibrium position after damage should include:

— Draft forward and aft, and mean draft midship
— Trim
— Heel angle
— Distance between equilibrium water line and down flooding openings
— Residual GM.

7.8 The software should calculate the righting lever GZ curve in damaged condition including correction for the free surface effect at intervals of heeling angles not exceeding 5 degrees, up to at least 50 degrees.

7.12 The software should calculate damage stability results based on the righting lever GZ curve including correction for the free surface effect such as equilibrium position and value of residual GM as well as the area under GZ curve between equilibrium and 20 degrees, value of maximum GZ between equilibrium and 20 degrees (or down flooding angle if this is less).

7.13 When applicable, the software should calculate damage stability taking into account a defined external heeling moment such as passenger heeling moment, wind heeling moment or launching of life boats.

7.14 It should be stated whether the software can calculate intermediate stages of flooding and how such calculations are performed, including flooding sequences if relevant.

7.15 The software should provide for graphical presentation of the equilibrium position after damage and GZ curve in damaged condition.

7.16 The user should be clearly informed whether damage stability has been calculated for the latest version of the loading condition, if damage stability is not performed automatically after each update of condition (which is not recommended).

8 Documentation to be submitted

8.1 – 8.3: To be in accordance with rules for classification: RU SHIP Pt.6 Ch.4 Sec.7 [2.1] and RU SHIP Pt.6 Ch.4 Sec.7 [4.3] as applicable.

8.4 Stored data should cover the intended operational trim range. If based on even keel data only, the accuracy of the stability calculations will decrease with increasing trim.

HISTORIC CHANGES

There are currently no historical changes for this document.

DNV GL

Driven by our purpose of safeguarding life, property and the environment, DNV GL enables organizations to advance the safety and sustainability of their business. We provide classification and technical assurance along with software and independent expert advisory services to the maritime, oil and gas, and energy industries. We also provide certification services to customers across a wide range of industries. Operating in more than 100 countries, our 16 000 professionals are dedicated to helping our customers make the world safer, smarter and greener.

SAFER, SMARTER, GREENER