

**International Association of Classification Societies
(IACS)**

**FSA of Bulk Carriers
Fore-end Watertight Integrity**

**Annex 9
Risk Control Options from literature**

Reference	RID	RCM	Effect	Assumption/Reasoning	Application/Condition Description
A Summary of UK/EC Assessors' Report					
	Para. 46	The longitudinal strengths of hulls should be tested under short crested very high wave conditions with the crest at a number of positions along the length. Resulting shear and bending stresses should be judged against lower structural safety factors reflecting the lower probability of occurrence of such events, I.e. survivability.	High longitudinal strengths of hulls?		
	Para. 44	To design ships to provide for survivability under extreme weather conditions.	Ships can survive under extreme weather conditions.		
	Para. 45	To examine redundancies within structures in the desing process.	Ships can have more redundancies within structures.		
	Para. 47	Making a double skinning mandatory in all new bulk carriers.	To reduce accidents caused mainly by single skinning in cargo holds.		
	Para. 48	To provide 'stoppers' not to cause loss of steering ability by way of redundanceis in steering gear and main propulsion systems.	To avoid dangerous situation such that loss of steering ability occurs in th high seas or close to land.		
IACS UR					
	S 12.3, 12.4	To increase minimum thickness of frame webs, and lower and upper brackets (for hold frames in single side skin bulk carriers)	More redundancies against corrosion		
	S12	Improving the strength of side structures by the UR S12.	To eliminate the possibility of flooding of the cargo hold due to cracking of the single side skin structure (side shell plating) and to further strengthen the safety of the first barrier against flooding.		
	S17	Enhancement of LONGITUDINAL STRENGTH OF HULL GIRDER IN FLOODED CONDITION FOR SINGLE SIDE SKIN BULK CARRIERS	Ensuring that longitudinal strength is to be sufficient enough to sustain the continued voyage in cases where any one cargo hold is flooded to the maximum equilibrium condition.	The longitudinal bending moment and shearing force emanating from the wave load are assumed as 80% of the value set out in UR S11 (the value equal to the manifested ratio of 10-8, and is proportional to the	To apply to all new single side skin bulk carriers of 150m in length or above contracted for construction on or after 1 July 1998, intending to carry solid

				most probable maximum lifetime wave load) , and are required to conform with the requirement of UR S11.	bulk cargoes having cargo density of 1.0t/m3 or above.
	S18	Enhancement of strength of corrugated transverse watertight bulkhead in the flooded condition.	Ensuring that vertically corrugated transverse watertight bulkheads are to be sufficient enough to sustain the water pressure caused by flooding of any one cargo hold.		
	S21	IACS UR S21 "Evaluation of Scantlings of Hatch Covers of Bulk Carrier Cargo Holds"	Reduce the potential for structural damage of Hatch Cover		
	Z.9	Corrosion Protection Coatings for Cargo Hold Space	Preventing corrosion		
	Z10.2	To enhance survey programme regarding thickness measurement of plates and close-up surveys of primary scantlings. (ESP)	To detect critical diminution of scantling more effectively.		
MSC69/2/1/Ad d.5	Para. 9.1	Using Formal Safety Assessments (FSA)	Provide 'stoppers' in the sequence of loss.		
MSC69/2/1/Ad d.5	Para. 9.2	Introducing a safety design regime which provides fro survivability under extreme weather conditions. (Designs for extreme weather conditions)	Ships can survive under extreme weather conditions.		
MSC69/2/1/Ad d.5	Para. 9.3	Changing Design Philosophy so that rule become more rigorous in terms of both stress and stiffness flow through structures with guidance for design, working practices and material choices and that examination of reduncancies with structures become form part of the design process.	More suvivability.		
MSC69/2/1/Ad d.5	Para. 9.4	Making a double skinning mandatory in all new bulk carriers. (Double skin plating in way of holds)	Removing the obvious failings of single skin hold designs.		
MSC69/2/1/Ad d.5	Para. 9.5	To provide 'stoppers' to prevent loss of steering ability (Loss of steering ability)	To get rid off dangerous situation such that loss of steering ability occurs in high seas or close toland.		
MSC69/2/1/Ad d.5	Para. 9.6	To review to ensure that vulnerable fittings and spaces are properly protected from green sea impact and take proper actions to introduce the new requirements for them.	To avoid flooding of spaces forward of the collision bulkhead.		
MSC69/2/1/Ad d.5	Para. 9.7	Protected under deck access to fore deck.which also provide protection to alarm and monitoring systems and other essential servies. (Fore deck and fore end spaces)	Crew can access fore deck in order to effect remedial action even in severe weathers, when the event of failures occurs at the forward end of low free board vessels.		

MSC69/2/1/Ad d.5	Para. 9.8	To revise the rule in order to address the overall structural strength of covers but also the coamings themselves and the 'sailor friendliness' of the design of attachments. (Hatch covers)	To provide the first line of defence against water ingress and sinking.		
MSC69/2/1/Ad d.5	Para. 9.9 (Item No.1 of 7)	Ventilator and air pipe design, positioning and protection	(See UK/EC A.R. 8.46)		
MSC69/2/1/Ad d.5	Para. 9.9 (Item No.2 of 7)	Spurling pipes	(See UK/EC A.R. 8.47, 8.48)		
MSC69/2/1/Ad d.5	Para. 9.9 (Item No.3 of 7)	Tank sounding systems	(See UK/EC A.R. 8.49, 8.50)		
MSC69/2/1/Ad d.5	Para. 9.9 (Item No.4 of 7)	Bilge alarms	(See UK/EC A.R. 8.51)		
MSC69/2/1/Ad d.5	Para. 9.9 (Item No.5 of 7)	Means of emergency pumping	(See UK/EC A.R. 8.52-8.57)		
MSC69/2/1/Ad d.5	Para. 9.9 (Item No.6 of 7)	Access hatches	(See UK/EC A.R. 8.58-8.61)		
MSC69/2/1/Ad d.5	Para. 9.9 (Item No.7 of 7)	Fore deck lighting	(See UK/EC A.R. 8.62)		
MSC72/INF.4 ANNEX	1.1.1. 1	Independent check of coating suitability during design and construction	Prevent applying incorrect coating specification and consequently		

			prevent rapid corrosion		
MSC72/INF.4 ANNEX	1.1.2.1	Independent check of coating application	Keep adequate coating quality and consequently prevent rapid corrosion		
MSC72/INF.4 ANNEX	1.1.3.1	Visual inspection of cargo hold by ship staff after each cargo discharge and touch up the coating damage, if any	Keep coating intact and consequently prevent rapid corrosion		
MSC72/INF.4 ANNEX	1.1.4.1/1.1.4.2	Visual inspection of cargo hold/ballast spaces by ship staff and touch up the coating damage, if any	Keep coating intact and consequently prevent rapid corrosion		
MSC72/INF.4 ANNEX	1.1.5.1	Maintenance the hull structure in accordance with planned maintenance program	Keep structural soundness		
MSC72/INF.4 ANNEX	1.1.5.2/3.1.1	Periodically surveyed by Class surveyor in accordance with Enhanced Survey Program	Detect the poor maintenance or structural failure and consequently keep structural soundness		
MSC72/INF.4 ANNEX	1.2.1.1/1.3.1.1	Plan approval by Class Society regarding to hull/hatch cover construction	Detect and correct the potential for structural damage		
MSC72/INF.4 ANNEX	1.2.1.2/1.3.1.2	Feeding back the damage experience to design criteria	Reduce the potential for structural damage		
MSC72/INF.4 ANNEX	1.2.1.3/1.3.1.3	Surveyed by Class surveyor during construction or repairing (especially to materials)	Prevent using wrong material/scantling and consequently reduce the potential for structural damage		
MSC72/INF.4 ANNEX	1.2.1.4/1.3.1.4	Surveyed by Class surveyor during construction or repairing (especially to workmanship)	Detect and correct poor workmanship and consequently reduce the potential for structural damage		
MSC72/INF.4 ANNEX	1.2.2.1	Watch the cargo loading/unloading according to approved Loading manual or approved Loading sequence	Avoid the action of excessive shear forces and/or bending moments		
MSC72/INF.4 ANNEX	1.2.2.1	Using Loading instruments	Avoid the action of excessive shear forces and/or bending moments		
MSC72/INF.4 ANNEX	1.2.3.1/1.2.3.2/1.3.3.2	Avoiding the voyage in rough weather with applying weather routine	Avoid excessive stressing to the hull		
MSC72/INF.4 ANNEX	1.2.3.1/1.2.3.2	Applying hull stress and motion monitoring system	Detect the abnormal stress on hull during voyage		

	3.2/1. 3.3.1/ 1.3.3. 2/1.3. 3.3/1. 3.3.4				
MSC72/INF.4 ANNEX	1.3.2. 1/1.1. 3.1/1. 3.3.2/ 1.3.3. 3/1.3. 3.4	Visual checks by crew and Class periodical surveys	Detect and repair of structural damage in Cargo Hold		
MSC72/INF.4 ANNEX	1.3.3. 1/1.3. 3.2/3. 1.1	Providing Forecastle or breakwater on forward deck	Protect No.1 Hatch and forward access hatch from green water		
MSC72/INF.4 ANNEX	1.3.3. 3/4.1. 2/4.1. 9/4.1. 10	Fitting Bilge alarms	Early detection and countermeasure against water ingress		
MSC72/INF.4 ANNEX	1.3.4. 1	Having a Ballast Water Exchange management plan, where each step in the plan has been checked for resonance effects.	Prevent severe sloshing caused by resonance with ship motion		
MSC72/INF.4 ANNEX	1.3.4. 2/1.3. 4.3	To establish strict procedures within the BWE management plan	Prevent blockage of air pipes and/or unintentional use of excessive pumping capacity and consequently avoid excessive pressure to ballast water tanks		
MSC72/INF.4 ANNEX	1.3.4. 4	Reassessment of existing requirements regarding to Ballast Water Exchange operation	Avoid inadequate/erroneous soundings (ship motions) and consequently prevent arising excessive loads and stresses during BWE operation		
MSC72/INF.4 ANNEX	2.1.1	Plan approval by Class Society regarding to hatch cover securing system	Reduce potential for ingress of water resulting from the failure of individual cleats or seals.		
MSC72/INF.4 ANNEX	2.2.1	Visual inspection before ship leaves the port regarding to handling of hatch cover securing system	Prevent ingress of water resulting from the failure of individual cleats or seals		

MSC72/INF.4 ANNEX	2.2.2	Reassessment of existing requirements regarding to hatch cover securing system	Reduce potential for ingress of water resulting from the failure of individual cleats or seals.		
MSC72/INF.4 ANNEX	2.3.1/ 2.3.2/ 2.3.3/ 3.2.1	Visual observation of rust effects and condition of seal. Chalk test. Hose test. Operability test. Class and statutory surveys.	Reduce the potential for ingress of water		
MSC72/INF.4 ANNEX	2.4.1	Inspections prior to and after heavy weather	Detection of loosening of securing arrangements due to hull deflections and consequently reduce the potential for ingress of water		
MSC72/INF.4 ANNEX	3.1.2/ 4.1.7/ 4.1.8	Observation by crew during routine inspection prior to bad weather	Avoiding the access hatch cover/pipes/ventilators left open by crew (for convenience or by mistake) or automatic closure fails to operate		
MSC72/INF.4 ANNEX	4.1.1/ 4.1.2/ 4.1.3/ 4.1.4/ 4.1.5	Observation by crew and inspection by Class and statutory surveyor regarding to pipings penetrating weather deck and their closing devices	Prevention of water ingress to spaces below weather deck through pipe systems		
MSC72/INF.4 ANNEX	4.1.10	Fitting Control panel indicator	Early detection and countermeasure against maloperation		
MSC72/INF.4 ANNEX	4.2.1	Visual observation. Class and statutory surveys	Detecting and correcting the poor maintenance and consequently reduce potential for ingress of water		
MSC72/INF.8 ANNEX	1.1.1. 1/1.1. 1.2	Enhanced Survey Program (ESP)	Detecting and being able to take measure for thickness diminution of structural members including welding parts		
MSC72/INF.8 ANNEX	1.1.5. 1/1.1. 5.2	Loading Computer (Loading Instruments)	Avoiding excessive hull girder bending moment/ shearing force/ torsional moment		
MSC72/INF.8 ANNEX	4.1/4. 2/4.3/ 4.4/4. 5	Tank sounding (using sounding pipe)	Detection of water ingress to tanks		
MSC72/INF.8 ANNEX	4.1/4. 2/4.3/ 4.4/4. 5	Bilge alarms	Early detection of water ingress		

Others	SOLAS Ch.II-1/Reg.3-2.2	To require effective corrosion prevention of seawater ballast tanks and approval by the Administration of the scheme for the selection, application and maintenance of the system.			
SOLAS XII	Regulation 10	This regulation states that prior to the loading of any bulk cargo, the shipper must declare the solid bulk cargo density. Any cargo which is declared to have a density within the range 1.25 to 1.78 tons per cubic meter is to have its density verified by an accredited testing organization.			
SOLAS XII	Regulation 11	This regulation states that all bulk carriers are to be fitted with a loading instrument which satisfies the requirements of an organization recognized by the flag State Administration, or the Administration.		The functional capabilities of the loading instrument are set forth in Conference resolution which refers to IACS Recommendation No. 48.	including existing bulk carriers which are 150 meters in length or over
SOLAS XII	Regulation 4	To stipulate that existing bulk carriers shall be able to withstand flooding of the foremost cargo hold in all loading conditions and remain afloat in a satisfactory condition.	Existing bulk carriers can withstand flooding of the foremost cargo hold in all loading conditions and remain afloat in a satisfactory condition.		
SOLAS XII	Regulation 4	To stipulate that new bulk carriers shall be able to withstand flooding of any one cargo hold in all loading conditions and remain afloat in a satisfactory condition of equilibrium. (Damage stability requirements applicable to bulk carriers)	New bulk carriers can withstand flooding of any one cargo hold in all loading conditions and remain afloat in a satisfactory condition of equilibrium.		
SOLAS XII	Regulation 5	To stipulate that new bulk carriers shall have sufficient strength to withstand flooding in any one cargo hold in all loading and ballast conditions.		Refer to IACS UR S17, S18 and S20.	
SOLAS XII	Regulation 6	To stipulate that the foremost cargo hold of existing bulk carriers shall have sufficient strength to withstand flooding.		The strength criteria for the transverse bulkhead and double bottom structure was prepared based on IACS Urs S19 and S22.	Existing bulk carriers of 150m in length or above carrying solid bulk cargo having density of 1.78t/m ³ or above.

SOLAS XII	Regulation 7	To prohibit a bulk carrier of 150 m in length and upwards of single side skin construction, of 10 years of age and over, from carrying solid bulk cargoes having a density of 1.78 tons per cubic meter and above. Unless it has satisfactorily undergone either:		Unless it has satisfactorily undergone either; 1) a periodical survey in accordance with the enhanced survey programme of inspections required by regulation XI/2; or 2) a survey of all cargo holds to the same extent as required for periodical surveys in the enhanced survey programme of inspections required by regulation XI/2.	
SOLAS XII	Regulation 8	To stipulate that the booklet required by regulation 7.2 in Chapter VI shall be endorsed by the Administration.	The booklets become auditable.		

SOLAS XII	Regulation 9	To stipulate that existing bulk carriers constructed with an insufficient number of transverse watertight bulkheads, and self-unloading bulk carrier of which transverse bulkhead is not watertight due to the presence of tunnels for self-unloader, may be exempted by the Administration from the application of regulations 4.2 and 6.		<p>On condition that they comply with the following requirements:</p> <p>.1 Degree of annual surveys of the foremost cargo hold is to be upgraded to the extent required by the inspection prescribed in the enhanced survey programme, therein for intermediate surveys of cargo holds.</p> <p>.2 Such bulk carriers are to be provided with bilge well high water level alarms in all cargo holds, or in cargo conveyor tunnels, as appropriate. These alarms are to give an audible and visual alarm on the navigation bridge, as approved by the Administration or an organization recognized by it.</p> <p>.3 Detailed information is to be provided on specific cargo hold flooding scenarios. This information is to be accompanied by detailed instructions on evacuation preparedness based on the ISM Code, and is to be used as the basis for crew training and drills.</p>	
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