



ISWG LRH
Agenda item 2

ISWG LRH/2/3
14 September 2010
ENGLISH ONLY

REVIEW OF THE DRAFT MSC CIRCULAR ON GUIDELINES FOR EVALUATION AND REPLACEMENT OF LIFEBOAT ON-LOAD RELEASE MECHANISMS

Proposed amended "Guidelines for evaluation and replacement of lifeboat on-load release mechanisms" referred to in SOLAS regulation III/1.5

Submitted by ICS, BIMCO, CLIA, IFSMA, IMCA, INTERCARGO, P&I Clubs, IPTA, INTERTANKO, ITF, NI, OCIMF and SIGTTO

SUMMARY

Executive summary: The industry co-sponsors provide discussion of and propose amendments to the proposed "Guidelines for evaluation and replacement of lifeboat on load release mechanisms", to chapter IV of the LSA Code and to proposed SOLAS regulation III/1.5

Strategic direction: 5.1

High-level action: 5.1.2

Planned output: 5.1.2.1

Action to be taken: Paragraph 22

Related documents: DE 43/18; DE 44/19; DE 45/27; DE 46/32; DE 47/25; DE 48/25; FP 50/21; DE 50/27; DE 51/28; DE 52/21; DE 53/3/4, DE 53/26; MSC 87/7/5; MSC 87/26 and ISWG LRH/2

Introduction

1 Since MSC 87, the Industry Lifeboat Group (ILG) has further considered the evaluation and replacement of lifeboat on-load release mechanisms and in this submission provides a detailed explanation of its technical review. Proposals at annex include amended draft guidelines to support the conclusions reached during this review.

2 The ILG technical review noted and supported the following required components in the proposals from the DE LSA working group:

- .1 requirement for compliance with paragraphs 4.4.7.6.3 to 4.4.7.6.5 of the LSA Code as amended by resolution MSC....(88);
- .2 process comprising a desk-top design review of the release mechanism undertaken by the ship's Administration, supplemented by a practical examination, the results being forwarded to IMO;

- .3 inadequacy of information for the design review rendering release mechanisms unacceptable;
 - .4 the adoption of anticipated wear as a key indicator of the suitability of a release mechanism for continued safe operation;
 - .5 requirements for release mechanisms found to be unsuitable for continued service to be replaced within defined timescales;
 - .6 acceptance of additional safety measures, including the use of fall prevention devices, until unsuitable release mechanisms are replaced; and
 - .7 procedure for assuring the suitability of replacement release mechanisms.
- 3 The industry proposals additionally include:
- .1 definitions section to maximize consistency of application;
 - .2 provision for urgently replacing release mechanisms found to be non-compliant;
 - .3 defined process and criterion for assessing the stability of release mechanisms;
 - .4 provision for an endurance test to demonstrate longevity of safe operation;
 - .5 an enhanced compliance review to improve the assessment of design integrity; and
 - .6 an expectation that evaluation reports submitted to the Organization will be circulated to Member Governments.

Discussion

4 It is considered that a design review of a particular type of release mechanism should be conducted only once, by a single Administration (being the Administration on whose behalf the previous approval was given). For types of release mechanism found to be satisfactory under the design review, each individual release mechanism of that type should then be subjected to a special physical examination to determine whether that release mechanism is suitable for continued safe operation or should be replaced.

5 Currently, paragraph 4.4.7.6.3 of the LSA Code as amended by resolution MSC....(88) only differentiates between: (a) there being a force tending to open the mechanism, or (b) there not being such a force. What is actually required for stability is the existence of a force which tends to close the mechanism, which is not the same as there not being a force which tends to open the mechanism. A proposed change to the wording of the LSA Code amendments to this effect is included at annex 2.

6 Annex 2 also includes additional wording to ensure that designs other than those with a hook tail and cam incorporate a sufficient range of stability.

7 Currently, section 4.4.7.6 of the LSA Code, as amended by resolution MSC....(88), does not require provision of a locking device, although a hydrostatic interlock is required unless other means are provided to indicate that the boat is waterborne. In the case of such

other means therefore, the amended Code permits a lifeboat to be lifted from the water, albeit with a closed hook that should not open itself, but nevertheless with a hook that is not locked. It is also noted that the mechanism shown in Figure 2 of the current draft Guidelines is described as having a self-locking capability, although it would be more accurate to describe the mechanism as having a latching capability.

8 Latching the mechanism in the closed state signifies that the hook is restrained from opening until the latch is activated, after which the mechanism will open under the influence of the weight of the boat. Locking signifies that there is also a device which prevents activation of the latch until it has itself been activated, i.e. the lock needs to be unlocked in order to activate the latch. Thus releasing the mechanism requires unlocking, followed by activation of the latch. A proposed change to the wording of the LSA Code amendments require every release mechanism to be provided with both a lock and a latch is included in annex 2.

9 Currently, the draft Guidelines stipulate neither the degree of stability required for safety, nor the acceptable limits of wear, despite these two aspects being crucial to the suitability of existing release mechanisms for continued service. The industry proposal therefore includes specific requirements in both respects, through the introduction of a stability appraisal and an endurance test.

10 With regard to stability, the key requirement is for the weight of the lifeboat to exert a closing force on the operating mechanism of sufficient magnitude to avoid, so far as reasonably practicable, inadvertent or premature release. Furthermore, this level of stability needs to be maintained throughout the operating life of the release mechanism, despite potential dimensional degradation through wear, etc., in service. The required amount of stability, and the tolerable level of wear (including wear at mating/rubbing surfaces; at bearings and pins, etc.; and stretch and lash of cables) is likely to vary significantly from one type of release mechanism to another.

11 It is therefore considered unreasonable to expect flag Administrations to determine the amount of stability and wear resistance necessary for particular release mechanism designs. Rather, it is the responsibility of the manufacturer to specify practical testing to validate stability and wear resistance and provide this information as part of the design review. In the event that, based on the submitted documentation, the flag Administration is not satisfied that the design provides sufficient stability under all operational conditions; all release mechanisms of this type would be deemed unacceptable.

12 The wear resistance of each particular type of release mechanism should be assessed by means of an endurance test comprising repeated on-load releases under partial loading followed by a number of on-load releases under full loading (to imitate, respectively, periodic drills followed by emergency use). The test should be witnessed by the flag State representative and conducted using a randomly selected production version of the mechanism (or equivalent). Unexpected release at any stage prior to completion of the test procedure would result in all release mechanisms of this type being deemed unacceptable. Safety factors in the proposed test specification could allow for dimensional degradation of components due to reasons other than repeated on-load release operations, resulting for example from ship vibration. (It should be noted that this proposed endurance test for existing hook types is similar to, but significantly less demanding than, the test defined in amended paragraph 6.9.4 of the IMO Recommendation on Testing of Life-saving Appliances in respect of new hooks).

13 Currently, the Guidelines seek to evaluate compliance or otherwise with only three subparagraphs of 4.4.7.6 of the LSA Code as amended by resolution MSC....(88). However there are other subparagraphs which have an important bearing on the quality and suitability

of existing release mechanisms. These subparagraphs cover aspects such as corrosion, and clarity of signage, operating instructions, controls and indicators. It is therefore proposed that the design review takes account of such other factors when assessing design and operational shortcomings and the resulting urgency of release mechanism replacement.

14 The draft Guidelines currently include explanatory diagrams of three types of release mechanism. It would be impractical and unwieldy to include many more (it is understood that there are in excess of 70 release types in existence). Furthermore, the proposed amended guidance (annex 1) sets out a specific approach, applicable to all hook types, for the assessment of stability characteristics and wear. The inclusion of illustrative examples is therefore unnecessary.

15 Although the concept of a proving test for lifting equipment has many precedents, a number of concerns were raised during discussion of the draft Guidelines at MSC 87 regarding the practicality and safety of conducting the proposed "hook stability test". On a ship in operational service, such a test could introduce additional hazards, could be fraught with difficulties and may be of negligible added value, when considered in conjunction with the stability appraisal and endurance test proposed in annex 1.

16 It is therefore proposed that, for release mechanisms of a type found to be satisfactory in the design review, the stability test be replaced by a special physical examination of every individual release mechanism. This special physical examination should take the form of an enhanced version of the 5-yearly thorough examination, undertaken on a one-off basis at the time of the next annual examination.

17 The purpose would be to assess the extent to which each existing release mechanism fulfils the intent of the range of requirements specified in the subparagraphs of 4.4.7.6 of the LSA Code as amended by resolution MSC....(88), despite the accumulated effect over time of the rigours of exposure and operation in a marine environment. Reliance on the experience and judgement of the flag State representative would be wholly appropriate for undertaking this special examination and, when combined with the outcome of the type-specific design review, should provide a robust overall assessment of the suitability of each individual release mechanism for safe ongoing service, at least between 5-year major service intervals.

18 A number of manufacturers are reported to have issued policy statements discouraging the use of fall prevention devices (FPDs) on the grounds that their equipment is not designed for shock loads. In this regard, it can be noted that fitting an FPD of the strop variety need not involve any modification to the lifeboat release mechanism or davits (no pins, holes, brackets or welded lugs). If the lifeboat is then lowered and launched properly, the only additional task for the boat's crew is to unshackle (and subsequently reconnect) the strops, a simple seamanship task that should pose no difficulty for trained seafarers. Assuming the drill proceeds without incident, no unusual or additional loads will be imposed on the boat or its launching equipment.

19 However, if unintended or premature release were to occur, the strops would reduce the likelihood of serious consequences, potentially saving lives. If such unintended or premature release were due to incorrect operation, crew error, faulty or inadequate maintenance, etc., no liability would fall upon the manufacturer, even if the boat or davit structures failed as a consequence of the resulting shock loading. Discouraging the use of FPDs on the grounds that equipment is not designed for the resulting shock loads is therefore irrelevant. On the other hand, if unintended or premature release were due to design, manufacturing or OEM servicing shortcomings, the manufacturer could be reassured that the likelihood of severe consequences would be reduced by the use of an FPD.

20 Consequential to the proposed amendments to the LSA Code as amended by resolution MSC....(88) and the proposed re-drafted Guidelines (annex 2 and annex 1), an amendment to new regulation 1.5 of chapter III of SOLAS is proposed at annex 3. The technical review to support the submission is attached as annex 4.

21 The content of document ISWG LRH/2 (Secretariat) is noted. The collation of previous work on this LSA topic is very much appreciated and highlights that many related issues have been identified but not completed. In particular it is noted that MSC.1/Circ.1327 regarding the fitting and use of FPD has been challenged by certain manufacturers but that despite support for industry concern (DE 53/3/4) regarding some manufacturers' position on this matter the issue has not been resolved. Other important related and ongoing issues such as specific manufacturer training materials, the standardization of control functions and colour coding as well as the ease of inspection and maintenance have yet to be concluded by the Organization.

Action requested of the ISWG

22 The Working Group is invited to consider the more detailed approach to evaluation of existing on-load release mechanisms than proposed by the DE Working Group, and particularly the information and proposed amendments in annexes 1 to 3, and annex 4, and decide as appropriate.

ANNEX 1

This annex comprises proposed re-drafted version of IMO's draft "Guidelines for Evaluation and replacement of lifeboat on-load release mechanisms", referred to in draft SOLAS regulation III/1.5, presented as clean text for clarity.

Application

1 This Guidance applies to conventional davit-launched, lifeboats fitted on ships constructed prior to [1 January 2011]. Where the release mechanism of the lifeboat has been replaced by a release mechanism complying with the requirements of the LSA Code as amended by resolution MSC....(88), the provisions of paragraphs 29 to 37 below apply.

2 Administrations should ensure that every lifeboat is examined in accordance with these guidelines at the earliest opportunity and no later than the next scheduled annual survey, and that action is taken accordingly.

3 Considering that the amendments to paragraph 4.4.7.6 of the LSA Code, as approved by resolution MSC....(88), represent important safety improvements, Administrations, shipowners and manufacturers are encouraged to evaluate existing lifeboat on-load release mechanisms in accordance with these Guidelines at the earliest available opportunity, in advance of the entry into force of SOLAS regulation III/1.5.

Definitions

4 The following words/phrases have the meanings defined below:

- .1 *Hooks*: Components of the release mechanism, which connect the lifeboat to the falls, and which can be restrained such that the weight of the boat is supported by the falls, or released to allow the weight of the boat to free the boat from the falls;
- .2 *Release mechanism*: All of the fixed and moving parts of the equipment provided on the lifeboat to support and secure the lifeboat on its lower falls blocks and to release and recover the lifeboat as desired;
- .3 *Type*: In relation to the design of a release mechanism means a family of identical release mechanisms of given lifting capacity (thus any change to the materials of construction, design arrangement or dimensions constitutes a change of type);
- .4 *On-load release*: The action of opening the release mechanism whilst there is load on the hooks and falls;
- .5 *Latch (latched, latching)*: A characteristic or feature of the release mechanism which when set prevents the hook from opening. Thus the hooks cannot open until and unless the latch has been deliberately activated;
- .6 *Lock (locked, locking)*: A characteristic or feature of the release mechanism which prevents activation of the latch until the lock is itself deliberately activated. Thus the hooks will not open until and unless the lock has been unlocked and the latch has been activated;

- .7 *Design review:* A desk-based assessment by an Administration of documentation and information relating to a particular type of release mechanism;
- .8 *Special physical examination:* A detailed survey undertaken by an Administration of the particular release mechanism installed on a particular lifeboat; and
- .9 *Operating mechanism:* Those elements of the "release mechanism" that crew members manipulate to access the various functions available.

Evaluation procedure

5 The evaluation comprises two sequential stages:

- .1 design review of the type of the release mechanism; followed by
- .2 special physical examination of the individual release mechanism fitted in every lifeboat. This in situ examination should include particular reference to ensuring the visibility of the hook to the operator and access for ease of operation and maintenance.

6 Depending on the outcome of this evaluation, every release mechanism should be categorized as being either compliant or non-compliant. Thereafter:

- .1 release mechanism categorized as being compliant may remain in service indefinitely for the life of the ship, subject to review by means of a special physical examination at every scheduled dry-docking period;
- .2 every release mechanism categorized as being non-compliant should be replaced or made compliant [within 6 months] or as determined by the Administration.

7 For release mechanisms categorized as being non-compliant, additional safety measures, including the use of fall prevention devices in accordance with MSC.1/Circ.1327, should be employed until the release mechanisms are replaced or made compliant.

8 Replacement release mechanisms shall comply with the requirements of the LSA Code as amended by resolution MSC....(88).

Design review

9 Each type of release mechanism should be subject to a design review comprising three parts:

- .1 stability appraisal;
- .2 compliance assessment: and
- .3 review of the results of an endurance test.

Stability appraisal

10 In principle, existing types of on-load release mechanism typically comprise three primary elements: a pair of hooks, a pair of hook restraints (one for each hook), and apparatus for activating hook release and resetting. Each hook connects one end of the

lifeboat to its respective lower falls block. Each hook restraint comprises a component which can be moved to one of two positions, either to prevent its hook from opening or to allow its hook to open. The apparatus for activating hook release and resetting typically comprises a variety of levers, pivots, rods, shafts, cables, sector plates, cranks, etc., the purpose of which is to activate the hook restraints into one or other of their two positions.

11 A release mechanism may be described as being stable if, when the mechanism is fully and properly reset to the "hooks closed" position, the weight of the lifeboat (acting through the two falls and hooks) exerts a closing effect on the hook (in compliance with paragraph 4.4.7.6.3 of the LSA Code as amended by resolution MSC....(88)). The release mechanism manufacturer should make available documents (the stability documentation) which:

- .1 Describe how this closing effect is generated by the design of the mechanism; and
- .2 Demonstrate that the amount of closing effect incorporated in the design provides sufficiently stability under all operational conditions¹.

12 The stability documentation should be examined by an Administration to assess the information provided, if necessary consulting with the manufacturer to clarify any concerns. In the event that the Administration is not satisfied that the design provides sufficient stability under all operational conditions, or in the event that the manufacturer is no longer in business, or the stability documentation is not available, all release mechanisms of that type should be categorized non-compliant.

Compliance assessment

13 Types of release mechanism found to be satisfactory in respect of the stability appraisal should be subjected to a compliance assessment, undertaken by an Administration. The purpose of the compliance assessment is to assess the extent to which each type of release mechanism fulfils the requirements for new release mechanisms specified in paragraphs 4.4.7.6.4 to 4.4.7.6.12 inclusive (the new requirements) of the LSA Code as amended by resolution MSC....(88).

14 In undertaking the compliance assessment, the Administration should consider relevant features of the design of the particular type of release mechanism, seeking supplementary information from the manufacturer where necessary. Initially, compliance with paragraphs 4.4.7.6.4 and 4.4.7.6.5 of the new requirements should be assessed. In cases where compliance with paragraph 4.4.7.6.5 cannot be established by design review, it may alternatively be evaluated by a suitable practical test of the hydrostatic interlock.

15 For designs compliant with paragraphs 4.4.7.6.4 and 4.4.7.6.5, the assessment should then focus on the extent to which the type of release mechanism complies with paragraphs 4.4.7.6.7 to 4.4.7.6.12 inclusive of the new requirements. The Administration should form a judgemental opinion as to whether each type of release mechanism is:

- .1 compliant; or
- .2 non-compliant.

¹ "All operational conditions" includes, for example, whatever the weight on the hook up to the fully laden weight of the boat; whether the boat is afloat or not; whether the boat is being raised, lowered or stopped; and irrespective of environmental conditions; etc.

16 The outcome of the compliance assessment (by type of release mechanism), in combination with the outcome of the subsequent special physical examination on every individual lifeboat, will inform the categorization of each individual release mechanism of that type.

Endurance test

17 Types of release mechanism found to be satisfactory in respect of the stability appraisal and compliant with paragraphs 4.4.7.6.4 and 4.4.7.6.5 of the LSA Code as amended by resolution MSC...(88) should be subjected to an endurance test.

18 Every lifeboat release mechanism should retain a sufficient level of stability throughout its operational lifetime, despite degradation of its components due to wear, material deterioration, etc., and despite any dimensional discrepancies due to initial manufacturing tolerances. Of primary importance in this respect is the potential for dimensional degradation, particularly of the hooks and their restraining components, during normal operational service of the ship. The purpose of the endurance test is to assess the ability of the release mechanism to maintain stability through life.

19 The test should be carried out on a randomly selected production version of the release mechanism, and be witnessed by the Administration. In the event that the particular type of release mechanism is no longer in production, the test should be carried out on a stock spare in the as-built condition, or on a refurbished release mechanism comprising OEM-approved working parts. In the event that it is not possible for the manufacturer to source or build a representative equivalent "new" release mechanism for the purpose of the test, all release mechanisms of that type should be categorized non-compliant.

20 The test should comprise repeated on-load release and resetting cycles of the release mechanism at a partially loaded condition, followed by three on-load release and resetting cycles of the release mechanism at a fully loaded condition. In this regard:

- .1 The partial load case should comprise the weight of the boat (complete with fuel, stores, etc.) plus three persons (or the minimum crew required for drills for the particular type of lifeboat², if higher), times a 1.2 factor of safety; and
- .2 The full load case should comprise the weight of the boat fully loaded with crew, passengers, fuel, stores, etc., times a 1.1 factor of safety.

21 As a minimum, the 5-yearly major service interval, or at the manufacturer's option the life expectancy of the ship, should be taken as the representative lifetime. The number of repeat cycles for the partial load case should be taken as 1.5 times the expected number of lifeboat drills during the representative lifetime. A report of the endurance test should be made available to the competent person. Unexpected release at any stage prior to completion of this test procedure should result in all release mechanisms of that type being categorized unsafe.

Special physical examination

22 Every release mechanism of a type found to be satisfactory in respect of the stability appraisal should be subject to a special physical examination. This examination should be undertaken by an Administration and should take place no later than the date of the next scheduled annual survey. It should comprise an enhanced version of the thorough examination normally undertaken at 5-yearly intervals.

² This should be increased to the minimum number of crew plus three persons for passenger ship lifeboats.

23 In addition to the scope of a normal annual survey and 5-yearly examination, the purpose of the special physical examination is to assess the extent to which each individual release mechanism, in the light of the accumulated effects of its operational and maintenance history, is suitable for ongoing service. In particular the examination should address the requirements of the the LSA Code as amended by resolution MSC....(88).

24 The scope of the special physical examination should also include a detailed assessment of the condition of the components of the release mechanism to observe the extent of corrosion, erosion and other types of material degradation that may have occurred and which would impair the ability of the release mechanism to maintain a sufficient level of stability until the next scheduled dry-docking.

25 The special physical examination should take place prior to any servicing, maintenance or repair work being undertaken on the release mechanism. This is in order to establish the condition of the release mechanism following the period of operational exposure since the previous servicing occasion. If significant improvements are subsequently implemented by means of servicing, maintenance or repair activity on this occasion, the impact of this work may, at the discretion of the Administration undertaking the examination, be taken into consideration when assessing the condition of the release mechanism.

26 Based on the results of the special physical examination, the Administration should form a judgemental opinion as to whether each individual release mechanism is:

- .1 compliant; or
- .2 non-compliant.

Overall outcome

27 The Administration should submit the result of each evaluation carried out in accordance with these Guidelines (design review plus special physical examination) to the Organization for circulation to Member Governments. Submissions to the Organization should be based on the reporting procedure³. For any particular type of release mechanism, an Administration need only conduct the design review once.

28 As an alternative to replacement, a release mechanism may be modified to comply with the requirements of some or all of paragraphs 4.4.7.6.4 to 4.4.7.6.13 inclusive of the LSA Code, as amended by resolution MSC....(88), provided that the modified release mechanism is subjected to the evaluation described in these Guidelines.

Procedure for replacement of release mechanisms

29 Where, in accordance with these Guidelines, a lifeboat release mechanism is replaced, the following details of the replacement mechanism and its installation should be submitted for review by the Administration or recognized organization:

- .1 drawings of the original hook arrangement (if possible confirming that the original point of suspension of the boat in relation to the boat remains unchanged and that the geometry of the hook above the centre does not adversely influence the operation of the hook). Structural changes to the link plates should be indicated;

³ Refer to the reporting procedure to be developed.

- .2 detailed drawings showing clearly the proposed changes (e.g., means of hook anchorage, including materials used for nuts and bolts with regard to strength and corrosion resistance);
- .3 if the drawings show that forces and/or force couples will change and/or the hook anchorage will change, calculation of static forces including safety factor of 6 according to the LSA Code from lifeboat hook into lifeboat structure including tension and shear forces in bolts, link plates, welds and keel shoe(s); and
- .4 a revised operation and maintenance manual reflecting changes to the original configuration.

30 Considering that a release mechanism system does not consist just of the hooks themselves, but also release handles, cabling, etc., in the lifeboat, the evaluation of a replacement hook system other than that originally provided in the lifeboat should include such factors as loadings of the release handle on the console, efficiency of any hydrostatic interlock in the light and loaded conditions, whether the size/configuration of the replacement equipment would affect the lifeboat's stability or seating space, and compatibility of the modified lifeboat system with its launching appliance.

31 The following tests should be carried out on installations of new release mechanisms to replace unsatisfactory mechanisms:

- .1 1.1 x load and simultaneous release test according to resolution MSC.81(70) (part 2, paragraph 5.3.1), or an equivalent method acceptable to the Administration;
- .2 load test according to resolution MSC.81(70) (part 2, paragraph 5.3.4), as amended by MSC.226(82), if the keel shoe/structure of the lifeboat is modified;
- .3 if the centre of the hook longitudinally, transversely and/or vertically relative to the boat has changed, the prototype hook release test according to resolution MSC.81(70) (part 1, paragraph 6.9.4), as amended by MSC.226(82), should be carried out; and
- .4 if the lifeboat is also a rescue boat and/or is installed on a cargo ship of 20,000 gross tonnage or more, the 5 knots installation test according to resolution MSC.81(70) (part 2, paragraph 5.4), should be carried out.

Note: "on-loadrelease mechanism" is defined as the complete system by which a lifeboat is released from its connections with the ships falls while suspended above the surface of the water. This system incorporates the operating mechanism (lever/cable), release hooks and hydrostatic interlock (if fitted).

ANNEX 2

PROPOSED AMENDMENTS TO SECTIONS 4.4.7.6.1 to 4.4.7.6.4 OF THE INTERNATIONAL LIFE-SAVING APPLIANCES (LSA) CODE (MSC 87/3, ANNEX 4)

CHAPTER IV SURVIVAL CRAFT

4.4.7.6 Every lifeboat to be launched by a fall or falls, except a free-fall lifeboat, shall be fitted with a release mechanism complying with the following requirements subject to subparagraph .9 below:

- .1 the release mechanism shall be so arranged that all hooks are released simultaneously;
- ~~.2~~ the release mechanism shall incorporate both a latch and a locking device;
- ~~.2-3~~ the release mechanism shall be designed so that the hook and latch ~~locking mechanism~~ remains fully closed under any operational conditions⁴ until they are ~~it is~~ deliberately caused to open by means of the operating mechanism:
 - .1 for designs utilizing a hook tail and cam, the release mechanism shall continue to comply with this requirement through a rotation of the cam of up to 45° in either direction from its latched ~~locked~~ position;
 - ~~.2~~ for other designs, the release mechanism shall provide an equivalent range of stability;
- ~~.3-4~~ to provide hook stability, the release mechanism shall be designed so that, when it is fully reset in the closed position, the weight of the lifeboat does not cause any force to be transmitted to the operating mechanism;
- ~~.4~~ locking devices and latches shall be designed so that they can not turn to open due to forces from the hook load;"

⁴ The phrase "any operational conditions" is intended to mean: Irrespective of whether there is weight on the hook(s); whether the boat is afloat or airborne; whether the boat is being raised or lowered or is stopped, is swinging in the wind or is subject to a current; and whatever the environmental conditions (hot, cold, wet, dry, night or day). The phrase should not be considered to also include fault conditions or erroneous operation.

ANNEX 3

**PROPOSED AMENDMENTS TO PROPOSED NEW REGULATION 1.5 OF
CHAPTER III OF SOLAS**

- 1.5 For all ships, not later than the first scheduled annual survey ~~dry-docking~~ after [date], lifeboat on-load release mechanisms shall be assessed against the requirements of ~~not complying with~~ paragraphs 4.4.7.6.3~~1~~ to 4.4.7.6.5~~14~~ of the Code. Any release mechanisms deemed to be unsatisfactory for continued service shall be replaced with equipment that complies with the Code.⁵

* Refer to the Guidelines for evaluation and replacement of lifeboat on-load release mechanisms (MSC.1/Circ....).

ANNEX 4

TECHNICAL REVIEW TO SUPPORT ILG SUBMISSION FOR MSC INTERSESSIONAL, OCTOBER 2010

1 This annex reports the outcome of a review of matters relating to IMO agenda item "Measures to Prevent Accidents with Lifeboats". The objective of the review was to identify improvements to the draft Guidelines for Evaluation and Replacement of Lifeboat On-load Release Mechanisms, referred to in SOLAS regulation III/1.5.

2 The scope of the review included:

- .1 the proposed new SOLAS regulation III/1.5;
- .2 proposed amendments to section 4.4.7.6 of the LSA Code;
- .3 the draft Guidelines as developed by DE 53;
- .4 relevant documents submitted to DE 53 and MSC 87; and
- .5 the report of MCA research project 555⁵.

SOLAS regulation III/1.5 and the Code amendments

3 SOLAS regulation III/1.5 calls for existing hooks either to comply with paragraphs 4.4.7.6.3 to 4.4.7.6.5 of the LSA Code (as recently amended), or be replaced. Regulation III/1.5 and the LSA Code amendments have been approved, but not yet adopted.

4 The draft Guidelines set out the mechanism by which compliance with paragraphs 4.4.7.6.3 to 4.4.7.6.5 of the Code should be evaluated.

5 The Code amendments were drafted by DE 52, based on work by the Correspondence Group established by DE 51. The terms of reference for the Correspondence Group and, effectively, the DE 52 working group included:

- .1 considering the "fail-safe" concept for on-load release gear and finalizing relevant amendments to the LSA Code; and
- .2 developing criteria for determining hooks of poor and unstable design with a view to their replacement.

6 The Correspondence Group and the DE 52 Working Group approached their work by first considering design requirements for new release hooks and then, based on these new hook requirements, deriving criteria for identifying poor and unstable hooks.

7 In so far as **new** hooks are concerned, the amendments modified paragraph 4.4.7.6 of the Code to include the following additional requirements:

- .2 *the mechanism shall be designed so that the hook and locking mechanism remains fully closed under any operational conditions until it is deliberately caused to open by means of the operating mechanism:*

⁵ Research Project 555, Development of Lifeboat Design, UK Maritime and Coastguard Agency, March 2006.

- .1 *for designs utilizing a hook tail and cam, the mechanism shall continue to comply with this requirement through a rotation of the cam of up to 45° in either direction from its locked position;*
- .3 *the mechanism shall be designed so that, when it is fully reset in the closed position, the weight of the lifeboat does not cause any force to be transmitted to the operating mechanism, which could cause the inadvertent release of the lifeboat;*
- .4 *locking devices shall be designed so that they cannot turn to open due to forces from the hook load;*
- .5 *if a hydrostatic interlock is provided, it shall automatically reset upon lifting the boat from the water,".*

(In passing, it can be noted that the text of new paragraph 4.4.7.6.3 only *implies* that the hooks have to be carrying the weight of the boat.)

8 In respect of **existing** hooks however, DE 52 decided that only subparagraphs 3, 4 and 5 should become used as criteria for identifying hooks of poor and unstable design (e.g., not subparagraph 2). The reason for this is not apparent, either from the report of DE 52 or the working group.

9 The meaning of, and distinction between, subparagraphs 2 and 3 is not entirely clear from their wording. Subparagraph 2 refers to a hook staying closed until a *user* wants it to open; whilst subparagraph 3 refers to a hook being reset such that the *mechanism* doesn't try to open it. Another difference comes in sub-subparagraph 2.1, which constitutes an approach to setting a stability *standard*, i.e. that the mechanism doesn't try to open itself despite +/- 45° latitude in resetting the cam (although the basis for selecting 45° is not apparent, and was queried by China during DE 52). But this requirement only applies to tail and cam mechanisms, and it may be that the +/- 45° range reflects the capability of particular existing designs, rather than being a rational standard.

10 Furthermore, the text of the amended Code contains no explicit requirement for a lock. Reference is made to a locking mechanism (in subparagraph 2), a locking device (in 4) and a hydrostatic interlock (in 5). But none of these specify that a lock shall be provided.

11 However, a requirement for a hydrostatic interlock is included in the Code by means of the amendment to paragraph 4.4.7.6.6 (previously paragraph 4.4.7.6.2.2), but this applies only if there are no other means to indicate that the boat is waterborne. Thus the amended Code would permit a boat being lifted out of the water, albeit with a closed hook that won't open itself, but nevertheless with a hook that is not locked.

12 Another of the criteria proposed by the correspondence group established at DE 51 for identifying hooks of poor and unstable design is the use of materials which are not corrosion resistant. However, DE 52 decided to limit the criteria to just the three aspects covered by paragraphs 4.4.7.6.3 to 4.4.7.6.5 of the Code. Thus, the new requirement demanding the use of corrosion resistant material (included as paragraph 4.4.7.6.8) is only applicable to new hooks.

13 This decision by DE 52 (effectively to ignore problems arising from the use of non-corrosion resistant materials), was made on the grounds that replacing hooks not made from corrosion resistant material would entail practical difficulties. Corrosion of hook

components (such as mating surfaces, linkages, pivots, control cables, etc.) can be expected to adversely affect proper operation (including release, resetting and stability), as evidenced by the inclusion of corrosion resistance in the requirements for new hooks. Ignoring this factor in existing hooks may therefore be a significant shortcoming in setting the criteria for replacing unsatisfactory hooks.

14 With regard to the pedigree of "... compliance with paragraphs 4.4.7.6.3 to 4.4.7.6.5 of the Code ...", DE 52 added a criterion (not identified by the correspondence group, but appearing as 4.4.7.6.5) that if a hydrostatic interlock is fitted, it should reset automatically. Again, the reason for this inclusion is not apparent, either from the report of DE 52 or the working group.

15 By contrast, the reasoning behind paragraphs 4.4.7.6.3 and 4.4.7.6.4 is set out clearly in the correspondence group's report to DE 52, providing an auditable trail of the justification of inclusion.

16 Paragraph 6.35 of DE 52's report to MSC also recognizes the need for consistent definitions of the terms hook, gear, mechanism, etc., referring back to an earlier submission by Japan (DE 48/5/1) and suggesting that this should be undertaken by the working group at DE 53. However, this does not seem to have taken place and, as noted above, ambiguity still exists.

17 Interestingly, approval of regulation III/1.5 implies that by the specified [date], hook designs that fulfil the amended Code requirements will be available. Either this is the case now (which suggests that the amended Code merely reflects some current designs and may not actually be safe enough), or there may be a timescale issue to allow for new designs to be devised, manufactured, type tested and approved. IMO meeting documents to date (whether from ILAMA or any other organization) appear to give no indication of the timescale needed to produce compliant hooks.

The draft Guidelines

18 Regarding the draft Guidelines document, the first draft was compiled by the correspondence group established at DE 52. A Working Group at DE 53 was tasked to finalize the draft, which was agreed by DE 53 and appears as annex 1 to DE 53's report to MSC 87.

19 As currently drafted, the Guidelines set out that compliance or otherwise with the amended Code should be demonstrated by means of a design review, supplemented by an optional stability test. The design review treats paragraphs 4.4.7.6.3 to 4.4.7.6.5 of the Code as a *fait accompli*, and assumes that reliance solely on those paragraphs is an appropriate basis for evaluating existing hooks. But, as indicated above, there is only partial justification in the available IMO documents for this presumption.

20 When developing the Guidelines, the correspondence group looked first at implementation issues, before seeking to establish protocols for the design review and practical test. The issues discussed included:

- .1 whether the outcome should be a single white list, black list, or both. This approach was rejected on the basis of there being no single body to conduct the evaluations, coupled with a reluctance of Administrations to accept evaluations undertaken by others;

- .2 that each Administration should evaluate the hooks (by implication, hook types) which it has approved for use, on the basis that Administrations will generally already hold the necessary design documentation and are ultimately responsible for ensuring compliance of ships under their flag; and
- .3 that Administrations would then publish the results in a central database (although this statement appears contrary to rejection of the single white/black list idea).

21 An argument was put forward that Administrations routinely evaluate equipment at least as complex as release hooks, and that evaluation of hooks should therefore be within their technical capabilities provided sufficiently clear and detailed requirements and criteria are available. However it is considered that the draft Guidelines do not yet provide sufficiently detailed criteria.

22 Information regarding production tolerances, wear rates, etc., will presumably be available to individual manufacturers, but many Administrations may indeed lack the capability to consistently assess fulfilment of Code requirements, for the following reason. The design illustrated in figure 2 of the current draft Guidelines explains that "self-locking" is achieved when $A > B$. Tolerances and levels of wear will affect the ratio A/B . Self-locking means that there is a small closing moment exerted on the cam by the hook tail. To open the hook under load requires the operator to overcome this closing moment. In so doing the operator actually lifts the boat slightly, because $(A^2 + B^2)^{0.5}$ exceeds A . The amount by which $(A^2 + B^2)^{0.5}$ exceeds A is one measure of the stability of the release gear, but stability is also directly proportional to the weight of the boat. The level of stability therefore varies significantly from fully laden during a real abandonment to light laden in drills. It is by no means clear that the level of stability necessary for safety has yet been properly established.

23 Based on the correspondence group's work, DE 53 agreed that the Guidelines should always comprise at least a design review, that the review should be undertaken by flag State Administrations and that the review should be on the basis of "hook type by hook type" evaluations (not "individual hook by individual hook"). A potential concern, not mentioned in the correspondence group's report, is the extent to which some hook designs may have been subject to progressive modifications, leading to slightly different versions or different sizes. A design review carried out on a "parent" version may not fully reflect the integrity of all derived versions.

24 Apart from Administrations publishing the results of their design reviews in a central database, there appears to have been no detailed consideration given to the problem of identifying the whereabouts of other examples of "failed" hook types, and notifying the relevant authorities.

25 With regard to the design review, the first and obvious requirement is that appropriate design documentation is available, as recognized in paragraph 7 of the Guidelines. Without design documentation, every hook of that type inevitably fails the test. On the assumption that suitable documentation is available, the Guidelines focus on the anticipated wear of critical parts over the service life of the mechanism. The term wear can be interpreted as meaning geometrical degradation. Because release gear is a mechanism, which is intended to be either open or closed, the principle of maintaining appropriate geometric dimensional tolerances amongst components of the mechanism constitutes a valid premise for identifying unsuitable hooks.

26 Presumably on the basis that Code paragraphs 4.4.7.6.3 and 4.4.7.6.4 distinguish between acceptable and unacceptable designs, the correspondence group took the view that "some designs may not be a problem when new, but can be expected to become so" due to degradation of the mechanism after repetitive use. But looking at the illustrative examples included in the Guidelines, it would be more accurate to say that at least one design does not meet the requirement of 4.4.7.6.3 even when new and that some designs whilst theoretically compliant when new, can be expected to become non-compliant due to degradation.

27 It may be noted (possibly in regard to the particular design(s) which clearly do not comply with paragraph 4.4.7.6.3), that the phrase "poor and unstable characteristics" was discarded by DE 53 on the grounds that it reflected badly on the hook's original makers and approvers.

28 The types of degradation discussed by the correspondence group are: wear at mating surfaces; and stretching and lash of cables. The draft Guidelines as agreed by DE 53 additionally mention corrosion and "normal clearances" (which is assumed to mean manufacturing tolerances) in the bearings of the hook and the cam. Figure 3 of the Guidelines clearly identifies two of these factors (corrosion of the hook tail, and wear at the hook and cam bearings). Wear at mating surfaces (i.e. the hook tail tip and cam face) is not explicitly mentioned, although is obviously also relevant, particularly in the light of paragraph 6 of the Guidelines which mentions "... anticipated wear of critical parts ...".

29 Stretching and lash of cables was dismissed by the correspondence group, on the grounds that this factor should be addressed by the annual service and inspection regime, although it can be argued that this applies equally to corrosion and wear. In any event, problems with operating cables or linkages are "downstream" of (e.g., further removed from) the real problem area which is, according to paragraphs 4.4.7.6.3 and 4.4.7.6.4 of the Code, whether the weight of the boat causes an opening force to be transferred to the operating mechanism.

30 The Guidelines do not stipulate specific tolerances for upper limits of wear (the combined effects of mating surface wear, corrosion and bearing wear), such limits being likely to vary from one hook type to another. An assumption is that this information, together with manufacturing tolerances, will be available for the purpose of the review. However, an interpretation of the situation could be that manufacturers do not actually know what the upper limit for wear is for their hooks; otherwise it would form part of the existing criteria for annual service and inspection, as in the case asserted for stretching and lash of cables (akin to the minimum depth of tread on vehicle tyres).

31 It is suggested that many or most Administrations may not be in a position to define acceptable upper limits of wear criteria, and that manufacturers may not be entirely unbiased. The Guidelines should therefore place an obligation on manufacturers to provide and justify upper limits of wear for each of their hook designs, and that inability to do so would be another failure criterion.

32 In this regard, ILAMA (in their comments on the draft Guidelines, in document MSC 87/7/8), propose deleting the reference to "anticipated wear" in the Guidelines, suggesting instead that the manufacturer should perform a 10-times on-load release (equivalent to 50 year life) after which a hook should pass the test. If done on an in-service hook, such a test might take the hook to the brink of failure, so would prove nothing. To be meaningful, it would have to be performed on a randomly selected production version, which may not be available for some existing hooks.

33 In this context it may also be noted that in document MSC 87/7/9, ILAMA make no mention of wear criteria (although the flowcharts they propose are useful). It is also noteworthy, in the light of the discussion above regarding of the amount of stability necessary for safety, that ILAMA propose deleting the illustrative diagrams from the Guidelines, despite the correspondence group's request for more diagrams illustrating different types of mechanism to be provided.

34 The Guidelines do not specify what is meant by repetitive use, although requirements regarding the frequency of lifeboat drills are defined in IMO regulations. Even this presumes that wear occurs primarily when the mechanism is operated during drills. But the components of a hook are continuously in contact, and may be under load, the whole time the boat is in the ship's davits. They may therefore be subject to vibration which can significantly exacerbate wear rates.

35 Although the draft Guidelines agreed by DE 53 mention corrosion as a factor, it is not apparent how (or even whether) consideration of corrosion should be part of the design review. Whilst the SOLAS amendment specifically excludes the need for existing hooks to comply with the new paragraph 4.4.7.6.8 of the Code, the Guidelines could make reference to the identification and examination of components liable to corrosion, coupled with an assessment of their criticality, type of protective coatings, means for lubrication, etc.

36 The correspondence group, in paragraph 18 of their report (DE 53/3), suggested that if a hook fails the design review it could be modified and treated as if it were a new hook. But of course, still being an existing (although modified) hook, it would then also have to meet the corrosion resistance requirements of paragraph 4.4.7.6.8 of the Code.

37 Attention is now turned to the proposed practical test. Although the correspondence group established by DE 52 had initially opted for the design review approach, it was the Bahamas Administration which later suggested adopting a practical test as a means of identifying hooks which should be replaced. The justification for this idea is that a test would avoid the problem of verifying that the hook on board is identical to the version subjected to the office-based design review. The test option is offered in the Guidelines as either an alternate or supplementary approach.

38 Conducting a practical test raises a variety of issues and problems, the answers to many of which are not obvious. Nevertheless, the concept of a "proving test" has several precedents (lifting gear generally, and lifeboats themselves, are subject by regulations to periodic inspection and test). The difficulty lies in defining an appropriate test, which is aimed at demonstrating what the release gear will not do (i.e. open unexpectedly) rather than what it will do.

39 Norway (in document MSC 87/7/3, commenting on the draft Guidelines) suggests that a design review on its own would be inadequate because "reality may differ from design" and that a test on its own would be inadequate because it cannot replicate wind, rain, waves, etc. Nevertheless, inclusion in the draft Guidelines (albeit in square brackets) indicates that there is considerable support for the idea of both a design review and a test.

40 One significant issue is whether the test should be performed before or after routine servicing. The draft Guidelines (and ILAMA, in document MSC 87/7/10) argue that the test should be undertaken after servicing, but what is more important is whether a hook remains stable even when it is due for its next routine service.

41 A second important issue is whether to test every hook on board a ship or only a sample. Paragraph 11 of the draft Guidelines implies that the hooks on just one boat should be tested, but if those fail, all remaining hooks on a cargo vessel and 20% of the other hooks on a passenger vessel should also be tested. This lesser standard for passenger ships is questionable; no-one would want to be lowered in a boat fitted with hooks of a type which had failed a test. ILAMA (in document MSC 87/7/10) suggest that all hooks should be tested anyway. This would be appropriate if testing becomes the principal means of identifying unsatisfactory hooks, but if testing merely supplements the design review, sampling is probably sufficient.

42 A linked issue is whether multiple tests are needed on a particular hook system, or whether one test suffices. The Guidelines describe a single test. Norway (in document MSC 87/7/3) proposes five repeat tests; and IACS (DE 53/3/Add.1) suggests a succession of tests at increasing load. There may be an argument for subjecting the hook to an on-load release between each repeat.

43 Another issue is whether the test would pose risks to personnel, although it is understood that nobody would be on board during the tests. There appear to have been no injuries during lifeboat accidents in the past, other than to those on board the boat. The potential for risks to personnel therefore seems small.

44 A variety of other issues regarding a practical test were raised by ILAMA (MSC 87/7/10), none of which yet appear satisfactorily resolved. Included are that:

- .1 An onboard test could damage the boat or davits, due to impact loading. But impact loads would only occur if a hook fails the test, after which the hooks would need replacement anyway, and the test would be treated as an incident that would need investigation.
- .2 Tests should be conducted ashore in a purpose-built rig. This appears to be sensible, but there would be risks involved dismantling and re-installing the hooks, and the boat would have to be lowered and recovered anyway.
- .3 The tests would be uncontrollable. But one could say that, if the release gear is liable to fail the test, current lifeboat drills are effectively uncontrollable.
- .4 There needs to be a person inside the boat observing the test. This appears unnecessary; either the boat falls off or stays connected, there's nothing else to observe and report.
- .5 Testing should be at 110% load, whereas the Guidelines suggest testing with the boat empty. In this respect, it might be argued that for a hook which is marginally stable, the higher the load the greater the stability (and vice versa); but adequate stability is required at both ends of the load scale.

45 Despite these diverse problems and uncertainties, the available IMO documents indicate broad agreement that testing would be a valuable adjunct to the design review, allowing a more robust and informative evaluation than a design review on its own. Clearly however, much greater clarity regarding the content and conduct of such tests is needed before the Guidelines can be approved. Otherwise, wide variations of interpretation by different Administrations is inevitable.

Conclusions

46 The discussion thus far has considered the proposed new SOLAS regulation III/1.5, the proposed amendments to section 4.4.7.6 of the LSA Code, the current draft of the Guidelines and associated IMO documents relevant to the development of these proposals. Those documents focus almost exclusively on matters relating to the design and stability of existing hooks, in relation to proposed design objectives for new hooks.

47 Many other topics relating to lifeboat safety, including for example ergonomic factors, operability, seafarer training and competence, clarity of instructions, maintenance procedures and routine servicing, etc., are generally not addressed in the documents under review. Such aspects are of course vitally important for the avoidance of accidents, but their bearing on the design quality and fitness-for-purpose of existing release mechanism itself is not so clear. Nevertheless it is considered that such topics warrant consideration in seeking to improve the Guidelines document.

48 It should be noted that, to complement the documentation review discussed above, information about problems, issues, concerns, incidents, etc., associated with different types of hook has been requested from a number of sources (including ILG member organizations, ILAMA and the Paris MoU). Although some information has been made available, generally speaking very little has been forthcoming. This report has therefore been compiled on the basis of the design and operational principles involved, rather than being primarily based in a reactionary way on specific incidents and accidents with different types of hook.

49 In summary, the foregoing review leads to the following conclusions:

- .1 The Code amendments developed by DE 52 and approved by MSC 86 contain various shortcomings; and
- .2 The predominant focus in the draft Guidelines on dimensional tolerances (in part reflecting wear rates) is probably valid in principle; but
- .3 The draft Guidelines also contain several shortcomings, principally in respect of determining acceptable upper limits of wear for design approval purposes; and
- .4 Testing of individual hooks could be a valuable supplement to design reviews; but
- .5 Many details remain to be clarified in defining a satisfactory test protocol.

Discussion of potential improvements to draft Guidelines

50 The overall approach set out in the current draft of the Guidelines comprises, for each type of hook: a review of the release mechanism design; undertaken by a ship's flag State; as a desk-top exercise; based on documentation; possibly supplemented by a practical test; with results forwarded by the flag State to IMO; and the results being entered into an IMO database. As a process, this has much to commend it, not just because it has already been agreed by DE, but primarily because it is essentially logical. It is also akin to the "safety case" concept proposed in MCA's 555 report. It is therefore proposed to retain this overall approach.

51 An immediate consequence of this situation is that if the necessary documentation is not available (for whatever reason) for a particular type of release gear, the review cannot be undertaken, and that type of hook has to be consigned to the "non-compliant" category. This route is recognized in paragraph 7 of the Guidelines as currently written, but an issue arises with the timescale for replacement which, as written, could be up to 5 years away.

52 Similarly, the current draft of the Guidelines proposes, as a pass/fail criterion, compliance with the draft Code amendment paragraph 4.4.7.6.3 ("the mechanism shall be designed so that, when it is fully reset in the closed position, the weight of the lifeboat does not cause any force to be transmitted to the operating mechanism, which could cause the inadvertent release of the lifeboat"). As a key criterion, this requirement is valid in principle, because it reflects the essential requirement for "stability", which is: When the hooks are fully and properly reset, does the weight of the boat tend to open, or to close, the mechanism?

53 However, paragraph 4.4.7.6.3 is rather loosely expressed. It differentiates between (a) there being a force tending to open the mechanism, or (b) there not being such a force. What is actually required for stability is the existence of a force which tends to close the mechanism, which is not the same thing as there not being a force which tends to open the mechanism. It is therefore proposed that the Guidelines be re-worded to make this clear (this change should be similarly reflected in a change to paragraph 4.4.7.6.3 of the Code).

54 But two difficult issues remain. First, the amendment says "... shall be designed so that ...". In this respect, "designed" needs to take proper account of manufacturing quality and tolerances, together with in-service degradation (the wear issue), such that the existence of a force which tends to close the mechanism is assured, at least between 5-year major service intervals if not through-life. This should be made explicit in the Guidelines.

55 Secondly, and equally as important, how big does this "force tending to close the mechanism" need to be for adequate stability? Answering this question is akin to the question of conventional ship stability in bygone times (GM and righting levers, etc.). In the face of uncertainty (sea states, ship handling, etc.) and conflicting requirements (staying upright but not being too stiff), an empirical approach based on very large quantities of historical data became the accepted way of determining an appropriate stability criterion.

Release hook stability

56 For release mechanisms, such data (that is how much closing force is enough, but not too much) – if it exists – does not appear to be in the public domain. It is presumed that individual manufacturers of those hook types designed to have self-closing characteristics have a rational basis for deciding how much closing force to incorporate in their design (such as the "0.6 mm" in figure 2 of the draft Guidelines). The Guidelines should therefore make it a requirement that, for every hook type subjected to a design review, the manufacturer must state and justify the minimum stability criterion for that design of hook. Absence of such information could constitute another "failure" criterion.

57 It should be noted that, unlike the requirement in paragraph 4.4.7.6.2.1 of the amended Code for new hooks employing a cam, it is not suggested that existing hooks should be demonstrably stable even if the mechanism has not been fully and properly reset. A requirement for manufacturers to establish and justify a stability criterion for existing hooks is therefore less demanding than is the case for new hooks.

58 In principle, the more stability, the better. The downside is that increased stability may require greater physical effort by the operator to open the hook, with obvious ergonomic and physiological limitations (not everyone is muscleman). An industry-wide comparison

would probably generate a range of different "closing force" values for different hooks and different manufacturers, from which a reasonable best practice value could be deduced (correlation with known accident data is probably asking too much at this stage).

59 Summarizing the discussion above, the Guidelines as currently written make no provision for a "safety margin" of hook stability. Paragraph 4.4.7.6.3 of the proposed Code amendments requires only that there shall be no opening force, so a zero force option would satisfy the criterion. But zero force puts a hook on the verge of instability, which should not be considered acceptable.

60 Going back to the proposed Code amendments, paragraph 4.4.7.6.2 (which is only applicable to new hooks) does **not** preclude there being weight transmitted to the operating mechanism, for example into a connecting link, shaft, cable or cam, any of which might be restrained from opening at a location remote from the hook. But if this link, shaft, cable or cam, or its restraint, fails for any reason, the hook would become unstable.

61 It is worth noting that the phrase "... any operational conditions ..." in paragraph 4.4.7.6.2 can be interpreted as meaning: whatever the weight on the hook; whether the boat is afloat or airborne; whether it is being raised or lowered, is stopped, bouncing, swinging in the wind or being dragged by a current; whether the weather is hot or freezing, night or day; etc. As written, therefore, it does not necessarily include fault conditions or erroneous operation; if that is intended, it should be explicitly stated. Also, a stability criterion for other hook types (equivalent to the +/- 45° for hook tail and cam types) needs to be written into the Code amendments to avoid there being a loophole.

Endurance test

62 Returning to the issue of design needing to take proper account of manufacturing tolerances and in-service degradation the Guidelines as currently written refer only to "anticipated wear", various elements of wear being mentioned in different parts of the text. There's no clear distinction between what might be termed upstream and downstream wear, that is on the "loaded" and on the "operating" sides respectively of the component of the mechanism which actually restrains or releases the hook. Given that the intent is that there should be no opening force transmitted to the operating mechanism, it is wear at, and upstream of, this interface that is crucial. Downstream wear might lead to difficulties operating or resetting the hook (which, unlike upstream wear, would generally be evident to the operator), but will not affect hook stability.

63 As already indicated, design for a stable hook needs to take proper account both of manufacturing quality and tolerances on the one hand, and in-service degradation on the other hand (degradation involving corrosion and erosion as well as wear at mating, rubbing, rolling and bearing surfaces of the mechanism). The overall end result is a dimensional inexactness, or tolerance margin, which the design needs to accommodate whilst retaining the minimum stability criterion required for that design of hook, as determined and justified by the manufacturer.

64 The draft Guidelines are silent regarding how the necessary margin of dimensional inexactness should be determined. As already indicated, it is considered unreasonable to expect flag Administrations to make this assessment for a wide variety of different hook types. Instead, the Guidelines should place this responsibility squarely at the door of the manufacturers. Each manufacturer has (or should have) the information, the means and, from the point of view of fitness-for-purpose of their product, the duty to provide this crucial information.

65 From the fitness-for-purpose point of view, the design requirements are in essence straightforward. Regulations, and operational reality, require the release mechanism:

- .1 to be operable on-load (within some maximum distance from the water);
- .2 to be operated as a matter of course during routine drills; and
- .3 potentially to be operated in an emergency.

66 This emergency capability needs to be available even after numerous routine drills. Routine drills will be undertaken with just a skeleton crew on board, whereas emergency operation will usually be with the boat fully laden. Furthermore, on-load hook designs, by their nature, require there to be some load on the falls for the hook actually to open when released, and many routine releases (for example onto choppy water, or in a current, or – for understandable reasons of urgency during practice sessions – before the boat is 100% waterborne) will be undertaken with some load in the falls.

67 A realistic design case therefore comprises multiple operation of the release mechanism under partial load, followed by single operation under full load (it being assumed that, following a real emergency deployment, the lifeboat and its release mechanism would undergo thorough refurbishment). From the perspective of what is effectively an updated type approval of existing hook types, each manufacturer should therefore be required to prove fulfilment of this design requirement by means of a practical "endurance test" witnessed by the flag State representative.

68 The 5-yearly major service interval should be taken as the minimum representative timeframe although, at the manufacturer's option, this could be the life expectancy of the ship. Regulations dictate how many routine drills will occur during that time period (for some ship types custom and practice may dictate a higher frequency). It is therefore proposed that the proving test comprises successive on-load releases for 1.5 times the number of expected drills at the partially loaded condition, followed by three on-load releases at the fully loaded condition. Furthermore that:

- .1 the partial load case comprises the weight of the boat (complete with fuel, stores, etc.) plus three persons (or the minimum crew required for drills for the particular type of boat, if higher) of standard mass, times a 1.2 factor of safety; and
- .2 the full load case comprises the weight of the boat (complete with fuel, stores, etc.) plus its full complement of crew and evacuees of standard mass, times a 1.1 factor of safety.

69 Unexpected release at any stage prior to completion of this test procedure would constitute failure for this hook type. The test should be carried out on a randomly selected production version of the hook, in a similar way to existing type approval testing. In the event that the particular type of hook is no longer in production, the test should be carried out on a stock spare in the as-built condition, or on a refurbished hook comprising "new" working parts. In the event that it is not possible for the manufacturer to source or build a representative equivalent "new" hook for the purpose of the test, the design should be considered as having failed.

70 Of course, the endurance test described above reflects only one source of in-service degradation, but is in line with earlier conclusions that the predominant focus in the draft Guidelines on dimensional tolerances is probably valid in principle. Nevertheless the test

comprises a rational approach to demonstrating reasonable assurance of hook stability, at least between 5-year major service intervals if not through-life. Aspects not taken into account include corrosion and erosion, and factors such as vibration damage to pins, bearings and faces in contact. To an extent these would be covered by the safety factors (1.5 and 3 for the number of cycles, and 1.2 and 1.1 for loads) suggested for the tests. Also, from a practical point of view, these aspects may be better addressed via physical inspection of individual hooks on board, rather than by means of the on-load release type-tests proposed above.

71 This proposed endurance test for existing hook types is similar to, but significantly less demanding than, that required for new hooks in the amended paragraph 6.9.4 of IMO's Recommendation on Testing of Life-saving Appliances. In particular, the proposal above does not include a requirement for dynamic loading, and the suggested safety factors and number of loading cycles differ and would need to be agreed. However, a requirement for an endurance test for existing hooks is considered valid in principle. It is suggested above that dimensional inexactness of downstream components of the release mechanism would (or, more to the point, should) be apparent to the operator, but will not affect hook stability. This is in contrast to upstream dimensional inexactness, which has a direct effect on hook stability but is unlikely to be evident to the operator. Problems downstream could either lead to difficulties operating the mechanism to initiate release, or to difficulties when resetting the hooks in preparation for recovering the boat after release. Of these two situations, the latter is of more concern because the whole of the foregoing discussion of "wear-testing" assumes that the hooks have been fully reset.

Design review

72 An important part of the design review should be to ensure either that the boat cannot be lifted unless the hooks have been properly and fully reset, or that there is at least a clear means of indicating to the crew that the hooks have been properly and fully reset. These requirements are spelt out in the pre-current-amendment version of the Code, as paragraphs now numbered 4.4.7.6.7 and 4.4.7.6.9 in the amended Code. The draft Guidelines are silent in this respect, and it is therefore proposed to include non-compliance with these requirements as another criterion of suitability for ongoing service. However, this aspect is of secondary importance compared with hook stability, so may not warrant a corresponding change to new SOLAS regulation III/1.5.

73 This new SOLAS regulation III/1.5 adopts the dry-docking interval (normally 5 years) as the timeframe for replacement of unsatisfactory hooks, but in the light of the various failure criteria proposed so far, there seems to be justification for two categories of hook suitability or otherwise:

- .1 compliant: Those which can be retained in service indefinitely, subject to routine annual examination and 5-yearly inspection and test;
- .2 non-compliant 1: Those which can be retained in service subject to the replacement or upgrading of components that render them compliant as determined by the Administration.
- .3 non-compliant 2: Those which cannot be relied on to continue in satisfactory service and, to avoid the risk of early failure, should be replaced with more urgency than implied by the dry-docking interval (this might be considered akin to PSC detention).

74 It has already been noted that the pre-current-amendment version of the Code includes two requirements not specified in the 2003 version of the Code, specifically paragraphs 4.4.7.6.3 (hooks not to carry load unless fully reset) and 4.4.7.6.4 (crew able to check that hooks are ready to lift). There are also two other additions not specified in the 2003 version, these being the requirements for clear operating instructions (in 4.4.7.6.5; now renumbered 4.4.7.6.10) and hanging off arrangements (in 4.4.7.6.7; now renumbered 4.4.7.6.12). It appears sensible to include these aspects within the scope of the design review because (i) clear instructions go hand-in-hand with proper resetting, and (ii) it appears that some unexpected release incidents occur during servicing and may have been prevented if suitable hanging off arrangements had been in place.

75 Additionally, paragraph 4.4.7.6.6 (now renumbered 4.4.7.6.11) calls for the release control to be marked in a contrasting colour. It is proposed that this also be included in the design review, if only because any necessary modifications to the equipment are likely to be minimal.

76 It has already been noted that, although the amended Code (paragraph 4.4.7.6.8) requires corrosion resistant materials for all new hooks, the draft Guidelines do not address corrosion as being a factor in the ongoing suitability of existing hooks. This is considered to be a significant shortcoming, but it is also recognized that the proposed hook endurance testing similarly does not address corrosion.

77 It has also already been suggested that flag State inspectors would typically not be competent to assess the level of stability required by different hook designs, or their rate of wear. However, corrosion is another matter, and it is considered appropriate to expect flag State inspectors to assess the material properties of components of a release mechanism and reach conclusions about their suitability (potentially informed by physical inspection on board, see discussion of proposed practical tests below). It is therefore proposed that the flag State's design review includes consideration of materials of construction and their corrosion resistance (including coatings and maintenance issues, if also informed by a physical inspection). The outcome of this part of the design review would then stand alongside the situation relating to the other factors discussed above (i.e. hooks unable to carry load unless fully reset; crew able to check that hooks are reset; adequacy of operating instructions; and hanging off arrangements).

78 In summary, it is considered that the design review should comprise three elements:

- .1 submission by the manufacturer, for review by the flag State, of documents specifying and justifying the minimum stability criterion for that design of hook (see paragraph 56 above);
- .2 conduct of a practical endurance test, witnessed by the flag State representative, to demonstrate fulfilment of design objectives despite in-service degradation of hook components (see paragraphs 60 to 69 above); and
- .3 submission by the manufacturer, for review by the flag State, of documents defining the degree of compliance or otherwise with paragraphs 4.4.7.6.7 to 4.4.7.6.14 (as renumbered in the current draft LSA Code amendment) inclusive (see paragraphs 73 to 78 above).

79 To be categorized as a "compliant" hook would require successful performance in all three respects. Failure in respect of the stability demonstration **or** the endurance test (**or** the absence of any or sufficient documentation) would inevitably constitute consignment to the "non-compliant" category.

Other matters

80 In the light of the above, it is considered that including diagrams of a few typical release mechanisms in the Guidelines is of limited value. Such diagrams are the sort of material that should be provided (although in significantly more detail) by manufacturers to flag States as part of the design review process for each particular hook type.

81 However, it would be helpful for the Guidelines to differentiate between "latching" and "locking". Latching the mechanism in the closed state signifies that the hook is restrained from opening until the latch is activated, after which the mechanism will open under the influence of the weight of the boat. Locking signifies that there is also a device which prevents activation of the latch until it has itself been activated, i.e. the lock needs to be de-activated in order to activate the latch. Thus releasing the mechanism requires unlocking followed by activation of the latch. In this respect, the draft Guidelines are misleading. The design shown in figure 2 is self-latching, not self-locking. Providing a mechanism satisfies the stability criterion and passes the endurance test, inserting a safety pin into the operating lever would constitute a locking device. Similarly a hydrostatic interlock could constitute a locking device, but only when the boat is not waterborne. For new hooks, there may be a justification for requiring both a latch and a locking device, to be effective at all times.

Fall prevention devices

82 Paragraph 7 of the draft Guidelines suggests that, for non-compliant release mechanisms, additional safety measures including the use of fall prevention devices (FPDs) should be employed until the hooks are replaced. However it is understood that, despite MSC.1/Circ.1327, certain hook manufacturers have issued policy statements strongly discouraging the use of FPDs.

83 In this regard, it can be observed that fitting an FPD of the strop variety need not involve any modification to the lifeboat release gear or davits: no pins, no holes, no brackets, no welded lugs, nothing except possibly attaching shackles to the hook housing. If the lifeboat is then lowered and launched properly, the only additional task for the boat's crew is to unshackle (and subsequently reconnect) the strops – a simple seamanship task that should pose no difficulty for a trained seafarer. Assuming the drill proceeds without incident, no unusual or additional loads will be imposed on the boat or its launching equipment.

84 However, if unintended or premature release were to occur, the strops would reduce the likelihood of serious consequences, potentially saving lives. If such unintended or premature release were due to incorrect operation, crew error, faulty or inadequate maintenance, etc., no liability would fall upon the hook/davit manufacturer, even if the boat, hook or davit structures failed as a result of the shock loading experienced as the strops took the load. A manufacturer's policy statement discouraging the use of FPDs on the grounds that their equipment is not designed for the resulting shock loads is therefore superfluous. On the other hand, if unintended or premature release were due to design, manufacturing or OEM servicing shortcomings, the manufacturer could be reassured that the likelihood of severe consequences would be reduced by the use of an FPD.

The MCA 555 report findings

85 As indicated at the outset of this report, the scope of the review that has been undertaken includes consideration of the findings of the MCA research study 555 report. Three aspects of that report appear to be particularly relevant with regard to the draft Guidelines:

- .1 Paragraph 0.3.3 (from the summary of recommendations);
- .2 Paragraph 2.2.3 (from the section discussing accident investigation reports); and
- .3 Paragraph 4.2.3 (from the section proposing a design specification).

86 Paragraph 0.3.3 of the 555 report states:

"We further recommend that all lifeboat on-load release hooks are demonstrated to be safe and fit for purpose by means of a safety case regime. This regime should comprise a design safety case for each type or make of hook, supplemented by an operational safety case incorporating the design safety case but extended to interface with ship-specific safety management arrangements."

As already mentioned, the general approach adopted in the draft Guidelines, comprising a generic design review supplemented by an installation-specific test, bears a reasonable resemblance to the safety case approach recommended in the 555 report. However, one important feature of a safety case is that the design assessment should be undertaken against clearly defined safety objectives, expressed in goal-setting terms. By introducing specific hook stability requirements (see paragraph 56 above), and specific endurance requirements (see paragraphs 67 and 68 above), the proposed amendments to the content of the Guidelines do exactly that.

87 Paragraph 2.2.3 of the 555 report states, *inter alia*:

"... If commonality of cause can be identified, then it would be 'fitness for purpose', in terms of the suitability of the lifeboat launching equipment for routine launch and recovery in a shipboard environment, in accordance with regulatory requirements. Here, fitness for purpose implies compatibility of function, design, maintenance, training and operation in the context of equipment exposed to the rigours of marine application. These rigours can include extremes of weather, a harsh operating environment, inaccessibility, reduced manning and minimal crew qualifications."

This statement explicitly links the technological design of launching equipment to the reality of the environment in which the equipment will be used. In so doing, maintenance, training and operational issues were highlighted but, recognizing that these aspects were being addressed through parallel initiatives at IMO, they were not pursued in greater detail in the 555 report. Nevertheless, some of these issues were included in the 555 report's outline requirements specification, as discussed below.

88 Of course, these "soft" aspects of the safety of ships' lifeboats are easier to address in the context of new, rather than existing, hooks. Existing equipment is inevitably constrained by the legacy of its genesis. This situation is reflected in the draft Guidelines for existing hooks which, as currently written, seek compliance with only selected clauses of the new hooks Code. For existing hooks, however, the maintenance, training and operational environment to which their use has been subjected has a significant impact on their reliability. It is therefore considered that these factors should be taken into account when assessing the degree to which existing hooks are likely to remain fit for purpose.

89 Thus: the ease with which crew members are able to establish whether the release mechanism has been fully reset; the clarity of the operating instructions provided for the crew; the arrangements for safely undertaking maintenance work; and the certainty of properly identifying the release control handle; combined with the extent and severity of

corrosion (and its implied quality of preventative maintenance), are all factors which it is suggested can and should be considered when assessing the suitability of the mechanism for ongoing service. Hence their inclusion in the proposed amendments to the draft Guidelines, such that the criteria for existing hooks reflects a significantly wider range of the "new hook" requirements of the amended Code (see paragraphs 75 to 78 above).

90 To this end, the concept of examining every individual hook, in addition to undertaking a design review of each hook type is endorsed. However, it is considered that this examination should take the form of an inspection of every hook, rather than the stability test currently outlined in the draft Guidelines. Conducting a stability test on every hook, in the context of a ship in operational service, would introduce additional hazards and could be fraught with difficulties. On the other hand, such a test would be of negligible additional value compared with information coming from the design review summarized in paragraph 79 above, covering "type-justification" of stability criteria coupled with endurance test results, supplemented by the professional assessment by flag State inspector, as outlined in paragraph 78 above.

91 The purpose of inspecting every hook, therefore, would be explicitly to assess the extent to which each existing hook fulfils these softer requirements, both generally and in respect of the specific Code requirements for new hooks, given the reality of the accumulated effect over time of the operating environment referred to in paragraph 2.2.3 of the 555 report. Thus lifeboat release mechanisms on a ship operating with well trained crew and effective safety management and maintenance regimes, are likely to score more highly than the same equipment on a ship operated under a lax regime. Furthermore, reliance on the experience and judgement of the flag State inspector is appropriate for these aspects. Coupled with the outcome of the type-specific design review summarized in paragraph 79 above, such hook-specific inspections should provide a robust overall assessment of the suitability of each hook release mechanism for ongoing service.

92 This hook inspection, as a supplement to the design review, would be undertaken on a one-off basis in conjunction with, and no later than, the next scheduled annual examination of each lifeboat's release gear. The outcome of this once-off examination, enhanced specifically to include the aspects outlined in paragraph 90 above, when combined with the outcome of the type-specific design review would dictate the categorization of individual hooks (in accordance with paragraph 74 above) and the associated replacement timescale.

93 Paragraph 4.2.3 of the 555 report sets out proposed design requirements, and was intended to apply to new hooks. Many, although not all, aspects can be applied in the context of existing hooks, as discussed below:

- .1 the purpose should be specifically defined to include operation during routine drills as a primary function: Achieved by introducing the endurance test to simulate repeated use during drills and thus confirm the ability of the release mechanism design to maintain stable characteristics despite the resulting wear.
- .2 realistic operating profile should be established, covering intended functions (including deployment, launch, recovery and lifting back on board into stowage), frequency of use, inspection periods, etc.: Achieved by defining the parameters of the endurance load test (load cases and number of repeat test cycles).

- .3 hook behaviour should be stable, such that all foreseeable mechanical faults or human errors leave the hook in a closed (and therefore safe) condition: Achieved in principle by introducing the requirement for manufacturers to define and justify the minimum stability criterion applicable to each particular type of hook; the Guidelines could additionally indicate the range of fault conditions that manufacturers need to consider when establishing their stability criteria (akin to the +/- 45° criterion in 4.4.7.6.2.1).
- .4 safety performance should be explicitly established as a design objective through incorporation of design risk criteria in the equipment specification: Acceptance of explicit safety performance criteria within the international shipping industry is not yet commonplace (for example, see the FSA debate regarding acceptable levels of risk). However, given that lifeboat drills are required by IMO legislation, accidents during drills often lead to serious consequences, and safety improvements are known to be achievable, there remains an imperative to reduce risk irrespective of any acceptance criteria.
- .5 these risk criteria should apply to the lifeboat launching system as a whole, and reflect (or improve on) the HSE tolerability criteria: Not applicable, see (d) above.
- .6 no single failure should lead to catastrophic consequences (these being defined as loss of control of the system, or incidents exposing operating staff or others to risk of injury): This is difficult to achieve with typical existing arrangements for lifeboat systems and their associated launching equipment; it is only really applicable if starting afresh to design entirely new abandonment concepts for ships.
- .7 safety performance metrics should be identified to demonstrate through tests and analysis that intended performance can be achieved: Achieved by introducing the requirement for manufacturers to establish and demonstrate specific hook stability criteria and carry out the defined endurance testing.
- .8 these metrics should include frequency rates for different failure modes and consequences, so as to demonstrate performance relative to risk acceptance criteria: Difficult, especially for existing hooks, in the light of comments at (d), (e) and (f) above.
- .9 the design should be such that simultaneous opening of both hooks of the twin-fall system will occur when required with a sufficiently high reliability for specified risk criteria to be achieved: Although a requirement for simultaneous opening already exists (as clause 4.4.7.6.1 of the LSA Code), the intent of this aspect of the 555 report was to establish an explicit performance requirement in terms of operational reliability of the equipment, despite the potential for known real-life problems to occur (friction, corrosion, jamming, metal fatigue, etc.); unfortunately the shipping industry generally lags behind other industrial sectors in terms of recognizing the benefits of collecting, collating and making use of reliability data for equipment operating in the marine environment. Like the acceptance of explicit safety performance criteria, reliability engineering is still some way off for the international shipping industry.

- .10 appropriate safety assessment techniques, including hazard identification, risk assessment and cost-benefit analysis should be used in design: Difficult to achieve in respect of existing hooks, but there is no reason why these well established tools should not be used by manufacturers when establishing and justifying the minimum stability criteria for each type of hook.
- .11 for example, failure modes, effects and criticality analysis techniques (FMECA) could be adopted to identify all possible fault and failure modes, including material failures, mechanical failures, human error and procedural violations: Similarly difficult to achieve for existing hooks, except in regard to manufacturers establishing minimum stability criteria.
- .12 consideration should be given in the design to ergonomic aspects of the man-machine interfaces involved in launching and recovering lifeboats, and to the need for visibility and accessibility of components for inspection purposes: Addressed in part by including individual hook assessments of (i) the ease with which crew are able to check that hooks are ready to lift (see paragraph 75 above) and (ii) the ease with which the release control can be uniquely identified (see paragraph 76 above).
- .13 realistic allowances should be included in design for in-service degradation through corrosion, erosion, vibration, electrolytic action, wear, etc.: Addressed in large measure by inclusion of (i) the endurance test and (ii) corrosion assessments of individual hooks.
- .14 geometrical compatibility of fit between components which are not intended to be compatible should be prevented: Not so far considered in this review, but could be included within the scope of the individual hook inspections and assessments discussed in paragraph 92 above.
- .15 safe systems of work should be established for all intended operations, taking account of manual handling aspects, operating limits, weights, etc.: Could readily be addressed in part during the individual hook inspections and assessments discussed in paragraph 92 above, through suitable wording in the Guidelines.
- .16 competence requirements for operation, inspection, servicing and maintenance should be established: Could similarly be readily addressed in part during the individual hook inspections and assessments discussed in paragraph 92 above, through suitable wording in the Guidelines.

94 To the extent it is reasonably practicable to do so, and subject to the inclusion of suitable wording within a revision to the draft Guidelines, it is therefore considered that many of the key principles set out in the 555 report can be implemented.

Summary

95 This review has sought to identify potential improvements to the IMO's draft Guidelines for Evaluation and Replacement of Lifeboat On-load Release Mechanisms, taking account of relevant documents submitted to recent DE and MSC sessions coupled with the findings of the MCA's research project 555. Potential areas for further improving the recent LSA Code amendments have also been identified. It is concluded that there is justification for significantly strengthening the proposed design review described in the current draft Guidelines, and for modifying the proposed appraisal of individual hooks.

96 In particular, it is proposed that the type-specific design review should comprise three elements, these being requirements for the hook manufacturer to:

- .1 establish and justify a stability criterion for each type of hook;
- .2 subject a "production" version of each type of hook to an endurance test;
and
- .3 define the extent to which each type of hook complies with various requirements now included in the Code for new hooks.

97 It is further proposed that, in lieu of the stability test currently described in the draft Guidelines, the type-specific design review is supplemented by individual hook-specific enhanced inspections to assess a variety of operational matters.

98 The role of the flag State Administration would then be to consider the documentation provided as part of the design review and enhanced inspection, and assign one of two categories to each individual hook, depending on the suitability of the hook for ongoing service and/or the timescale for its replacement.
