

ANNEX 4 HAZARD IDENTIFICATION

1. Summary

This paper presents, to the Committee, an interim report of the part of HAZID of FSA study on bulk carrier safety that is being carried out by Japan. The interim report of Japanese FSA study on bulk carrier safety is submitted by Japan separately.

2. Method and techniques used to carry out STEP 1

The HAZID Worksheet was developed by HAZID meetings and by correspondence within the research committee for FSA study of bulk carrier safety that is established in Shipbuilding Research Association of Japan. Details of the research committee are described in a separate information paper about the FSA study submitted to the Committee.

3. Interim Results of STEP 1

The HAZID Worksheet has not been completed yet. In order to narrow the range of HAZID works at this stage, capesize bulk carries with single side skin were focused on. The accident categories covered in the report are as follows and HAZID worksheets for rest of accident categories will be developed in near future.

- Accident Category 1: Structural Failure of Cargo Hold Part
- Accident Category 2: Structural Failure of Fore End Part
- Accident Category 3: Structural Failure of Aft End Part
- Accident Category 4: Water Ingress through Openings

In order to rank identified hazards, Frequency Index (F.I.) and Severity Index (S.I.) are defined as shown in Table 1 and Table 2 respectively. It is difficult to put into figures into F.I. and S.I. columns to each identified hazard. This work is on going and will be finished in a month or so.

The interim HAZID worksheets are attached to this interim report.

Table 1 Definition of Frequency Index

Frequency Index (F.I.)	Frequency	Definition	per ship-year
1	Extremely Remote	- Likely to occur several times in 10 years in the world fleet of bulk carriers (about 5000 ships)	equal or less than 0.0001/ship-year
2	Remote	- Likely to occur several times per year in the world fleet of bulk carriers (about 5000 ships)	0.001/ship-year
3	Reasonably Probable	- Likely to occur once in 10 years in a bulk carrier,	0.1/ship-year
4	Frequent	- Likely to occur yearly or more frequently in a bulk carrier	equal or more than 1.0/ship-year

Table 2 Definition of Severity Index

Severity Index (S.I.)	Severity	Definition	Number of Fatalities
1	Insignificant	- Failure that can be readily compensated by the crew - No significant harm to people, property or the environment	0.01
2	Minor	- Local damage to ship - Marginal conditions for, or injuries to, crew	0.1
3	Major	- Major casualties excluding total loss - Single fatality or multiple severe injuries	1
4	Catastrophic	- Total loss (actual loss and constructive total loss) - Many fatalities	10

Table-3 Risk Matrix for Bulk Carrier FSA Study

7	Frequent	Level 4	Level 3	Level 2	Level 1
6		Level 5	Level 4	Level 3	Level 2
5	Reasonably	Level 6	Level 5	Level 4	Level 3
4		Level 7	Level 6	Level 5	Level 4
3	Remote	Level 8	Level 7	Level 6	Level 5
2		Level 9	Level 8	Level 7	Level 6
1	Extremely Remote	Level 10	Level 9	Level 8	Level 7
F.I.		Insignificant	Minor	Major	Catastrophic
	S.I.	1	2	3	4

Table 4 Result of Screening of the identified hazards

N	ID	R.I.	Level	HAZARD	MOD
1	1.1.3.1	7.86	4	Dents on inner bottom plate. side shell structure. hopper plate and BHD	Load
2	1.1.4.3	7.71	4	Excessive impact load to forward side shell structure (in No.1 cargo hold)	All
3	1.1.1.1	7.29	5	Rapid corrosion of hold frame	All
4	1.1.4.1	7.29	5	Extreme dynamic sea water pressure to side shell of cargo holds (without counter pressure by cargo)	All
5	1.4.3.2	7.00	5	Dents on tank top plate (inner bottom plate)	Load
6	1.1.1.2	6.64	5	Rapid corrosion of side shell (including welding bead)	All
7	1.1.5.1	6.64	5	Excessive hull girder bending moment/ shearing force	All
8	1.1.3.2	6.57	5	Dents on hatch cover top	Load
9	1.1.1.3	6.50	5	Rapid corrosion of transverse bulkheads including lower and upper stools	All
10	1.1.1.5	6.50	5	Rapid corrosion of cargo hatch coaming	All
11	1.4.1.2	6.50	5	Rapid corrosion of bottom shell plate underneath bellmouth/sounding pipes	All
12	2.2.4.1	6.50	5	Excessive wave load to foremost exposed deck	All
13	1.2.1.1	6.43	6	Rapid corrosion of structural members	All
14	1.3.3.2	6.42	6	Dents on hopper plate	Load
15	1.1.2.1	6.36	6	Excessive (/Over) Stress concentration at hold frame bracket end	All
16	1.1.4.2	6.36	6	Excessive wave impact load on cross deck	All
17	2.2.4.2	6.36	6	Excessive wave impact load to foremost shell structure	All

18	1.2.4.3	6.31	6	Excessive water pressure in ballast tanks at ballast water exchange operation	WBE
19	4.1.1.	6.31	6	Water Ingress through chain pipe	All
20	1.1.2.7	6.29	6	Stress concentration at hatch coaming end bracket	All
21	1.3.1.1	6.25	6	Rapid corrosion of structural members	All
22	1.1.1.4	6.21	6	Rapid corrosion of cross deck	All
23	1.1.2.8	6.14	6	Stress concentration on hatch coaming (e.g. securing device support, etc.)	All
24	1.2.2.2	6.10	6	High Stress at the corner of trans-ring	All
25	1.4.4.1	6.07	6	Excessive impact load to forward bottom shell structure	Ballast
26	1.3.4.2	6.00	6	Excessive water pressure in ballast tanks at ballast water exchange operation	WBE
27	2.2.3.1	6.00	6	Dents on side shell plate	Anchoring
28	1.2.4.1	5.93	6	Excessive wave impact load on upper deck	All
29	2.1.1.3	5.93	6	Rapid corrosion of bottom shell plate underneath bellmouth/sounding pipes	All
30	1.4.2.1	5.92	6	Stress concentration at bottom/inner bottom longitudinal	All
31	1.4.2.2	5.92	6	Stress concentration at girders and floors	All
32	1.3.2.4	5.91	6	Stress concentration at connection of bilge hopper tank sloping plate and inner bottom plate	All
33	2.1.1.2	5.86	6	Rapid corrosion of side shell (including welding bead)	All
34	1.1.2.9	5.86	6	Excessive (/Over) additional stress to fore most side shell structure by forced displacement (in No.1 cargo hold)	All
35	2.3.1.1	5.86	6	Rapid corrosion of wall and top/bottom plate	All
36	1.4.3.1	5.79	6	Dents on shell members in way of double bottom tank	All
37	1.3.3.1	5.75	6	Dents on shell plate in way of bilge hopper tank	All
38	1.3.5.1	5.75	6	Excessive hull girder bending moment/ shearing force	All
39	1.2.2.1	5.73	6	Stress concentration at lowest side longitudinal	All
40	1.3.2.1	5.73	6	Stress concentration at side/bottom/hopper longitudinal	All

HAZID Worksheet

Accident Category 1

Structural Failure in Cargo Hold Part

ID	Hazard Description / Hazardous Situation	Phase	Cause	Effect	Detection	Scenario / Accident Sub-category	Regulation	F.I.	S.I.	Remarks (including Frequency of Hazards)
1.1	Cargo Hold									
1.1.1	Corrosion									
1.1.1.1	Rapid corrosion of hold frame	All	<ul style="list-style-type: none"> > Incorrect selection of coating specification > Poor painting workmanship > Paint damage by cargo > Paint damage by inadequate discharge manner of bulldozer etc. > Paint damage by local stress > Sweat > Corrosive chemicals such as sulphur > Hold washing by sea water > Poor maintenance 	<ul style="list-style-type: none"> > Thickness diminution of structural members including welding parts > Crack initiation or Penetration > Frame separation in part from shell plate 	Visual inspection by crew and surveyors	Structural failure of side shell structure in way of cargo hold	SOLAS XI A.744(18) IACS UR S12 and Z10.2 (introduced into Class Rules) Class Rules			Enhanced Survey Program (ESP) and IACS UR are effective (ESP from 1993) Reasonably probable
1.1.1.2	Rapid corrosion of side shell (including welding bead)	All	<ul style="list-style-type: none"> > Incorrect selection of coating specification > Poor painting workmanship > Paint damage by cargo > Paint damage by inadequate discharge manner of bulldozer etc. > Paint damage by local stress > Sweat > Corrosive chemicals such as sulphur > Hold washing by sea water > Poor maintenance 	<ul style="list-style-type: none"> > Thickness diminution of structural members including welding parts > Crack initiation or penetration 	Visual inspection by crew and surveyors	Loss of watertight/ structural integrity	SOLAS XI A.744(18) IACS UR S12 and Z10.2 (introduced into Class Rules) Class Rules			Enhanced Survey Program (ESP) and IACS UR are effective (ESP from 1993) Remote

HAZID Worksheet

Accident Category 1

Structural Failure in Cargo Hold Part

ID	Hazard Description / Hazardous Situation	Phase	Cause	Effect	Detection	Scenario / Accident Sub-category	Regulation	F.I.	S.I.	Remarks (including Frequency of Hazards)
1.1.2.1	Excessive (/Over) Stress concentration at hold frame bracket end	All	> Cyclic stress by wave load > Poor detail design > Poor workmanship including poor alignment control > Corrosion > Physical damage in cargo discharging (e.g. notch / deformation)	> Fatigue cracking of hold frame bracket end > Crack induced by stress corrosion	Visual inspection Design approval can check the poor detail design	Structural failure of side shell structure	Class rule			Enhanced Survey Program (ESP) is effective Remote
1.1.2.2	Stress concentration at welding joint of bulkhead lower stool and inner bottom plate	All	> Poor alignment control > Poor welding workmanship > Physical damage > Corrosion	Cracks on welding bead	Visual inspection	Loss of watertight/ structural integrity	Class rule			Enhanced Survey Program (ESP) is effective Remote
1.1.2.3	Stress concentration at welding joint of topside tank sloping plate and transverse bulkhead	All	> Structural complexity > Poor workmanship (welding/painting) > Corrosion	Cracks on welding bead	Visual inspection	Loss of watertight/ structural integrity	Class rule			Enhanced Survey Program (ESP) is effective Remote
1.1.2.4	Stress concentration at welding joint of bilge hopper tank sloping plate and transverse bulkhead	All	> Structural complexity > Poor workmanship (welding/painting) > Corrosion	Cracks on welding bead	Visual inspection	Loss of watertight/ structural integrity	Class rule			Enhanced Survey Program (ESP) is effective Remote
1.1.2.5	Stress concentration at welding joint of shelf plate of lower/ upper stools and corrugate bulkheads	All	> Structural complexity > Poor workmanship (welding/painting) > Corrosion	Cracks on welding bead	Visual inspection	Loss of watertight/ structural integrity	Class rule			Enhanced Survey Program (ESP) is effective Remote

HAZID Worksheet

Accident Category 1

Structural Failure in Cargo Hold Part

ID	Hazard Description / Hazardous Situation	Phase	Cause	Effect	Detection	Scenario / Accident Sub-category	Regulation	F.I.	S.I.	Remarks (including Frequency of Hazards)
1.1.2.6	Stress concentration at hatch opening corner	All	> Inadequate detail design > Poor workmanship	Crack on upper deck plate	Visual inspection	Structural failure of upper deck	Class rule			Enhanced Survey Program (ESP) is effective Remote
1.1.2.7	Stress concentration at hatch coaming end bracket	All	>Cyclic stress by wave load >Poor detail design >Poor workmanship (welding/painting)	Fatigue cracking at hatch coaming end	Visual inspection	Structural failure of hatch coaming Crack Propagation to upper deck	Class rule			Enhanced Survey Program (ESP) is effective Remote
1.1.2.8	Stress concentration on hatch coaming (e.g. securing device support, etc.)	All	>Cyclic stress (by wave load, hatch opening/closing operation, etc.) >Poor detail design >Poor workmanship (welding/painting)	Cracks on hatch coaming	Visual inspection	Structural failure of hatch coaming Crack Propagation to upper deck	Class rule			Enhanced Survey Program (ESP) is effective Remote
1.1.2.9	Excessive (/Over) additional stress to fore most side shell structure by forced displacement (in No.1 cargo hold)	All	> Inadequate local design > Abrupt change of stiffness of side structure	> Crack on ballancing bracket or side stringer > Crack on side shell plate	Visual inspection Design approval can check the inadequate	Structural failure of side shell structure in way of fore most cargo hold	Class rule			Enhanced Survey Program (ESP) is effective Remote
1.1.3	Dents or Deformation									
1.1.3.1	Dents on inner bottom plate, side shell structure, hopper plate and BHD	Loading/Unloading	Physical damage during loading/unloading	Decrease of hold strength	Visual inspection	Structural failure of hold structure	Class rule			Enhanced Survey Program (ESP) is effective Frequent
1.1.3.2	Dents on hatch cover top	Loading/Unloading	Physical damage during loading/unloading	Decrease of hatch cover strength	Visual inspection	Structural failure of hatch covers	Class rule			Enhanced Survey Program (ESP) is effective Remote

HAZID Worksheet

Accident Category 1

Structural Failure in Cargo Hold Part

ID	Hazard Description / Hazardous Situation	Phase	Cause	Effect	Detection	Scenario / Accident Sub-category	Regulation	F.I.	S.I.	Remarks (including Frequency of Hazards)
1.1.4	Excessive or Extreme Local Load									
1.1.4.1	Extreme dynamic sea water pressure to side shell of cargo holds (without counter pressure by cargo)	All	> Encountering heavy weather in condition of Loading high density cargo	Over-stressing of side shell structure	Visual inspection	Structural failure of side structure	Class rule			Resonably probable
1.1.4.2	Excessive wave impact load on cross deck	All	> Inadequate ship operation in rough sea > Sloshing in ballast hold	Deformation of upper deck structure and/or fittings	Visual inspection	Structural failure of upper deck and/or fittings				Enhanced Survey Program (ESP) is effective Remote
1.1.4.3	Excessive impact load to forward side shell structure (in No.1 cargo hold)	All	Panting in rough sea	Over-stressing of forward side shell structure	Visual inspection	Structural failure of forward side shell structure	Class rule			Enhanced Survey Program (ESP) is effective Reasonably probable
1.1.4.4	Excessive pressure/vacuum of deep tank hold	Ballasting/deballasting	Inadequate handling of air escape pipe head /ventilator	Deformation of cargo hold structure Deformation of cargo hatch covers /coamings	Visual inspection	Structural failure of cargo hold hatch cover	Class rule			Enhanced Survey Program (ESP) is effective Extremely Remote
1.1.4.5	Excessive sloshing load of water ballast in deep tank hold	Heavy Ballast	Incorrect ballasting to deep tank hold	Over-stressing of deep tank hold Over-stressing of hatch cover	Visual inspection	Structural failure of deep tank hold hatch covers/cross decks	Class rule			Enhanced Survey Program (ESP) is effective Remote

HAZID Worksheet

Accident Category 1

Structural Failure in Cargo Hold Part

ID	Hazard Description / Hazardous Situation	Phase	Cause	Effect	Detection	Scenario / Accident Sub-category	Regulation	F.I.	S.I.	Remarks (including Frequency of Hazards)
1.2.1.1	Rapid corrosion of structural members	All	> Incorrect selection of coating specification > Poor painting workmanship > Paint damage by local stress > Inadequate galvanic protection in ballast tank > Poor maintenance	> Thickness diminution of structural members including welding parts > Crack initiation or penetration > Dettach of deck longitudinals from upper deck	Visual inspection by crew and surveyors	Structural failure of structural members in way of top side tank	SOLAS XI A.744(18) IACS UR S12 and Z10.2 (introduced into Class Rules) Class Rules			Enhanced Survey Program (ESP) and IACS UR are effective (ESP from 1993) Reasonably probable
1.2.2	Stress Concentration									
1.2.2.1	Stress concentration at lowest side longitudinals	All	> Inadequate detail design	Crack initiation	Visual inspection	Structural failure of side shell in way of top side tank	Class rule			Enhanced Survey Program (ESP) is effective Remote
1.2.2.2	High Stress at the corner of trans ring	All	> Inadequate detail design	Stress corrosion Crack initiation Buckling	Visual inspection	Structral failure of trans ring in way of top side tank	Class rule			Enhanced Survey Program (ESP) is effective Reasonably Probable
1.2.2.3	Stress concentration at structural members in way of connecting trunk (e.g. diaphragms)	All	> Inadequate detail design	Crack initiation	Visual inspection	Structural failure of trans ring in way of connecting trunk	Class rule			Enhanced Survey Program (ESP) is effective Remote
1.2.3	Dents or Deformation									
1.2.3.1	Dents on tank top plate (upper deck)	Loading/ Unloading	> Physical damage during loading/unloading	Decrease of upper deck strength	Visual inspection	Structural failure of deck structure	Class rule			Enhanced Survey Program (ESP) is effective Remote

HAZID Worksheet

Accident Category 1

Structural Failure in Cargo Hold Part

ID	Hazard Description / Hazardous Situation	Phase	Cause	Effect	Detection	Scenario / Accident Sub-category	Regulation	F.I.	S.I.	Remarks (including Frequency of Hazards)
1.2.4	Extreme Local Load									
1.2.4.1	Excessive wave impact load on upper deck	All	> Inadequate ship operation > Voyage in rough sea	Deformation of upper deck structure and/or fittings	Visual inspection	Structural failure of upper deck and/or fittings	Class rule			Enhanced Survey Program (ESP) is effective Remote
1.2.4.2	Excessive pressure/vacuum of tanks	Ballast including ballasting/ deballasting	> Freezing of air escape pipe head, ballast water, etc. > Inadequate handling of air escape pipe head	Deformation of tanks	Visual inspection	Structural failure of tanks	Class rule			Enhanced Survey Program (ESP) is effective Extremely Remote
1.2.4.3	Excessive water pressure in ballast tanks at ballast water exchange operation	Ballast Exchange	> Inadequate ballast exchange operation	Over-stressing of ballast tank	Visual inspection	Structural failure of ballast tank	Class rule			Enhanced Survey Program (ESP) is effective Remote
1.2.5	Excessive Global									
1.2.5.1	Excessive hull girder bending moment/ shearing force	All	> Incorrect loading operation > Voyage in rough sea	Over-stressing of hull girder	>Loading calculation >weather forecast	Structural failure of hull girder	Class rule SOLAS XII/11			Using loading computer is effective Remote
1.3	Bilge Hopper Tank									
1.3.1	Corrosion									
1.3.1.1	Rapid corrosion of structural members	All	> Incorrect selection of coating specification > Poor painting workmanship > Paint damage by local stress - Inadequate galvanic protection in ballast tank >Poor maintenance	>Thickness diminution of structural members including welding parts > Crack initiation or penetration	Visual inspection by crew and surveyors	Structural failure of structural members in way of bilge hopper tank	SOLAS XI A.744(18) IACS UR S12 and Z10.2 (introduced into Class Rules)			Enhanced Survey Program (ESP) and IACS UR are effective (ESP from 1993) Remote

HAZID Worksheet

Accident Category 1

Structural Failure in Cargo Hold Part

ID	Hazard Description / Hazardous Situation	Phase	Cause	Effect	Detection	Scenario / Accident Sub-category	Regulation	F.I.	S.I.	Remarks (including Frequency of Hazards)
1.3.2	Stress Concentration									
1.3.2.1	Stress concentration at side/bottom/hopper longitudinals	All	Inadequate detail design	Crack Injtiation	Visual inspection	Structural failure of side/bottom shell or hopper plate in way of bilge hopper tank	Class rule			Enhanced Survey Program (ESP) is effective Remote
1.3.2.2	High Stress at the corner of trans ring	All	Inadequate detail design	Stress corrosion Crack initiation Buckling	Visual inspection	Structral failure of trans ring in way of bilige hopper tank	Class rule			Enhanced Survey Program (ESP) is effective Remote
1.3.2.3	Stress concentration at the end of bilge keels	All	Inadequate detail design	Crack initiation	Visual inspection	Structral failure of bilge shell plate	Class rule			Enhanced Survey Program (ESP) is effective Remote
1.3.2.4	Stress concentration at connection of bilge hopper tank sloping plate and inner bottom plate	All	> Poor alignment control > Poor welding workmanship > Physical damage > Corrosion > Inadequate detail design	Cracks on welding bead or knuckle	Visual inspection	Loss of watertight/ structural integrity	Class rule			Enhanced Survey Program (ESP) is effective Remote
1.3.3	Dents or Deformation									
1.3.3.1	Dents on shell plate in way of bilge hopper tank	All	Physical damage by contact	Decrease of shell structural strength	Visual inspection	Structural failure of side/bottom shell plate in way of bilge hopper tank	Class rule			Enhanced Survey Program (ESP) is effective Remote
1.3.3.2	Dents on hopper plate	Loading/ Unloading	Physical damage during loading/unloading	Decrease of strength of hopper structure	Visual inspection	Structural failure of hopper structure	Class rule			Enhanced Survey Program (ESP) is effective Frequent

HAZID Worksheet

Accident Category 1

Structural Failure in Cargo Hold Part

ID	Hazard Description / Hazardous Situation	Phase	Cause	Effect	Detection	Scenario / Accident Sub-category	Regulation	F.I.	S.I.	Remarks (including Frequency of Hazards)
1.3.4	Extreme Local Load									
1.3.4.1	Excessive pressure/vacuum of tanks	Ballast including ballasting/deballasting	Freezing of air escape pipe head, ballast water, etc. > Inadequate handling of air escape pipe head	Deformation of tanks	Visual inspection	Structural failure of tanks				Enhanced Survey Program (ESP) is effective Extremely Remote
1.3.4.2	Excessive water pressure in ballast tanks at ballast water exchange operation	Ballast Exchange	> Inadequate ballast exchange operation	Over-stressing of ballast tank	Visual inspection	Structural failure of ballast tank	Class rule			Enhanced Survey Program (ESP) is effective Remote
1.3.5	Excessive Global									
1.3.5.1	Excessive hull girder bending moment/ shearing force	All	> Incorrect loading operation > Voyage in rough sea	Over-stressing of hull girder	>Loading calculation >weather forecast	Structural failure of hull girder	Class rule SOLAS XII/11			Using loading computer is effective Remote
1.4	Double Bottom Tank									
1.4.1	Corrosion									
1.4.1.1	Rapid corrosion of structural members (except for 1.4.1.2)	All	> Incorrect selection of coating specification > Poor painting workmanship > Paint damage by local stress > Inadequate galvanic protection in ballast tank >Poor maintenance	>Thickness diminution of structural members including welding parts > Crack initiation or penetration	Visual inspection by crew and surveyors	Structural failure of structural members in way of double bottom tank	SOLAS XI A.744(18) IACS UR S12 and Z10.2 (introduced into Class Rules)			Enhanced Survey Program (ESP) and IACS UR are effective (ESP from 1993) Remote

HAZID Worksheet

Accident Category 1

Structural Failure in Cargo Hold Part

ID	Hazard Description / Hazardous Situation	Phase	Cause	Effect	Detection	Scenario / Accident Sub-category	Regulation	F.I.	S.I.	Remarks (including Frequency of Hazards)
1.4.3.1	Dents on shell members in way of double bottom tank	All	Physical damage by contact	Decrease of shell structural strength	Visual inspection	Structural failure of double bottom structure	Class rule			Enhanced Survey Program (ESP) is effective Remote
1.4.3.2	Dents on tank top plate (inner bottom plate)	Loading/Unloading	Physical damage during loading/unloading	Decrease of double bottom strength	Visual inspection	Structural failure of inner bottom in way of double bottom tank	Class rule			Enhanced Survey Program (ESP) is effective Frequent
1.4.4	Extreme Local Load									
1.4.4.1	Excessive impact load to forward bottom shell structure	Ballast	> Slamming in rough sea > Insufficient bow draught	Over-stressing of forward bottom shell structure	Visual inspection	Structural failure of forward bottom structure	Class rule			Extremely Remote
1.4.4.2	Excessive pressure/vacuum of tanks	Ballast including ballasting/deballasting	> Freezing of air escape pipe head, etc. > Inadequate handling of air escape pipe head	Deformation of tanks	Visual inspection	Structural failure of tanks				Enhanced Survey Program (ESP) is effective Extremely Remote
1.4.4.3	Excessive water pressure in ballast tanks at ballast water exchange operation	Ballast Exchange	> Inadequate ballast exchange operation	Over-stressing of ballast tank	Visual inspection	Structural failure of ballast tank	Class rule			Enhanced Survey Program (ESP) is effective Remote
1.4.4.4	Excessive load by inhomogenous/uneven cargo loading	Loading/Unloading	> Inadequate loading procedure	Over-stressing to double bottom structures	Visual inspection	Structural failure of double bottom structure				Extremely Remote
1.4.5	Excessive Global									
1.4.5.1	Excessive hull girder bending moment/shearing force	All	> Incorrect loading operation > Voyage in rough sea	Over-stressing of hull girder	> Loading calculation > weather forecast	Structural failure of hull girder	Class rule SOLAS XII/11			Using loading computer is effective Remote

HAZID Worksheet

Accident Category 2

Structural Failure in Fore End Part

ID	Hazard Description / Hazardous Situation	Phase	Cause	Effect	Detection	Scenario / Accident Sub-category	Regulation	F.I.	S.I.	Remarks (including Frequency of Hazards)
2.1	Fore Peak Tank									
2.1.1	Corrosion									
2.1.1.1	Rapid corrosion of internal structural members in fore peak tank (e.g. frame, transverses, stringers, girders)	All	>Incorrect selection of coating specification >Poor painting workmanship >Inadequate detail design	>Decrease in plate thickness >Decrease in strength	Visual inspection	Structural failure of side shell structure in way of fore peak tank	Class rule A.744(18)			Enhanced Survey Program (ESP) is effective Remote
2.1.1.2	Rapid corrosion of side shell (including welding bead)	All	>Incorrect selection of coating specification >Poor workmanship (welding/painting) > Paint damage by chain and anchor	Decrease in strength Crack initiation or penetration	Visual inspection	Structural failure of side shell structure in way of fore peak tank	Class rule A.744(18)			Enhanced Survey Program (ESP) is effective Reasonably probable
2.1.1.3	Rapid corrosion of bottom shell plate underneath bellmouthes or sounding pipes	All	> Incorrect selection of coating specification > Poor painting workmanship > Paint damage by vacuum effect of ballast water suction or something like that > Inadequate galvanic protection in ballast tank > Poor maintenance of paint and striking plate	>Thickness diminution >penetration	Visual inspection	Structural failure of bottom plates in way of fore peak tank	SOLAS XI A.744(18) IACS UR S12 and Z10.2 (introduced into Class Rules) Class Rules			Enhanced Survey Program (ESP) and IACS UR are effective (ESP from 1993) Reasonably probable
2.1.2	Stress Concentration									
2.1.2.1	Stress concentration at frame/transverse connection	All	> Cyclic stress by wave load > Inadequate detail design	Fatigue cracking of frame/transverse connection	Visual inspection	Structural failure of side shell structure	Class rule			Enhanced Survey Program (ESP) is effective Remote

HAZID Worksheet

Accident Category 2

Structural Failure in Fore End Part

ID	Hazard Description / Hazardous Situation	Phase	Cause	Effect	Detection	Scenario / Accident Sub-category	Regulation	F.I.	S.I.	Remarks (including Frequency of Hazards)
2.1.2.2	Stress concentration at counter structure on Collision BHD against bilge hopper tank	All	> Cyclic stress by wave load > Structural complexity > Inadequate detail design > Poor alignment control > Poor workmanship (welding/painting) > Corrosion	Cracks on structure	Visual inspection	Loss of watertight/ structural integrity	Class rule			Enhanced Survey Program (ESP) is effective Remote
2.1.2.3	Stress concentration at counter structure on Collision BHD against top side tank	All	> Cyclic stress by wave load > Structural complexity > Inadequate detail design > Poor alignment control > Poor workmanship (welding/painting) > Corrosion	Cracks on structure	Visual inspection	Loss of watertight/ structural integrity	Class rule			Enhanced Survey Program (ESP) is effective Remote
2.1.2.4	Stress concentration at Collision BHD lower end	All	> Cyclic stress by wave load > Inadequate detail design > Poor alignment control > Poor workmanship (welding/painting) > Corrosion	Cracks on structure	Visual inspection	Loss of watertight/ structural integrity	Class rule			Enhanced Survey Program (ESP) is effective Extremely Remote
2.1.3	Dents or Deformation									
2.1.3.1	Dents on side shell plate	Anchoring	Physical damage by anchor and chain	Decrease of strength	Visual inspection	Structural failure of side shell structure	Class rule			Reasonably probable
2.1.4	Excessive Local Load									
2.1.4.1	Excessive wave impact load to forward bottom shell	Ballast	> Slamming in rough sea	Over-stressing of forward bottom shell structure	Visual inspection	Structural failure of forward bottom structure	Class rule			Extremely Remote

HAZID Worksheet

Accident Category 2

Structural Failure in Fore End Part

ID	Hazard Description / Hazardous Situation	Phase	Cause	Effect	Detection	Scenario / Accident Sub-category	Regulation	F.I.	S.I.	Remarks (including Frequency of Hazards)
2.2.4.1	Excessive wave load to foremost exposed deck	All	> Extreme load of Green water in rough sea > Inadequate ship operation	> Deformation of deck structure > Breakdown of fittings (e.g. small hatches)	Visual inspection	Loss of watertight/ structural integrity	ILLC			Reasonably probable
2.2.4.2	Excessive wave impact load to foremost shell structure	All	Panting in rough sea	Over-stressing of foremost shell structure	Visual inspection	Structural failure of foremost shell structure	Class rule			Reasonably probable
2.3	Chain Lockers									
2.3.1	Corrosion									
2.3.1.1	Rapid corrosion of wall and top/bottom plate	All	> Paint damage by chain contact > Incorrect selection of coating specification > Poor painting workmanship > Poor maintenance	> Decrease in plate thickness > Penetration	Visual inspection	Loss of watertight/ structural integrity	Class rule			Reasonably probable
2.3.3	Dents or Deformation									
2.3.3.1	Dents on wall and bootom plate	Anchoring	> Physical damage by chain	Decrease of strength	Visual inspection	Loss of watertight/ structural integrity	Class rule			Extremely Remote
2.3.4	Excessive Local Load									
2.3.4.1	Excessive impact load at cable clench by anchoring	Anchoring	> Mis-operation > Malfunction of anchoring arrangement	Breakdown of bottom plate at cable clench	Visual inspection	Loss of watertight/ structural integrity	Class rule			Remote

HAZID Worksheet

Accident Category 4

Water Ingress through Opening

ID	Hazard Description / Hazardous Situation	Phase	Cause	Effect	Detection	Scenario / Accident Sub-category	Regulation	F.I.	S.I.	Remarks (including Frequency of Hazard)
Fore End Part										
4.1.1	Water Ingress through chain pipe	All	> Green water in rough sea	Water ingress to chain locker	Bilge alarm (if any) Sounding pipe	Potential flooding of fore part				Frequent
4.1.2	Water Ingress through small hatches on exposed deck	All	> Green water in rough sea > Mis-handling by crew > Poor securing by crew > Corrosion > Poor maintenance	Water ingress to bos'n store	Bilge alarm (if any)	Potential flooding of fore part	ILLC			Remote
4.1.3	Water ingress through doors to bos'n store	All	> Green water in rough sea > Mis-handling by crew > Corrosion > Poor maintenance	Water ingress to bos'n store	Bilge alarm (if any)	Potential flooding of fore part	ILLC			Remote
4.1.4	Water ingress through air pipe/ventirator	All	> Green water in rough sea > Negligence of closing > Breakdown by excessive sea loads > Corrosion > Poor maintenance	Water ingress to bos'n store and/or fore peak tank	Bilge alarm (if any) Sounding pipe	Potential flooding of fore part	ILLC			Remote
4.2 Cargo Hold Part										
4.2.1	Water ingress through cargo hatch	All	> Green water in rough sea > Corrosion > Negligence of closing > Poor maintenance	Water ingress to cargo hold	Bilge alarm (if any) Sounding pipe	Flooding of cargo hold	ILLC			Extremely Remote
4.2.2	Water ingress through air pipe/ventilator	All	> Breakdown by Excessive sea water load > Corrosion > Negligence of closing > Poor maintenance	Water ingress to cargo hold/tanks	Bilge alarm (if any) Sounding pipe	Flooding of cargo hold/tanks	ILLC			Extremely Remote

HAZID Worksheet

Accident Category 4

Water Ingress through Opening

ID	Hazard Description / Hazardous Situation	Phase	Cause	Effect	Detection	Scenario / Accident Sub-category	Regulation	F.I.	S.I.	Remarks (including Frequency of Hazard)
4.3 Engine Room Part										
4.3.1	Water ingress through openings (e.g. doors, sky light)	All	> Green water in rough sea > Corrosion > Poor maintenance > Negligence of closing	Water ingress to engine room	Visual Inspection Bilge alarm (if any) Sounding pipe	Flooding of engine room	ILLC			Extremely remote
4.3.2	Water ingress through ventilator	All	> Breakdown by excessive sea water load > Green water in rough sea > Corrosion > Poor maintenance > Negligence of closing	Water ingress to engine room	Visual Inspection Bilge alarm (if any) Sounding pipe	Flooding of engine room	ILLC			Extremely remote
4.4 Aft End Part										
4.4.1	Water ingress through openings (e.g. doors, rope hatch)	All	> Green water in rough sea > Corrosion > Poor maintenance > Negligence of closing	Water ingress to aft end part	Visual Inspection Bilge alarm (if any) Sounding pipe	Flooding of steering engine room, aft peak tank or emergency fire pump room	ILLC			Extremely remote
4.4.2	Water ingress through air pipe/ventilator	All	> Breakdown by Excessive sea water load > Corrosion > Negligence of closing > Poor maintenance	Water ingress to aft end part	Bilge alarm (if any) Sounding pipe	Flooding of steering engine room, aft peak tank or emergency fire pump room	ILLC			Extremely Remote
4.5 Others										
4.5.1	Water ingress through piping system	All	>Poor maintenance >Corrosion of piping system >Negligence of closing valves, etc	Water ingress to unexpected compartments through piping system	Bilge alarm (if any) Sounding pipe	Flooding of unexpected compartments	ILLC			Extremely Remote