CONVERSION OF SHIPS

OCTOBER 2000
FOREWORD

DET NORSKE VERITAS is an autonomous and independent Foundation with the objective of safeguarding life, property and the environment at sea and ashore.

DET NORSKE VERITAS AS is a fully owned subsidiary Society of the Foundation. It undertakes classification and certification of ships, mobile offshore units, fixed offshore structures, facilities and systems for shipping and other industries. The Society also carries out research and development associated with these functions.

DET NORSKE VERITAS operates a worldwide network of survey stations and is authorised by more than 120 national administrations to carry out surveys and, in most cases, issue certificates on their behalf.

Classification Notes

Classification Notes are publications that give practical information on classification of ships and other objects. Examples of design solutions, calculation methods, specifications of test procedures, as well as acceptable repair methods for some components are given as interpretations of the more general rule requirements.

A list of Classification Notes is found in the latest edition of the Introduction booklets to the "Rules for Classification of Ships", the "Rules for Classification of Mobile Offshore Units" and the "Rules for Classification of High Speed, Light Craft and Naval Surface Craft". In "Rules for Classification of Fixed Offshore Installations", only those Classification Notes that are relevant for this type of structure, have been listed.

The list of Classification Notes is also included in the current "Classification Services - Publications" issued by the Society, which is available on request. All publications may be ordered from the Society’s Web site http://exchange.dnv.com.
1. Introduction

1.1 Application
This Classification Note only covers conversion of ships. Conversion of offshore installations or converting ships to offshore installations is not covered.

1.2 Retention of class
See the Rules for Classification of Ships Pt.1 Ch.1 Sec.3 B600.

1.3 Definition of a conversion
From a structural point of view, any changes of the ship structure is to be regarded as a conversion; from alteration of the main dimensions (such as length, breadth, depth) to installing thrusters, generators, cranes or winches, or similar.

Note that the following aspects are also treated as conversions:

1) Increasing the maximum allowable draught.
2) Modifications reported by surveyors that have not been approved by DNV in advance.
3) Change of flag, provided the new flag State has additional requirements. This will be a case for the new flag State.
4) Adding new class notations normally implies new requirements.
5) Class transfer from a classification society that is not a member of IACS (International Association of Classification Societies).

1.4 Major conversions
A major conversion is defined in the Rules for Classification of Ships Pt.1 Ch.1 Sec.3 B605 as follows:

By modifications of a major character it is to be understood that major conversions are defined as a conversion of an existing ship:

i) which substantially alters the dimensions or carrying capacity of the ship; or
ii) which changes the type of ship; or
iii) the intent of which in the opinion of the Society substantially prolongs the life of the ship.

(MARPOL 73/78, Annex I, Regulation 1(8)(a))

1.5 Application of the rules

1.5.1 Generally
Normally, the current rules provide the basis for approval of major conversions. However, in some cases the basis of the current rules and the rules applied at the newbuilding stage will be considerably different. One possible approach will be to follow the rules applied at the newbuilding stage. Moreover, the current rules may be significantly stricter, which is often a result of practical experiences e.g. damage to ships in operation. Applying earlier rules should therefore be done with some precaution. Application of earlier rules will be decided on a case by case basis.

1.5.2 Increased draught
Increased draught is normally not regarded as a major conversion despite the phrase carrying capacity in 1.4. However, precaution should be taken if the increase in draught is major. This is dealt with more specifically in 2.1.

1.5.3 Structural strength
With regard to hull strength, the vessel is at least to be strengthened according to the increased loads caused by the conversion.

1.5.4 Stability
Stability is perhaps one of the most important aspects to clarify when planning a major conversion and also conversions in general due to damage stability requirements. In particular, it should be noted that for a dry cargo ship over 80 m in length where no damage stability requirements have previously been in force, it may be necessary to submit damage stability index calculations demonstrating that the level of subdivision is not less than before the conversion.

1.5.5 New class notations
Upon assignment of new class notations, the current rules are to be complied with.

1.5.6 Statutory
SOLAS, MARPOL, IBC/BCH codes and IGC code are not covered by this Classification Note. Reference is given to the applicable rules and regulations.

1.5.7 Flag States
It is important to note that the flag States may have additional requirements.

1.6 Documentation required by class
See Annex I for documentation requirements with respect to conversions.

1.7 Relevant references for conversion
The Rules for Classification of Ships and all Guidelines are applicable, as appropriate.
2. Structural Strength

2.1 Increased draught

2.1.1 General

Some items may have vital influence on the feasibility of the project and the amount of work required, such as:

1) What draught was approved earlier?
2) Has the question regarding increased draught been raised before for this ship or for sister ships?
3) Will there be any redefinition of the freeboard deck? If yes, may vertical extent of watertight bulkheads interrupt the project (Ro-ro ships, trawlers, general cargo ships)?
4) The freeboard has to be approved according to the load line regulations. Extensive calculations may be wasted if the questioned draught has to be reduced because it is not according to the load line regulations.
5) The global strength.
6) Extension of watertight bulkheads.
7) Bow height requirement.
8) Stern or bow doors and doors in the ship's side.
9) Position of side scuttles.
10) Position of valves and discharges.
11) Bottom of net bin for fishing vessels.

2.1.2 Application of the rules

Increased draught is normally not regarded as a major conversion. This may however depend on the background for the deeper draught. A major change in load capacity or load type for a bulk carrier or a tanker could for instance be regarded as a major conversion. This will be evaluated on a case by case basis.

The current rules are normally to be applied but previous rules may be accepted, based on special considerations.

2.1.3 Global strength

The distribution of still water bending moment (Msw) and shear forces (Qsw) are a function of distribution of buoyancy, lightweight and cargo (dwt) over the ship's length. The type of vessel and the cargo distribution will therefore have an important impact on how an increase in a ship's draught will affect the longitudinal strength.

Wave bending moment and shear forces are very little influenced by the ship's draught. The block-coefficient Cb, increases with increasing draught, but this can in most cases be ignored, and design wave bending moments and shear forces are consequently unchanged.

Still water bending moment (Msw) and shear force (Qsw) for loading conditions with increased draught are often within values for existing loading conditions. However, Msw and Qsw can be critical, depending on the type of vessel, e.g. sagging moment amidships and shear force at the collision and forward engine room bulkheads for vessels with a large block coefficient, such as tankers for chemicals and bulk carriers.

The actual distribution of Msw and Qsw is seldom known at the time when an increased draught is requested. The evaluation is therefore normally based on previous approved loading conditions, or previous approved maximum still water bending moment and shear forces. In cases where the existing loading conditions are irrelevant, e.g. due to a major conversion of the vessel, rule design values or design limits are to be applied.

The loading manual is to be updated and submitted for approval when applicable.

The cargo or loading instrument is to be adjusted, if found necessary.

2.1.4 Local strength

2.1.4.1 Ship's sides and deck

Scantlings of structural elements are to be checked based on the new design sea-pressure.

1) Frames, stringers and longitudinals, especially at the ends of the ship.
2) Forecastle structure.
3) Transverse strength of deck and ship side in way of cargo holds for open vessels (e.g. general cargo vessel with one large cargo hold opening).
4) Main frames for bulk carriers. Frames in empty holds.
5) Transverse strength of deck between cargo holds for bulk carriers. Buckling control.

2.1.4.2 Girder system in bottom and sides

The girder system is to be checked based on the increased design sea pressure and increased cargo weight in tanks, holds on deck, if relevant.

1) Bottom structure in tankers (floors and longitudinal girders). A limitation on net pressure on the bottom may be given.
2) Double bottom and bulkheads strength for bulk carriers. Double bottom analysis may be required.

2.1.4.3 Deck houses

Change of freeboard deck may lead to a substantial increase in the design pressure for the front bulkhead. E.g. old 2nd tier becomes 1st tier if the old main deck is covered by a new forecastle deck.

Plating and stiffeners on front bulkhead are to be checked for strength.

Side and end bulkheads are to be checked for strength if the freeboard deck is changed.

2.1.4.4 Bulkheads and decks acting as top/bottom of tanks

Watertight bulkheads are to be dimensioned for increased static pressure, due to new damage waterline or new freeboard deck (bulkhead deck).
Checking of bulkhead scantlings is normally only required if the freeboard deck is changed, since the increase in damaged water line must be considerable before it has any consequence for the bulkhead strength.

Tank bulkheads, bottom and top are to be checked if the height of the air pipes is increased, e.g. relevant when a vessel's depth is increased. In this case DNV is to be informed.

Cargo hold and tank bulkheads are to be checked if the total weight in hold or tank is increased beyond the previously approved limits (increased cargo density). In this case DNV is to be informed.

2.1.4.5 Hatch covers
The requirements for sill height and strength increase when the position of such changes from Position 2 to Position 1. Structural strength of hatch covers is to be checked when the freeboard deck is changed, especially hatch covers in the fore ship.

2.1.4.6 The ice belt
The ice belt is to be especially considered. See 2.9.

2.1.4.7 Bow impact
Need only be checked for vessels with large flare when the increase in draught is substantial.

2.1.5 Structural arrangement when the freeboard deck is redefined
2.1.5.1 Collision bulkhead
No openings are accepted below the freeboard deck.

The requirement for the longitudinal position of the bulkhead is normally not influenced. It should however be checked when the freeboard deck is redefined.

The vertical height of the collision bulkhead is to extend to the next deck above the freeboard deck for ships having complete or long forward superstructure. Openings or doors in the existing upper part are to be closed.

Note that steps in the collision bulkhead can be accepted if all parts of the bulkhead are within the rule limits.

2.1.5.2 Fore engine room bulkhead
The bulkhead is to extend watertight to the freeboard deck. Doors in bulkheads acting as fore engine room bulkhead above the 'tween deck are to be watertight and fitted with signboards stating that the doors are to be kept closed at sea. Sill height is to be to the wateline or maximum 600 mm. Scuttles in 'tween deck bulkheads may be kept if fitted with deadlights.

2.1.5.3 After peak bulkhead
Three alternatives are normally accepted, see Figure 2-1: a) Ships already fitted with a complete bulkhead from side to side between the aft perpendicular and the fore engine room bulkhead may use this as the after peak bulkhead. Strength is to be checked. The bulkhead is to extend to first watertight deck above the wateline. If the accommodation deck acts as a part of the bulkhead, the height of the deck from the bottom is to be at least equal to the height of the bottom floors. Inclined decks are acceptable.
b) A bulkhead is fitted between old and first watertight deck above the wateline. Doors are to be watertight with a sill height to the wateline or maximum 600 mm. c) Entrance down to the aft accommodation below 'tween deck is closed by a steel casing with watertight steel door and with a sill height to the wateline or maximum 600 mm. This arrangement is normally applied only for older vessels.

Note that the net bin bottom on fishing vessels is not to be below the new wateline.

Figure 2-1 Three different arrangements of the aft peak bulkhead for a fishing vessel (old type)
Approval of the above mentioned alternatives is based on that the entrance down to the engine room from tween deck below water line is closed by steel casing with weathertight steel doors with a sill to the waterline or maximum 600 mm.

Where parts of a deck form a part of the watertight bulkhead, the deck is to be dimensioned accordingly.

The rules state no requirement with regard to position of the afterpeak or fore engine room bulkheads, but:

- one may not define a bulkhead both as an after peak and a fore engine bulkhead
- the entrance down to the engine room is to be located between the bulkheads.

2.1.5.4 Doors and hatches

Previous superstructure deck, defined as Position 2 deck, may now be exposed freeboard deck defined as Position 1 deck. This means that the height of hatch coamings and door sills is to be checked and may have to be extended.

2.1.5.5 Bow height

The minimum bow height is calculated according to the load line regulations. Note the minimum longitudinal extension of the forecastle.

Acceptable solutions to obtain acceptable bow height, see Figure 2-2:

a) A new forecastle deck is built above the existing. Note that the space between the old and the new deck is to be arranged with access using a manhole or similar. This alternative may require that deck equipment (anchoring winches etc.) are removed and refitted on the new deck.

b) A new forecastle deck is built enclosing existing forecastle and the deck equipment. The new part is to be made watertight and the anchor chain pipes are to be arranged with closing arrangements at the upper end.

c) New forecastle.

2.1.5.6 Doors in the ship's side

This may be illustrated in the following two instances:

1. The waterline is above the door sill:
   Fitting of a second door of equivalent strength and watertightness is one acceptable arrangement. Leakage detection is to be fitted in the compartment between the two doors and drainage to the bilge controlled by an easily accessible screw down valve. Alternatively, the existing door is to be permanently sealed off.

2. The waterline is below the door sill:
   The rules give no requirement in regard to the minimum height from the uppermost waterline to the ship side door sill. This means that the waterline may be in line with the sill of a door. A leakage or a cargo heel in port may then flood the lower cargo hold (tank top) capsize the ship. A normal recommendation is the fitting of an inner sill, which can withstand a heel of 2.5 degrees without flooding the hold. Drainage is to be provided between the new and the old sill, see Figure 2-3.

2.1.5.7 Ventilators, air pipes, scuppers and discharges

If the height of the air pipes is increased then the tanks are to be checked for the new design loads. DNV is to be informed.
2.1.5.8 Openings when freeboard deck is redefined

Old freeboard deck drains are to be closed. The minimum height between the waterline and the light valves is 500 mm. If the rudder carrier is flooded, an additional sealing box is to be fitted.

2.1.6 Checklist for increased draught

1) Watertight bulkheads
   - vertical extent
   - strength
   - position of collision bulkhead
2) minimum bow height
3) position of overboard discharges
4) position of side scuttles
5) doors in the ship's side
6) position of rudder carrier
7) hatchway coaming and covers
8) ice belt strength and vertical extent
9) longitudinal strength (if applicable)
10) local strength
    - weather deck
    - forecastle deck
    - ship's sides
    - bottom
    - deckhouse front and sides.

2.2 Lengthening of vessels

2.2.1 Application of the rules

Reference is made to the introduction, for general information.

Lengthening of a vessel is always regarded as a major conversion with regard to strength. This means that the current rules apply with respect to local and global strength.

The design process to determine the required scantlings for the new section should be similar as for a new building. Scantlings of the new hull section must be in accordance with current rules, i.e. the rule requirements for minimum thickness and minimum section modulus are to be complied with.

In regard to existing parts of the vessel, the minimum thickness requirements are normally not complied with if the vessel is lengthened. Usually, this can be dealt with as follows:

- If the minimum thickness complies with the newbuilding stage rules, no further considerations are necessary, in this aspect.
- Deletion of class notations, e.g. Fishing Vessel or Supply Vessel, may reduce the minimum requirements.
- Minor discrepancies are, in general, acceptable, provided the strength is acceptable.

The design still water bending moments and design loads (sea pressure, bow impact, slamming, accelerations) are directly dependent on the length. This means that the complete vessel has to be reassessed for strength.

It should be noted that minor strength discrepancies may be accepted as reduced corrosion margins if requested by the owner. Memo for owner or surveyor will normally be given in such cases.

2.2.2 Documentation requirements

The following drawings and documentation are required to be submitted for approval or information, in connection with lengthening of a vessel, see also Appendix I:

1) General arrangement.
2) Tank plan.
3) Midship section with material properties (new Ch, speed and design draught to be stated on the drawing).
4) Shell expansion.
5) Profile and deck plan.
6) New section.
7) Design loading conditions or loading manual, see the rules.
8) Reinforcement of existing structure.
9) Docking plan (L > 100 m).
10) New equipment number calculation and proposal of upgraded anchoring equipment as far as relevant.

2.2.3 Longitudinal strength

The coherence between a vessel's length and required longitudinal hull girder scantlings, with respect to bending moments and shear forces is discussed here. Lengthening of a vessel will have an influence on both still water and wave induced hull girder loads. Global design loads, and acceptance criteria for the hull girder, are given in the Rules for Classification of Ships.

The actual still water bending moments and shear forces on a hull girder is dependent on both the vessel's length and type (hull shape and buoyancy, lightweight distribution and cargo distribution). The design still water bending moments, given by the rules, is a function of \( L^3 \), i.e. an increase in the length will lead to a rapid increase in the design bending moment, see Figure 2-4.

Figure 2-4 Stillwater bending moments along the vessel length for \( L=100 \text{ m} \) and \( L=130 \text{ m} \)

The actual still water bending moments and shear forces on a hull girder is dependent on both the vessel's length and type (hull shape and buoyancy, lightweight distribution and cargo distribution). The design still water bending moments, given by the rules, is a function of \( L^3 \), i.e. an increase in the length will lead to a rapid increase in the design bending moment, see Figure 2-4.
Still water bending moment less than the rule design still water bending moment can be used provided relevant and realistic loading conditions are submitted for approval. For some types of vessel e.g. cruise vessels, which often are pure hogging vessels, zero (0) or the minimum hogging condition as design "sagging condition" can be accepted.

Wave induced loads on the hull girder are also a function of the ship length. The rule design wave bending moments is a function of \( L^3 \) i.e. increasing the length will imply a rapid increase in the wave bending moment, see Figure 2-5.

From Figures 2-4 and 2-5, it may be seen that a 30% increase in length will lead to approximately 90% increase in both the rule still water and wave bending moment. In other words, the requirement to section modulus will increase with 90% for a lengthening of 30%. The minimum requirement to the section modulus about the horizontal neutral axis, which must be fulfilled for all vessels irrespective of loading conditions, will increase similarly.

### 2.2.3.1 Longitudinal strength evaluation

Scantlings of the new hull section must be in accordance with the current rules. The existing vessel must be reassessed according to the current rules, based on the new length, and hence the new design bending and shear forces. Such evaluation should include checking of the relevant cross sections, with respect to fulfilment of the rule requirements for section modulus, buckling control of longitudinal structural elements and shear strength control. In addition, it is to be checked that the plate thickness is according to the rule minimum.

Minimum requirements for thickness are a function of the ship's length, see Table 2-1. Acceptance of deficiencies in scantlings must be based on performed calculations proving that both the longitudinal and local strength of the vessel is satisfactory with the actual deficiencies, e.g. buckling control of longitudinal strength element such as bottom and strength deck plating. Corrosion allowance, according to the rules, is to be deducted from the plate thickness when carrying out the buckling check.

<table>
<thead>
<tr>
<th>Length, ( L ) (m)</th>
<th>Bottom and sides</th>
<th>Keel</th>
<th>Deck</th>
<th>Shell, ICE-C</th>
<th>Bottom decks</th>
</tr>
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<td>7</td>
<td>9.5</td>
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<td>11.5</td>
<td>7</td>
</tr>
<tr>
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<td>10.8</td>
<td>7</td>
<td>14.25</td>
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<td>9</td>
<td>12</td>
<td>7.5</td>
<td>17</td>
<td>8</td>
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<tr>
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<td>14.5</td>
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<tr>
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<td>12</td>
<td>17</td>
<td>9.5</td>
<td>25</td>
<td>10</td>
</tr>
</tbody>
</table>

Table 2-1 Typical minimum thickness requirements for some plates, corrosion addition \( t_k \) is not included (mm)

The allowable stress in longitudinal strength members, when checking for lateral loads, is dependent on the longitudinal hull girder stress. Members, which were acceptable before the lengthening, may fail to fulfil the rule requirements after the lengthening, due to reduced allowable stresses.

### 2.2.3.2 Shear strength

The rule design wave shear forces will increase when a ship's length is increased, see Figure 2-6.

Evaluation of global shear strength is especially important for vessels with large or many openings in the side shell, in way of the quarter length fore and aft. It is important to check both vertical and horizontal shear for passenger and cruise vessels, which have many windows with a small distance between them. The allowable shear stress, shear buckling and secondary bending of shell plating between the windows is to be controlled.

For vessels with a relatively simple longitudinal structure (single skin vessel or vessel with continuous longitudinal bulkhead(s)), rule values or the Nauticus Section Scantling shear stream analysis may be used. For more complex vessels, it may be required to carry out FEM analysis in order to achieve a satisfactory shear stress level.

Figure 2-6 Wave shear force distribution along the vessel length for \( L=180 \) m and \( L=210 \) m
2.2.3.3 Racking analysis

For vessels with large deck areas over several decks, without any transverse bulkhead in the cargo area, such as ro-ro vessels, racking analyses may be required. How the lengthening effects the vessel’s racking capacity has to be considered before racking analysis is required and the extension of such.

2.2.3.4 Torsion

For ships with large deck openings (total width of hatch openings in one transverse section exceeding 65% of the ship breadth or length of hatch opening exceeding 75% of hold length) the longitudinal strength including torsion may be required to be considered. This is normally only applicable for bulk carriers and container carriers.

See the following references:

- Rules for Ships Pt.5 Ch.2 Sec.6: Container Carriers
- Classification Note 31.1: Strength Analysis for Hull Strength in Bulk Carriers.

2.2.3.5 Reinforcement of existing structure

For a newbuilding or a new section, it is normally not a problem e.g. to increase the plate thickness or the size of the longitudinals in order to achieve satisfactory section modulus or buckling capacity. Such proposals will in most cases be unrealistic for existing parts of a ship, due to the cost involved in first removing the old structure and then inserting a new structure, with the required scantlings.

Reinforcement of existing ships must therefore be based on what is possible to achieve bearing in mind the conversion cost involved. However, proposed reinforcement shall always comply with the rule requirement.

Problems, which frequently occur for the existing structure, are:

1) Section modulus for the existing structure does not fulfill the rule minimum or the required section modulus based on the new design bending moments and shear forces.
2) Buckling of longitudinal strength elements, such as bottom plating, strength deck plating, side shell plating etc. Transversely stiffened plating is to be especially considered.
3) The rule minimum thickness is not fulfilled for all structural elements.
4) Torsion strength of vessel with large deck openings, i.e. a general cargo vessel with one large hatch opening, open hatch container vessel. The longitudinal strength, including torsion may be required to be considered.
5) Shear strength in way of quarter length from AP and FP for vessel with many or large openings in the side shell, e.g. cruise vessels.

The following reinforcements can be applied:

1) Fitting of doubler plates on bottom, strength deck or at shear strake in order to increase the section modulus, and hence reduce the longitudinal hull girder stress.
2) Increase breadth by fitting of sponsons, in order to increase the section modulus.
3) Fit intermediate stiffeners or longitudinals in order to increase both section modulus and buckling capacity.
4) Buckling stiffeners.
5) Doublers on side shell in order to increase shear capacity or closing of windows or openings.

Acceptable ways to increase the section modulus by fitting doublers, is described in 2.11.

2.2.4 Local strength general

The following areas are to be considered with regard to strength:

- ship’s side, especially fore and aft ship
- bow impact affected area
- slamming affected area
- bottom
- ice belt
- weather decks, especially fore and aft ship
- hatches
- superstructures, especially front bulkhead.

2.2.5 Local strength - New section

The new section is to be checked with respect to requirements stated in the current rules.

2.2.6 Local strength - Existing parts of the ship

2.2.6.1 Structures exposed to sea loads

The ship length is included in both the minimum sea pressure and the rule sea pressure. Increased length will however not result in a major change in the sea pressure.

E.g. given a ship with the particulars:

\[
L = 50 \text{ m}, B = 12 \text{ m}, D = 10 \text{ m}, T = 6 \text{ m}, Cb = 0.6, V = 15,
\]

an increase of the length of 40% will only lead to a sea pressure increase of approximately 15% in way of FP at the base line. The pressure alteration will increase if the draught is less than given above.

Larger ships will generally experience a smaller pressure increase than smaller ships when the length is altered. Considering that Cb increases with the length, one may experience that the sea pressure will remain unchanged when the ship is lengthened.

The percentage increase of sea pressure should be checked before detailed calculations are carried out. If the sea pressure increases by less than:

- 5 %, then frames need not be checked
- 10 %, then plating need not be checked.
For increased draughts below 10%, frames and plating need normally only be checked in the fore and the aft ship.

It is however important to take rule changes into consideration. Old ships may have to be checked even for small sea pressure alterations, as the current rules are applied for major conversions.

2.2.6.2 Superstructures
The front bulkhead is to be checked as the length of the vessel has major influence on the design pressure.

The superstructure sides should also be checked on the lower tiers, especially if the draught is increased.

2.2.6.3 Ship sides for bulk carriers or general cargo carriers with large hatch openings in deck
The ship side is carried by deep web frames or stringers or deck strips. If the latter carries the side and the cargo space is altered, these stringers or deck strips are to be checked according to the new span and sea pressure. The most conservative load case is to be applied i.e. empty hold and maximum sea pressure if applicable.

When applying a beam element model one should note that the hatch coaming will be the upper deck strip flange.

2.2.6.4 Hatches
Hatches that were previously located within Position 2 may after the ship lengthening be located within Position 1. Thus the requirement for hatch coaming height and strength increases. The minimum load on the hatches according to the convention rules increases with the ship length. The weather deck load increases.

2.2.6.5 Slamming
The area affected by slamming is always to be checked when the length is increased. The rule slamming pressure increases rapidly (over proportional) and almost linear with the ship length. The extension of the area affected by slamming will also increase, see Figure 2-7.

E.g. for a ship which is lengthened from 80 to 100 m (25%) with a forward minimum ballast draught of 3 m, the slamming pressure will increase by approximately 75%.

Discrepancies may be handled in the following ways:

a) Plating: Intermediate stiffeners are fitted or plating is renewed.

b) Stiffeners: Intermediate stiffeners are fitted or existing stiffeners are strengthened with brackets, additional flanges or struts.

c) Shear area of bottom floors or girders: Manholes are closed, floors or girders are fitted with doublers, additional floors or girders are fitted.

d) Weight of ballast may be deducted. New load conditions apply.

Figure 2-7 Slamming pressure for different ballast conditions as a function of the vessel length
In ships with large holds in the forecastle, one may often find a shear area deficiency in bottom floors or girders according to the rule formula. As additional steel in the bottom may become costly for the shipowner, it is important to know that it is possible to carry out a direct stress analysis of the bottom structure based on the slamming pressure.

The shear area summation formula is based on the fact that the slamming pressure is very local. The mean allowable shear stress is set to 100 N/mm² and the slamming pressure is reduced as a function of the affected area.

- for an area \((L \times D / 20)\) a minimum pressure of \(p = p_{slamming}/2\) is applied.
- \((L \times D / 60) \leq (L \times b) \leq (L \times D / 80) \Rightarrow p = p_{slamming}/2\)

High bending stresses according to this model may be neglected as the slamming pressure is assumed to be peaky.

2.2.6.6 Bow impact
The forecastle need only be checked according to the bow impact pressure for ships with well-rounded bow lines and/or flare. The bow impact pressure increases significantly less (in %) than the slamming pressure when the ship length is increased.

For direct calculations of girder or frame arrangements, the following parameters may be used:

- as the bow impact pressure is peaky, \(p_{fl} / 2\) is applied on the model.
- allowable shear stress: \(\tau = 110 \text{ N/mm}^2\)
- allowable bending stress: \(\sigma = 235 \text{ N/mm}^2\)
- the girders are assumed simply supported at both ends.

2.2.6.7 Ice belt
The ice belt is to be especially considered. See 2.9.

2.2.7 Checklist for lengthening - strength
1) Documentation requirements (See Appendix A)
2) Watertight bulkheads
- number
- position
- collision bulkhead.

3) Minimum bow height
4) Anchoring equipment
   - new equipment number
   - upgrading.

5) Longitudinal strength (if applicable)
   - new midship section, $Z_0$
   - new midship section, buckling
   - existing parts amidship, $Z_0$
   - existing parts, buckling
   - shear strength
   - shear strength existing parts.

6) Local Strength
   - new midship section
   - existing ship sides
   - ice belt
   - existing bottom
   - forecastle deck
   - slamming
   - bow impact
   - hatchway coaming and covers
   - deckhouse front and sides.

2.3 Increased breadth

2.3.1 General
Increasing a vessel's breadth is performed by fitting sponsons to the ship's side. It may be carried out to reduce draught or to increase deadweight.

2.3.2 Documentation requirements
The following documentation is to be submitted for approval, also see Appendix A:
1) New shell expansion and framing plan.
2) Steel structural details and welding details.
3) Proposal for new equipment number and updated anchoring equipment.
4) New loading manual, if applicable.

For information:
1) General arrangement.
2) Tank plan.

2.3.3 The following is to be considered
1) Minimum thickness requirement for pontoon sides will be as for side shell. Similar for frames.
2) It is of utmost importance that the sponson framing is aligned with the existing frames, see Figure 2-8.
3) When the sponsons are tapered at the ends, slot welding of the shell plating to the frames will be accepted where access is not possible, unless the vessel has assigned ice class notation, see below.

The slot weld throat thickness is normally to be 0.6 mm. see Figure 2-9 and 2-10. See the rules with regard to the required arrangement of the slots in the plating. Closed spaces are to be conserved.

4) Ice belt.
   Pontons in the ice belt are to be strengthened according to the assigned ice class notation. See 2.9.

5) The equipment number may change due to the increased displacement and hence proposal for new number is to be submitted for approval. See 2.5.
2.4 Increased depth

2.4.1 General
Increasing the depth of a vessel is normally done by fitting of a new shelter deck, e.g. in connection with an increased draught where freeboard deck is redefined. The most important consequences may be that the new deck will be a strength deck (and freeboard deck) and that the equipment number increases due to the increased wind area.

2.4.2 Documentation requirements
The following documentation is to be submitted for approval, also see Appendix A:

1) Deck plan with applicable deck load.
2) Shell expansion or framing plan of new part.
3) New loading manual if applicable.
4) Proposal for new equipment number and updated anchoring equipment.

For information:

1) General arrangement.
2) Updated tank plan if air pipe heights are increased.

2.4.3 The following is to be considered

1) If the new deck is to be regarded as a strength deck, then all scantlings (minimum, allowable stress level, sheer strake) are to be considered consequently. If not, scantlings may be as for superstructure weather decks.
2) If the distance between effective transverse bulkheads is large, raking analysis should be considered.
3) The enclosed deck is to be fitted with drainage arrangement according to the rules.
4) If the old weather deck (main deck) is to be used as cargo deck after conversion, new load (t/m²) and possible strengthening thereof is to be submitted for approval.
5) Fishing vessels: The minimum requirement for hatch coaming heights on freeboard decks, within L/4 from P.P. is 600 mm. Upon application, DNV or the flag State may accept a coaming height of hatches or door sill of 300 mm, on doors or hatches leading below this deck. The minimum freeboard is presupposed to be increased to the same level as the hatch coaming is reduced, or 50 % of the reduced door sill height.
   The minimum requirement for hatch coaming heights on position 2 decks, within L/4 from P.P. is 450 mm. Upon application as described in 5), 225 mm may be accepted.
6) The equipment number may change due to the increased wind area and hence a proposal for a new number is to be submitted for approval. See 2.5.
7) Tank bulkheads to be checked for new design pressure if air pipe heights of tanks are increased.

2.5 Anchoring equipment

2.5.1 General
Being a function of the vessel’s displacement and the area of vessel profile above the waterline, the equipment number and letter will normally increase in connection with a major conversion. Deficiencies with regard to anchoring equipment may however be accepted upon special considerations.

2.5.2 Documentation requirements
New equipment number calculations is always to be submitted for approval when considering:
- increased length L, breadth B or depth D
- additional superstructures or other new structures that considerably increase the wind exposed area
- applying new class notations requiring additional anchoring equipment (e.g. class notation Supply Vessel).

Note that an increased draught does not normally alter the vessel’s equipment number as the decreased wind exposed area compensates for the increased displacement. DNV, therefore, does not normally require calculations in these cases.

See also the rule guidance in regard to mooring and towing lines.

2.5.3 Acceptance criteria for equipment deficiency
A principle of equivalence with the rules is normally used. After conversion of the vessel, the anchoring equipment shall have the required holding power and the required level of safety according to the new letter.

1) Chain diameter: A reduction of 12 % according to new letter for wear and corrosion is allowed.
2) Chain length: No reduction is accepted.
3) Anchor weight: A deficiency of 25 % is accepted. The deficiency is to be compensated with additional lengths of chain of same weight as the anchor weight deficiency + 50 %. The last 50 % shall compensate for reduced holding power of smaller anchors. Minimum compensation will always be one additional length.

Equipment deficiency, compensated for by additional lengths of chain, is to be according to the new letter. Renewals after the conversion are as far as practicable to be according to the new letter, and a reference to this will be noted as a Memo for Owner and in the Appendix to the classification certificate.
## 2.5.4 Important consequences

1) Chain lockers may have to be converted.
2) Anchor pockets may have to be converted. Note the possibility to change to high holding power anchors, allowing a weight reduction of 25%.
3) Cable lifters may have to be renewed according to new chain diameter. Note that increased chain material quality will reduce upgrading requirement.
4) Hoisting speed of windlass shall maintain 9 m/min after upgrading of equipment.
5) Upgrading of windlass, chain stoppers and chain securing may have to be considered for increased breaking strength of chain.

### 2.5.5 Example 1

Existing equipment onboard according to letter 'I' i.e. 2 x 900 kg anchors + 357,5 m 30 mm NV K1 chain.

New required equipment according to letter 'I': 2 x 1140 kg anchors + 385,0 m 34 mm NV K1 chain.

Existing chain may be kept: 34 mm – 12% = 29,9 mm.

Equipment deficiency will be as follows:

<table>
<thead>
<tr>
<th>Chain length deficiency</th>
<th>Weight deficiency of anchors</th>
</tr>
</thead>
<tbody>
<tr>
<td>385 m – 357,5 m = 27,5 m</td>
<td>(2 x 900 kg – 2 x 1140 kg) x 1,5 = 720 kg</td>
</tr>
</tbody>
</table>

\[ \text{Weight compensation:} \quad 720 \text{ kg :} 25,1 \text{ kg/m} = 29 \text{ m} \]

\[ \Rightarrow \text{Required:} \quad 27,5 \text{ m} + 29 \text{ m} = 2 \text{ additional lengths of} \quad 27,5 \text{ m} 34 \text{ mm NV K1 chain; one on each side. Existing anchors remain.} \]

A Memo for Owner will be issued e.g.: "Due to lengthening of the vessel, the equipment number has been increased corresponding to letter 'I'. To compensate the shortage in weight of anchor and chain cable, one length of chain cable has been added on each side. Renewals are as far as practicable to be in accordance with letter 'I'.''

A similar reference will be given in the Appendix to the classification certificate.

### 2.5.6 Example 2

Existing equipment onboard according to letter 'A' i.e. 2 x 4050 kg anchors + 522,5 m 56 mm NV K2 chain.

New required equipment according to letter 'D': 2 x 4890 kg anchors + 550 m 62 mm NV K2 chain.

Existing chain may be kept: 62 mm – 12% = 54,6 mm. The owner wishes however to renew the chain in order to increase the corrosion margin. Cable lifters cannot take 62 mm chain and the owner therefore decides to use NV K3 chain.

Equipment after conversion will be as follows:

<table>
<thead>
<tr>
<th>Chain</th>
<th>Anchors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requirement according to letter: 550 m, 54 mm NV K3</td>
<td>Weight deficiency: (2 x 4890 kg – 2 x 4050 kg) x 1,50 = 2621 kg</td>
</tr>
<tr>
<td>Weight compensation: 2621 kg : 63 kg/m = 42 m</td>
<td></td>
</tr>
<tr>
<td>[ \Rightarrow \text{Required:} \quad 530 m + 42 m = 22 \text{ lengths of} \quad 54 \text{ mm NV K3 chain; 11 lengths on each side. Existing anchors remain.} ]</td>
<td></td>
</tr>
</tbody>
</table>

A Memo for Owner will be issued similar as in example 1.

### 2.5.7 Example 3

Similar as example 2 but owner wishes to change to high holding power anchors due to lack of space in the anchor pockets. Equipment after conversion will be as follows:

<table>
<thead>
<tr>
<th>Chain</th>
<th>Anchors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requirement according to letter: 550 m, 54 mm NV K3</td>
<td>HHP anchors – weight requirement: 4890 kg – 25% = 3668 kg</td>
</tr>
<tr>
<td>[ \Rightarrow \text{Required:} \quad 530 m = 20 \text{ lengths of} \quad 54 \text{ mm NV K3 chain; 10 lengths on each side and 2 x 3668 HHP anchors.} ]</td>
<td></td>
</tr>
</tbody>
</table>

No Memo for Owner will be issued.

### 2.6 Steering arrangement

Any change in the ship's main parameters, such as the rudder, propulsion or power supply systems, may have impact on the steering capability of the ship. If the rudder has been altered, or if an alteration of the ship could otherwise affect the ship's steering capability, then a new sea trial for testing of the rudder and the steering gear, including documenting the steering capability of the ship, is to be carried out.

If the rule requirement to the rudder stock in way of the tiller exceeds 230 mm after the conversion, then an alternative power supply to the steering gear will be required, assuming that the new rules apply.
Any modification to the rudder and or the steering gear will be subject to approval and survey. Installation of unconventional propulsion and steering arrangement, such as azimuth thrusters, are subject to approval, survey and testing to the same degree as conventional propulsion and steering arrangements.

The following documentation is to be submitted for approval:

1) Updated or new arrangement drawings of rudder, steering gear and steering compartment.
2) Drawings and particulars of all changes to azimuth thrusters, rudder, stock, bearing and steering gear inclusive all relevant piping, control and monitoring systems. Material data and ratings shall be specified.
3) Updated operating instructions (posters in wheel house and in steering gear compartment).

All new parts and relevant components are to be delivered with a DNV certificate.

The sea trial of the rudder and steering gear is to be carried out at full speed, i.e. the same conditions that are required for a new ship.

2.7 Hydro acoustic bottom equipment and retractable thrusters

2.7.1 General

An arrangement drawing is to be submitted for information. Structural drawings showing the foundations and the watertight compartment are to be submitted for approval.

Hydro acoustic bottom equipment, (typically sonar transducers fitted on a shaft, enabling the sonar transducer to be lowered through the vessel's bottom) is to be fitted in a separate watertight compartment.

In general, the compartment should house the whole unit. However, where this is not possible, it is accepted that only the dock for the sonar transducer is fitted in a separate compartment. In such cases a stuffing box is to be fitted on the shaft at the top of the compartment, and the upper end of the shaft is to be made watertight with respect to the relevant sea pressure.

In order to minimise damage, in case the sonar transducer should hit the bottom, the shaft is to be efficiently supported in the transverse and longitudinal directions.

There are to be operating instructions onboard the vessel stating how the instrument is to be operated. The instructions are to emphasise the correct use, in order to maintain watertight integrity.

2.7.2 Mounting of retractable thrusters

Arrangement drawings, showing the system, are to be submitted for information. Structural drawings showing the foundation of the thrusters and the watertight compartment are to be submitted for approval. Relevant forces and bending moments are to be stated on the submitted drawings. See also 7.

Retractable thrusters are to be fitted in a separate watertight compartment. Welds on plating forming hull boundaries are to be carried out with full penetration. Special consideration with respect to arrangement must be made on tankers with low flash-point cargo in order to comply with relevant rule requirements for this type of vessel.

2.8 Mounting of side thrusters

Arrangement drawings, showing thruster arrangement, are to be submitted for information. Structural drawings showing the tunnel and support of the thrusters and the watertight compartment, when required, are to be submitted for approval. Relevant loads are to be stated on the submitted drawings.

Resiliently mounted thrusters are to be fitted in a separate watertight compartment, unless the sealing arrangement is especially approved for that purpose. Welds on plating forming hull boundaries are to be carried out with full penetration.

Special consideration, with respect to the arrangement of the exhaust pipe outlet from a diesel engine, must be made on tankers and other vessels with similar restrictions with respect to fire safety.

For documentation requirements also see 7.

2.9 Ice belt

2.9.1 Generally

Longitudinal extension of forward, midship and aft ice region is dependent upon the vessel's length, its breadth and the given ice class notation. The vertical extension is dependent upon the ice class notation. The extension and strength of the ice belt is very often utilised with regard to the initial draught. This means that the ice strengthening often fails to meet the requirement given by a possible new draught. Attention is to be paid to the extension of the ice belt, in both directions.

DNV accepts that the class notation ICE-C is valid to a maximum specified draught, which is less than the new draught. If such an arrangement is chosen, a reference to this will be given in the Appendix to the classification certificate and as a Memo for Owner. This procedure is not acceptable for the Baltic ice class notations.

2.9.2 ICE-C

1) Plating: The plating rule thickness formula is dependent on the vessel length L.
2) Frames: Dependent on L and the draught T.
3) Engine output: Dependent on displacement.

Discrepancies are usually handled as follows:

a) Plating: Fitting of doublers.

b) Frames: Strengthened with additional flanges or brackets or supported by stringers (must be specially considered). Intermediate framing may have to be extended.
A deviation of 250 mm with respect to the extension of stiffeners may be accepted if the stiffeners are connected to a deck or stringer in way of the upper end.

It is important to note that the rule requirements according to ICE-C need not be taken higher than for ICE-1C. This is important to check, if the plate thickness is too low or existing frames are under-dimensional but have short spans (ICE-C framing requirement are not dependent on the frame span).

2.9.3 Baltic ice class notations

The ice pressure is dependent on the vessel's displacement and its propulsion power. It is important to find the total ice pressure increase and consider the amount of checkpoints according to this.

- Ordinary and intermediate frames are generally to be checked if the ice pressure increases more than 5%.
- The ice belt plating is generally to be checked if the ice pressure increases with more than 10%.

Design ice-pressure increase for increasing displacement, in most cases this can be ignored. Only a considerable increase in draught will require the adjustment of the ice-pressure.

2.9.4 Strengthening in the ice belt

If the owner does not intend to carry out the required strengthening, the ice class notation will be deleted.

2.9.4.1 Shell plating

Doubler plates are normally accepted in connection with conversions or increased draught of vessels, in order to fulfill the ice class requirements with respect to shell thickness. Where doubler plates are to be used for increasing the shell thickness, the guidance below should be followed:

1) Minimum thickness of doubler plates 10.0 mm.
2) Breadth of doubler should not exceed 325 mm.
3) Adjacent doubler plates are to be connected with full penetration welding, see Figure 2-11.
4) Welds along the doubler plates sides are to be at least:
   \[ a = 0.5 t_{db} \]
   Slot welds will not be accepted in the foreship for ICE-1B and ICE-1C and will not be accepted in the fore- and amidship for ice class ICE-1A\(^F\), ICE-1A\(^S\), and ICE-1A. Slot welds are to be completely filled with welding in the ice belt.
5) Thickness of doubler plates is to be determined by the following formulae:

Required doubler plate thickness for transverse and longitudinal framing:

\[
t_{db} = \sqrt[3]{\frac{445 P_{PL} t_{ex} s^2}{\sigma_f}} - t_{ex}^{\frac{3}{2}} - t_c \quad t_{db} \leq t_{ex}
\]

\[
t_{db} = \sqrt[3]{\frac{t_{ice}^3 - t_{ex}^3}{3}} \quad t_{db} \geq t_{ex}
\]

- \( t_{ice} \) = required shell thickness for the given ice class (without \( t_c \))
- \( t_{ex} \) = existing shell thickness
- \( t_{db} \) = required thickness of doubler
- \( P_{PL} \) = 0.75 \( P \), where \( P \) = the design ice pressure
- \( \sigma_f \) = yield stress of the material (N/mm\(^2\))
- \( s \) = stiffener spacing in m measured along the plating between ordinary and/or intermediate stiffeners
- \( t_c \) = increment for abrasion and corrosion (mm), normally 2 mm
Figure 2-11 Section A-A - Extending the ice belt vertical with doublers. Welding detail

Figure 2-12 Fitting of doublers when framing is longitudinal

Figure 2-13 Fitting of doublers when framing is transverse

Figure 2-14 Section B-B - Welding of doublers to shell
2.10 Strengthening for local overloading

When increased environmental loading due to increased main dimensions or increased draught necessitates strengthening of the existing steel structure, some arrangements must be approved which are usually not approved during a newbuilding phase.

2.10.1 Strengthening of plating

Increased sea pressure will seldom necessitate strengthening of plating. Such are usually required due to:

1) Increased slamming pressure.
2) Increased bow impact pressure.
3) Increased design load for decks.
4) Increased tank loading.
5) Increased ice belt extension or pressure.
6) Increased longitudinal stress level.

In the four first cases, fitting of intermediate stiffening is most often used. Refitting of plating may be necessary in extreme cases or when increased local loading is combined with increased longitudinal stresses. It may be necessary to strengthen existing stiffeners as well as adding intermediate. In regard to the ice belt, see 2.9. In regard to the increased longitudinal stress level, this is usually handled by the fitting of doublers, see 2.11.

2.10.2 Strengthening of stiffeners

The strengthening of stiffeners due to increased environmental loads or loads from new equipment is usually handled in one of the three following ways:

1) The stiffeners' end brackets are increased or new larger brackets are fitted. The alignment of supporting structures is to be especially considered.
2) The stiffeners' sections are increased. The additional flanges are to extend beyond the existing end brackets. Where the sections are considerably increased, new brackets should be fitted.
3) The stiffeners are supported by girders, stringers or struts. Note that when girders are fitted on the outside of a bulkhead, typical strengthening on the superstructure front connection area is to be applied, with brackets.

See also Figures 2-15 to 2-17.

2.10.3 Strengthening of girders

Girders may be strengthened with regard to bending strength and shear strength, see Figures 2-18 to 2-20.

1) When strengthening girders in order to reduce bending stresses, the sections are to be increased in the same way as for stiffeners. Doublers are to be extended beyond brackets. This may be done by slotting the doubler in the way of the bracket or by making the section unsymmetrical. The latter will require additional tripping brackets.

2) To reduce shear stresses in girders, two solutions are normally acceptable:
   a) Increase girder height.
b) Increase shear area by fitting of a doubler. The doubler is to be located in way of the shear centre of the girder. Doublers outside the shear centre will not be accepted.

![Figure 2-19 Strengthening of girders for shear strength](image)

Doublers for shear are to extend fully to the girders ends and are to be tapered inboard. When the doubler height is equal to the girder height, the doubler is to be welded with full penetration welds.

![Figure 2-20 Fitting of shear doubler](image)

2.11 Application of doublers for longitudinal strength

Where the stress level in existing structures is increased above the maximum allowable, either according to buckling criteria or according to longitudinal strength criteria, fitting of doublers may be an accepted solution. Doublers may be fitted at deck or bottom for insufficient bending strength or at sides for insufficient shear strength.

Increased area in deck, bottom due to longitudinal strength, may be obtained from the formula:

\[ \Delta A \geq \frac{\Delta Z}{Z + Y_T} \]

\[ \Delta A = \text{required increase in deck/bottom area (cm}^2) \]

\[ \Delta Z = \text{required increase in deck/bottom section modulus (cm}^2) \]

\[ Z = \text{actual section modulus (cm}^2) \]

\[ A = \text{actual total area in the cross section (cm}^2) \]

\[ Y_T = \text{distance from deck or bottom to neutral axis (cm)} \]

It is assumed that the doubler material is of the same quality as the existing deck or bottom plating.

2.11.1 Welding of doublers

Doublers are to be welded to effective longitudinal material with continuous welding along the edges.

Throat thickness of the welds to the deck or bottom plating for tapered terminations is normally to be:

\[ a_t \geq 0.4 t \text{ (mm)} \]

and

\[ a_t \geq 3 + 0.1 t \text{ (mm)} \]

\[ t = \text{thickness of strap (mm)} \]

Where doubler plates are tapered within \( 0.2 \frac{L}{2} \) and \( 0.25 \frac{L}{2} \), fore and aft of amidships, the weld area surrounding the taper of each doubler should not be less than \( 1.75 \times \) the doubler area. Where several doublers are terminated in the same region, the sectional area \( A^* \) of the strengthened part, see Figure 2-21, should not be less than:

\[ A^* > 1.75 \left( \sum_{i=1}^{n} A_i + A_0 \right) \]

![Figure 2-21 Weld area in doubler ends](image)

For doublers plates with breadth, \( b \), exceeding:

\[ b = 100 + 30 t, \text{ maximum 850 mm} \]

welding through evenly distributed slots will be required.
2.12 Installation of special fixed ballast materials

2.12.1 General
The following is based on USCG's Circular from 1982:

NAVIGATION AND VESSEL INSPECTION CIRCULAR No. 5-82

When fixed ballast is installed, the following Memo to Owners is to be given:

"Tank(s) ........ have been filled with ....... tons (m^3) of fixed ballast, of the type ........, with a specific gravity of ........ t/m^3.

The ballast is to be removed for the survey of the tanks on request from the Society."

2.12.2 Fixed ballast, general
Fixed ballast may be installed to increase stability on new or existing vessels. If fixed ballast is to be used aboard vessels requiring stability tests, it should be installed prior to conducting the test. On existing vessels, addition or removal of fixed ballast may require that a new stability test be performed on the vessel. The mass and location of fixed ballast on such vessels should be included in the stability calculations.

The use of high density materials for fixed ballast installations may cause excessive structural loading on a vessel. Therefore, the following plans and calculations may be required to be submitted for approval:

1) An arrangement plan showing proposed types, locations and quantities of fixed ballast.
2) A capacity plan showing the original capacity of each space in which fixed ballast will be installed.
3) A structural evaluation of each fixed ballast compartment for the mass and location of the proposed ballast installation.

Special arrangements may be necessary to provide proper ventilation and to facilitate the installation and inspection of the ballast material. The following guidance applies to all fixed ballast installations:

1) Each ballast tank should be fitted with vents to the weather deck. Flame screens should be installed if organic decay is possible.
2) Fixed ballast should not be installed in tanks containing piping systems that require inspection. If fixed ballast must be installed in such tanks, a pipe tunnel or other suitable arrangement should be made to permit inspection of the piping.
3) The ballast material should be properly secured to prevent shifting in severe weather.
4) Inspection openings should be provided in each corner of the ballast space for detection of shifting or settling of the material or seepage of water into the ballast space. Manholes may be provided for this purpose in double bottom tanks. If concrete caps are used to secure the ballast, ullage pipes at least 200 mm in diameter should be fitted in the concrete to permit inspection of the ballast material.
5) An expansion trunk should be provided which is adequate for the maximum volumetric expansion of liquid ballast.
6) Plans showing ventilation of the fixed ballast space, the securing arrangement of the ballast material, and all closure plate installations for openings cut in the vessel structure may be required to be submitted for approval.

Fixed ballast is often installed in compartments or tanks that would normally be examined for deterioration during periodic inspections. The following procedures may be followed in lieu of emptying fixed ballast tanks at each inspection period:

1) The atmosphere in each tank should be sampled and analysed by a certified marine chemist who should follow the provisions of NFPA 306 to determine if gas evolution is present.
2) All fixed ballast installations should be accessed through the ullage openings provided. The ballast material should be inspected for shifting, settling, and excessive moisture. Visible change to the ballast material may be cause for removal and additional inspection.
3) If a bacteriostatic agent is required, a sample of ballast fluid from the mid-depth of each tank should be removed for analysis to determine the bacteriostatic agent residual and the presence of any methane gas or gas producing bacterin. If there is evidence that the bacteriostatic agent residual is inadequate to prevent bacterin growth, the fluid should be pumped out and supplied with a bacteriostatic agent.
4) If installed, the tank material test pieces should be examined to determine the apparent type and rate of corrosion. If there is indication that extensive or accelerated corrosion is taking place the ballast material should be pumped out and the tank cleaned for internal examination.

Plans, calculations and procedures for approval of fixed ballast installations should be submitted in one co-ordinated package. DNV's approval of the package should be obtained prior to installation of the ballast material.

2.12.3 Fixed mud ballast
Special drilling mud type fluids (Baryte) may be used as fixed ballast, under the following provisions:

1) Bacteriostatic agent. A bacteriostatic agent effective against aerobic as well as anaerobic bacteria should be thoroughly mixed with the fluid in accordance with the manufacturer's specifications.
2) Anticorrosivity. The pH factor of the fluid should be adjusted to a value which minimise corrosion for the particular metals involved. Corrosion inhibitors may be added to the fluid, but they should not interfere with the action of the bacteriostatic agent or affect the physical properties of the fluid such as suspension, viscosity, etc.
3) Settling. Fluids should have sufficient viscosity and gel strength to minimise settling of solids.
4) **Thermal expansion.** Volumetric expansion should not be greater than four tenths of one percent (0.4%) over a temperature range from -2°C to 30°C.

5) **Freezing.** The fluid should withstand a low temperature ambient of -2°C without freezing. Unless adjacent to high temperature spaces, the expected maximum temperature of the ballast should be taken as 30°C.

6) **Proposed ballast.** A sample of proposed ballast fluid should be prepared by the manufacturer and subjected to at least a thirty day test to insure that all of the above requirements are fulfilled. A report of the test should be made available to the surveyor prior to installation of the fluid.

7) **Corrosion test plates.** Corrosion test specimens, in the form of two 100 x 500 mm plates 10 mm thick and of the same material as the internal structure of the ballast tanks and welded together to form a plate 200 mm wide, should be attached to the underside of the manhole cover on each expansion trunk for the ballast tanks in such a way that the corrosion test specimens hang down to the mid-depth of the ballast tanks. A permanent record of the date of installation, thickness and weight of each corrosion test specimen should be kept on board the vessel. Specimen thickness, weight and date of inspection should be placed in this record after each inspection.

8) **Air pockets.** When pumping the fluid into the ballast tanks, care should be taken to eliminate all air pockets. Permanently installed ship's pumps or piping should not be used for handling the fluid.

### 2.12.4 Iron ore concentrate ballast

Dry iron ore concentrate ballast may be used as fixed ballast under the following provisions:

1) **Density.** The overall density of the material after installation should be equal to the calculated density as submitted. Compaction is usually necessary to achieve the calculated density and to prevent later settling. Before capping, the actual weight of the ballast material should be determined and recorded.

2) **Concrete caps.** Concrete caps should be used to prevent shifting of ballast material in partially filled spaces. All excess water should be removed before the concrete is poured. A moisture barrier such as plastic sheeting should be installed on top of the ballast before pouring the concrete to prevent additional moisture of the ballast spaces so that the concrete will flow around them and provide anchoring points to prevent the caps from shifting.

3) **Corrosion test plates.** Corrosion test specimens, in the form described under 2.12.3 should be provided.

Iron ore concentrate slurry may be installed in ballast compartments under the following provisions:

1) **Slurry contents.** A list of ingredients of the slurry should be submitted to the Coast Guard for approval. The list should include a brief description of each ingredient and its weight and volume per slurry unit. Wet and dry weight and pH range for the complete slurry mixture should be calculated.

2) **Cut-outs.** Numerous openings in the ballast tank top may be necessary to assure that the slurry flows between each frame, however, sufficient strength must be maintained in structural tank tops. A plan showing the location and size of each cut-out and the welding procedure to replace them should be submitted.

3) **Air pockets.** Shifting will occur unless all air pockets within the ballast compartment have been filled. After de-watering is completed, the fillage below the tank top should not exceed 100 mm at any point. An inspection for shifting ballast material should be made following the first several voyages if air pocketing is suspected.

4) **Moisture.** The percentage volume of moisture entrained in the ballast after installation should not be greater than 7% over a temperature range from -2°C to 30°C.

5) **Corrosion test plates.** Corrosion test specimens, in the form described under 2.12.3 should be provided.

### 3. Stability

#### 3.1 DNV involvement

DNV handles stability as a statutory matter when authorised by the flag Administration. In these cases decisions handled by the Administration are handled by the class.

DNV handles stability as a class matter for vessels:

- built after 1992-07-01
- having undergone a major conversion after 1992-07-01.

When stability is a class matter, but DNV is not authorised by the flag State, DNV will base the class approval on the approval of the Administration, if possible. The final stability documentation carrying the approval stamp of the Administration is then to be submitted for approval and for class file, together with the Administration's approval letter. Preliminary documentation need not be submitted, nor will it be necessary to submit inclining test procedure or report or attend at the test.

Note that some class notations such as Tug, Supply Vessel, SF, Crane Vessel and Crane contain stability requirements not necessarily covered by the statutory approval (see also Table A1 in the Rules for Ships Pt.3 Ch.4 Sec.3). In these cases it will be necessary for DNV to be involved from the preliminary stage.
3.2 Increased draught

3.2.1 General
This is normally not regarded as a major conversion, see 2.1.2. Thus, the converted ship must continue complying with the same intact and damage stability requirements, but now up to the new summer load line draught (and timber draught, if relevant). Note, however, that for a dry cargo ship over 80 m in length where no damage stability requirements have previously been in force, it may be necessary to submit damage stability index calculations demonstrating that the level of subdivision is not less than before the conversion. This is to be decided by the flag Administration.

3.2.2 Documentation requirements
The following documentation will be required for all ships:
- stability booklet or loading manual including loading conditions, hydrostatic data, cross curves and limiting stability data covering the new maximum draught.

Where damage stability requirements are applicable:
- damage stability calculations covering the loading conditions in the stability booklet or loading manual or damage KG/GM limiting curves for the full draught range.

For passenger ships:
- floodable length calculations.

For ro-ro passenger ships not yet upgraded to current SOLAS standard:
- calculation of A/A max at the new maximum draught.

For dry cargo ships over 80 m in length where no damage stability requirements have previously been in force (when required by the flag Administration):
- calculation of A/R ratio for the ship before and after the conversion as required by MSC/Circ.650.

For ships carrying grain cargo:
- grain stability booklet including loading conditions and maximum allowable heeling moments covering the new maximum draught.

For ships with a loading instrument approved with respect to stability:
- test loading condition at new maximum draught.
- stored characteristic data for the increased draught range.

When strengthening and/or other conversion work changes the light ship particulars (see also 3.5):
- inclining test procedure
- inclining test report.

In the latter case, preliminary versions of the stability booklet or loading manual and damage stability calculations will also be required.

3.2.3 Survey points
To meet damage stability requirements at the increased draught, it may be necessary to increase air pipe heights, install weather-tight or watertight doors, etc. In these cases it is very important that the position of openings with type of closing appliances assumed in the damage stability calculations, are verified by the surveyor.

3.3 Major conversions

3.3.1 General
This covers change in main dimensions (see also 1.4). The ship is to comply with the rules and statutory requirements currently in force for new ships. The exception is existing dry cargo ships over 80 m in length where no damage stability requirements have previously been in force, where it will be sufficient to prove that the level of subdivision is not less than before the conversion.

Change of ship type is also regarded as a major conversion. The ship is to comply with the rules and statutory requirements currently in force for new ships (no exceptions). As an example, a cargo ship converted to a passenger ship shall comply with the regulations in force for new passenger ships regardless of the date of construction.

3.3.2 Documentation requirements
The following will be required for all ships:
- preliminary and final stability booklet or loading manual
- inclining test procedure
- inclining test report.

Where damage stability requirements are applicable:
- preliminary and final damage stability calculations
- internal watertight integrity plan.

For passenger ships:
- floodable length calculations.

For dry cargo ships built after 1992-02-01 and for passenger ships:
- damage control plan
- damage control manual.

For change in main dimensions of a dry cargo ship over 80 m in length where no damage stability requirements have previously been in force:
- calculation of A/R ratio for the ship before and after the conversion as required by MSC/Circ.650.

For ships carrying grain cargo:
- preliminary and final grain stability booklet

DET NORSKE VERITAS
For ships with a loading instrument approved with respect to stability:
- new test loading conditions
- revised stored characteristic data.

When the conversion changes the lightship particulars (see also 3.5):
- inclining test procedure
- inclining test report.

In the latter case, preliminary versions of the stability booklet or loading manual and damage stability calculations will also be required.

3.4 Internal modifications
3.4.1 General
The converted ship must continue to comply with the same intact and damage stability requirements, at least to the same extent as before the modification. Modifications to tanks and cargo spaces may make it necessary to revise loading conditions and tank or hold data. Similarly, the damage stability may be influenced by internal modifications and therefore need revision.

Note that for a dry cargo ship over 80 m in length where no damage stability requirements have previously been in force, it may be necessary to submit damage stability index calculations demonstrating that the level of subdivision is not less than before the conversion.

3.4.2 Documentation requirements
The following will be required for all ships:
- stability booklet or loading manual including updated loading conditions and tank or cargo space data.

Where damage stability requirements are applicable:
- damage stability calculations covering the loading conditions in the stability booklet or loading manual or damage KG/GM limiting curves.

For passenger ships:
- revised floodable length calculations.

For dry cargo ships over 80 m in length where no damage stability requirements have previously been in force:
- calculation of A/R ratio for the ship before and after the conversion as required by MSC/Circ.650.

For ships carrying grain cargo:
- grain stability booklet including updated loading conditions and cargo hold volumetric heeling moments
- revised grain loading plan.
3.5.4 Documentation requirements
This will vary depending on the conversion and must be clarified with DNV (although it is assumed that 3.2 to 3.4 cover most cases).

3.6 Conversions that may have an effect on stability

3.6.1 Change of tank contents
When the types of liquid in tanks are changed, it will normally be necessary to revise the loading conditions as well as the tank plan or tables and submit an updated stability booklet or loading manual. Typical examples are an increase in fuel capacity by converting fresh water or ballast tanks, conversion of combined fuel or ballast tanks to exclusive fuel tanks, and conversion of tanks in supply vessels to high density cargo tanks.

Where the damage stability calculations are direct calculations based on actual loading conditions, or otherwise assume a specified tank content in intact condition, revised damage stability calculations may also be necessary.

3.6.2 Increase of load on deck
Additional loading conditions covering the new maximum deck load are to be calculated and submitted as part of a revised stability booklet or loading manual.

3.6.3 Increase in windage areas
New loading conditions including weather criteria calculations may have to be submitted as part of a revised stability booklet or loading manual. A typical example is increase of stack height on container ships.

3.6.4 Tugs and supply vessels, increase of bollard pull
For vessels with the class notations Tug or Supply Vessel (in the latter case: only if engaged in towing), where the bollard pull is increased, calculations according to the Rules for Ships Pt.5 Ch.7 Sec.2 E or Pt.5 Ch.7 Sec.3 D302 are to be submitted for approval.

3.6.5 Fire fighters, increase in monitor heeling moment
For vessels with the class notation Fire Fighter where the monitor heeling moment is increased, calculations according to the Rules for Ships Pt.5 Ch.7 Sec.5 I are to be submitted for approval.

3.6.6 Crane vessels, modification of crane arrangement
For vessels with the class notation Crane Vessel or Crane, where the maximum hook load is increased or other changes are made to the crane arrangement that could adversely affect the stability, calculations according to the Rules for Ships Pt.5 Ch.7 Sec.8 D200 are to be submitted for approval.

3.6.7 Upgrade of ice class
Upgrade from class notation ICE-xx to POLAR or Icebreaker will require damage stability calculations in accordance with the Rules for Ships Pt.5 Ch.1 Sec.4 L.

3.6.8 Increase of number of passengers
For passenger vessels where the number of passengers is increased, it may be necessary to require new floodable length calculations, new damage stability calculations and a revised stability booklet or loading manual.

3.7 Stability documentation and other formal matters

3.7.1 Preliminary stability documentation
Preliminary documentation must be submitted for approval at least 6 weeks in advance of the completion of the conversion.

3.7.2 Dispensation from an inclining test
In order to allow time for preparations in case a dispensation from an inclining test cannot be granted, the application for a dispensation together with lightship particulars found by calculations (see 3.5.3), must be submitted together with the preliminary stability documentation.

3.7.3 Inclining test procedure
This must be submitted for approval at least 3 working days in advance of the test.

3.7.4 Inclining test report
The inclining test report is to be endorsed by the surveyor and be submitted for approval.

3.7.5 Departure of converted and inclined ship
In general, preliminary documentation is to be onboard in approved order and the inclining test is to be approved before the ship departs.
4. Load Line

4.1 Increased draught – freeboard deck not redefined

4.1.1 Important aspects with respect to load line conditions of assignment

a) **Sanitary discharges**
   The requirements for number of, type and position of closing of valves are determined by the height of the lowest inboard opening for each system above the new summer water line.
   See the Rules for Ships Pt.3 Ch.1 or Ch.2 Sec.11 K.
b) **Side scuttles in the ship’s sides and windows**
   For side scuttles in the ship’s sides, the distance from lowest sill of the lowest scuttle to the new summer water line is not to less than the largest of either 0.025 B or 500 mm.
   Increased glass thickness for side scuttles and windows may be required.
   See Rules for Ships Pt.3 Ch.1 or Ch.2 Sec.11 L.
c) **Minimum bow height**
   See Rules for Ships Pt.3 Ch.5 Sec.3 M.
d) **Exemption from the load line convention**
   Possible previous exemption with respect to load line may have been granted for a specific draught.

4.1.2 Required load line documentation

Form No. 44.401a, “Record of Conditions of Assignment” and Freeboard plan is to be updated for possible changes made.

4.2 Increased draught – freeboard deck redefined

4.2.1 Important aspects with respect to load line conditions of assignment

1) See a), b), c) and d) above.
2) Stricter Position 1 requirements, according to ICLL 66, may be required for closing appliances with respect to sills, coamings, scantlings of hatch covers, freeing arrangement etc.

4.2.2 Required load line documentation

1) Updated Form No. 44.401a, “Record of Conditions of Assignment”.
2) Updated Freeboard plan.
3) New Form No. 44.402a, “Report on Measurements for Load Line”.

4.3 Alteration of main dimensions

4.3.1 Important aspects with respect to load line conditions of assignment and freeboard assignment

1) New freeboard calculation to be carried out based on new Form No. 44.402a, “Report on Measurements for Load Line”.
   Note:
   - Lesser draught may be expected for lengthening of vessels that was previously assigned maximum geometrical draught.
   - Minimum bow height requirement increases with increase of L.
   - Length of forecastle, from F.P., is required to minimum cover 7% of the new L after lengthening in order to be included in the available bow height.

2) See a), b), c) and d) above.

4.3.2 Required load line documentation

1) Updated Form No. 44.401a, “Record of Conditions of Assignment”.
2) Updated Freeboard plan.
3) New Form No. 44.402a, “Report on Measurements for Load Line”.

4.4 Alteration of - or new superstructure

4.4.1 Important aspects with respect to load line conditions of assignment and freeboard assignment

1) New freeboard calculation is to be carried out.
   Note:
   - Lesser draught may be expected for reduction of superstructure.
   - For modification of forecastle the mean covered length, from F.P., is required to be minimum 7% of the new L in order to be included in the available bow height.

4.4.2 Required load line documentation

1) Updated Form No. 44.401a, “Record of Conditions of Assignment”.
2) Updated Freeboard plan.
3) Updated or new Form No. 44.402a, “Report on Measurements for Load Line”.

5. Life-saving Appliances and COLREG and ILO Crew Accommodation

5.1 Life-saving appliances

If the life-saving appliances or arrangements are changed due to the conversion, alteration or modification, then drawings showing the new arrangement are to be submitted to DNV for approval. The following should be noted in this respect:

When life-saving appliances or arrangements of the ship is replaced or the ship undergo repairs, alterations or modifications of a major character which involve replacement of, or any addition to, their existing life-saving appliances or arrangements, such life-saving appliances or arrangements, in so far as is reasonable and practicable, is to comply with the requirements which are applicable under chapter III of the SOLAS convention in force.
However, if a survival craft other than an inflatable liferaft is replaced without replacing its launching appliance, or vice versa, the survival craft or launching appliances may be of the same type as that replaced.

5.2 COLREG
(Convention on the International Regulations for Preventing Collision at Sea)

If the conversion, alteration or modification involves that the navigation light arrangements and/or sound signal appliances are changed, then drawings showing the new arrangement is to be submitted to DNV for approval.

5.3 ILO Crew accommodation
If the superstructure (crew accommodation) is replaced or modified, then drawings showing the new arrangement is to be submitted to DNV for approval.

6. Electrical Components

6.1 Documentation

6.1.1 General
All changes in the electrical system are to be specified. This applies to changes to the already existing system, new electrical installations and changes or additions of a class notation. For changes in rudder stock size from below to above 230 mm, see 2.6 for further details.

6.1.2 Documentation requirements
For changes in the electrical equipment the following documentation should be submitted to DNV:

For changes in the electrical system:
- single line diagram.

For changes in installed power (e.g. changes in motor load or installed generator power):
- power consumption balance covering the following operational modes: normal at sea, manoeuvring, special operations and emergency
- discrimination analysis
- short circuit calculations (if the short circuit current changes).

For changes in the switchboard or installation of new switchboard:
- drawings of the switchboard.

For changes in bus-bar- or circuit-breaker size or type:
- discrimination analysis (only if the change of breakers affects the selectivity in the system).

For generators powered by the main propulsion system, e.g. power take off (PTO):
- section of shaft generators with bearing arrangement and details of lubrication.

6.2 New class notations
New rules will apply to the vessel if the following changes are done:

1) If the size of the vessel is changed from below 500 gross tonnage to above 500 gross tonnage there will be a requirement to installation of emergency power according to the Rules for Ships Pt.4 Ch.4.

2) Conversion from a HS LC Passenger A to a HS LC Passenger B vessel, stricter regulations regarding emergency installations will apply according to the Rules for Classification of High Speed, Light Craft and Naval Surface Craft.

6.3 Certification
New electrical equipment is to be certified according to the Rules for Ships Pt.4 Ch.4.

6.4 Testing
New electrical equipment is to be tested according to the Rules for Ships Pt.4 Ch.4.

7. Fire Safety

7.1 General
The Rules for Ships Pt.4 Ch.6 will apply to all ships assigned main class. For vessels changing class notation of obtaining additional class notations after the conversion, special requirements will be applicable as referred to in Pt.4 Ch.6 Sec.1 B200 and for vessels with the following additional class notations:

- OILREC, see also Pt.5 Ch.7 Sec.12 B200
- LFL, see also Pt.5 Ch.7 Sec.11 F100 to F300
- DSV-I SF-I SF-II SF, see also Pt.6 Ch.1 Sec.4 E100
- DYNPOS-AUTO, see also Pt.6 Ch.7 Sec.1 to Sec.5
- Drilling Vessel, see also Pt.5 Ch.7 Sec.6
- Oil Production and Storage Vessel, (FPSO), see also Pt.5 Ch.9 Sec.6
- HELDK-S and HELDK-SH see also Pt.6 Ch.1 Sec.2.

7.2 Documentation requirements
Required drawings are given in Appendix A. See also Rules for Ships Pt.4 Ch.6 Sec.1 D.

The drawings submitted should show all fire safety details as for newbuildings. Equipment used should be type approved when required by the rules. Special attention should be made to equipment placed onboard an EU and EFTA vessel, where equipment mentioned in the Marine Equipment Directive is required to be CE marked (wheel marking).

MSC/Circ.847 "Interpretations of vague expressions and other vague wording in SOLAS Chapter II-2" will apply.
7.3 Special arrangement

For vessels fitted with an helicopter deck the following should be noted:

All helicopter decks are to comply with the Rules for Ships Pt.4 Ch.6 Sec.13. When additional class notations HELDK-S or HELDK-SH, is given, Pt.6 Ch.1 Sec.2 will apply.

For vessels with the class notation **Cable Laying Vessel** spaces containing cables are regarded as cargo spaces, and should be fitted with a fixed fire extinguishing system approved by DNV.

### 8. Machinery

#### 8.1 Documentation

**8.1.1 General**

All changes in the machinery systems, or components, which are covered by the scope of class are subject to approval and survey. Installation of new equipment, which becomes under ditto scope, e.g. a side thruster, is subject to approval with respect to equipment design and installation on board and shall be delivered with a certificate.

All changes in the machinery systems are to be specified. This applies to changes to the already existing system, new installations and change or addition of class notations.

**8.1.2 Documentation requirements**

For changes in the machinery systems and/or components the following documentation shall be submitted:

For changes in the propulsion system:
- updated or new arrangement drawing(s)
- drawings and particulars of all changes in shafting system inclusive propeller and gear, main engine and all relevant piping, control and monitoring systems.
- Material data and power rating shall be specified
- torsional vibration calculations if the mass-elastic system is affected by changes (e.g. new propeller, new type elastic coupling, new engine type, etc.) and P > 200 kW
- calculation of natural frequencies of resiliently mounted engines
- shaft alignment calculations, axial vibration calculations upon request.

For changes in installed power, or class notations (e.g. new or higher ice class):
- new power rating and/or class notation.

For change and/or installation of generator set:
- updated or new arrangement drawing
- torsional vibration calculations if P > 200 kW
- calculation of natural frequencies of resiliently mounted engines
- relevant piping, control and monitoring system diagrams.

For change and/or installation of thruster:
- arrangement drawings in thruster room and thruster itself
- drawings of connections to the ship’s hull
- torsional vibration calculations if P > 200 kW
- engine mounting (fixing to foundation) arrangement (note that resilient mounting of diesel engine requires that vibration calculations are to be submitted)
- piping systems: lubrication oil, hydraulic oil, cooling, fuel, starting air and exhaust (insulation)
- control and monitoring systems.

#### 8.2 Certification

New machinery equipment is to be certified according to the Rules for Ships Pt.4 Ch.2.

#### 8.3 Testing

Function and load testing of machinery including verification of any running or load restrictions and setting safety valves, etc. is to be carried out. Proper function and performance of the propulsion system after any modification shall be verified at sea trial. Quay test may be accepted for minor changes, provided that function testing can be properly carried out. If the alteration may effect the ship's manoeuvrability, a new sea trial for testing and documenting stopping time and manoeuvrability shall be carried out.

### 9. Piping Systems

#### 9.1 Documentation

**9.1.1 General**

All changes in machinery and ship piping systems or components, which are covered by the scope of class, are subject to approval and survey. All changes in machinery and ship piping systems are to be specified. This applies to changes to the already existing system, new installations and change or addition of class notations.

**9.1.2 Documentation requirements**

For changes in the machinery and ship piping systems and/or components the following documentation shall be submitted:

For changes in the propulsion system:
- updated engine room arrangement (if applicable)
- schematic drawings of piping systems with clear identification of modifications. In case of lengthening, schematic drawings simply showing extension of piping systems need not be submitted for approval, but the modifications are to be reflected in as carried out drawings
- if a new class notation is assigned, document requirements as specified in the rules are to be submitted.
9.2 Application of rules

9.2.1 General

In case of a new class notation being assigned, the latest edition of the relevant rules is to be applied. The latest edition of the rules is to be applied on the part of the piping system subject to modification. New components in a piping system are to be certified in accordance with the requirements in the latest edition of the rules.

9.3 Testing

For new and modified piping systems the requirements for manufacture, workmanship, inspection and testing as specified in the latest edition of the rules apply.
## Appendix A Conversion documentation requirements

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</tbody>
</table>
## Appendix B  Conversion particulars - Information for approval fee calculation

*Submit this form to the nearest local DNV station or to the DNV Head Office for calculation of approval fee.*

<table>
<thead>
<tr>
<th>Name of vessel:</th>
<th>DNV kl. No.:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vessel owner:</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Class notation after conversion:</th>
<th>Flag after conversion:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Shiptype after conversion:</th>
<th>Flag after conversion:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Conversion yard (if decided):</th>
<th>Start of shop work:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Yard address:</th>
<th>Delivery date:</th>
</tr>
</thead>
</table>

### Particulars:

<table>
<thead>
<tr>
<th>Before</th>
<th>After</th>
<th>Change in internal subdivision:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length:</td>
<td></td>
<td>Lengthened stern or midship:</td>
</tr>
<tr>
<td>Breadth:</td>
<td></td>
<td>Length of pontoons:</td>
</tr>
<tr>
<td>Depth:</td>
<td></td>
<td>New strength deck?</td>
</tr>
<tr>
<td>Draught:</td>
<td></td>
<td>Freeboard deck changed?</td>
</tr>
</tbody>
</table>

### Other structural additions or alterations

<table>
<thead>
<tr>
<th>Number and area of new accommodation decks:</th>
</tr>
</thead>
<tbody>
<tr>
<td>New weather- or tween decks, area and load (t/m²):</td>
</tr>
<tr>
<td>Number of berths after conversion:</td>
</tr>
<tr>
<td>Change in internal subdivision:</td>
</tr>
<tr>
<td>New tanks, give number, type and size if known:</td>
</tr>
<tr>
<td>Increased air pipe heights on existing tanks, number of tanks:</td>
</tr>
<tr>
<td>Number of new hatches and ports:</td>
</tr>
<tr>
<td>Number of new work winches:</td>
</tr>
<tr>
<td>New cranes with SWL:</td>
</tr>
<tr>
<td>New stern A-frame, SWL:</td>
</tr>
<tr>
<td>Number of other A-frame or davits:</td>
</tr>
<tr>
<td>Number and type of new thrusters:</td>
</tr>
<tr>
<td>New helicopter deck:</td>
</tr>
<tr>
<td>New systems for propulsion, steering, navigation, etc.:</td>
</tr>
<tr>
<td>New or additional main engines (number and effect):</td>
</tr>
<tr>
<td>New or additional generators (number and effect):</td>
</tr>
<tr>
<td>Alterations to main switchboard:</td>
</tr>
<tr>
<td>New rudder(s):</td>
</tr>
<tr>
<td>New nozzle(s):</td>
</tr>
</tbody>
</table>

### New tonnage certificates

<table>
<thead>
<tr>
<th>Certificate of Tonnage Measurement 1969</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suez Canal Special Tonnage Certificate</td>
</tr>
<tr>
<td>Panama Canal Tonnage Certificate</td>
</tr>
</tbody>
</table>

**Short description of conversion:**

Please note that our offer will include plan approval only. Certification of materials and components, surveys and travel expenses will be invoiced separately.

<table>
<thead>
<tr>
<th>Place</th>
<th>Date</th>
<th>Signature and stamp</th>
</tr>
</thead>
</table>

**DET NORSKE VERITAS AS, VERITASVEIEN 1, N-1322 HØVIK, NORWAY, TEL: +47 67 57 99 00, FAX: +47 67 57 99 11**  
**http://www.dnv.com**