



MARITIME SAFETY COMMITTEE  
81st session  
Agenda item 8

MSC 81/8/1  
27 January 2006  
Original: ENGLISH

## FLAG STATE IMPLEMENTATION

### Study on incidents of explosions on chemical and product tankers

#### Report of the activities of the Inter-Industry Working Group (IIWG)

Submitted by ICS, IAPH, IACS, CEFIC, OCIMF, INTERTANKO and IPTA

#### SUMMARY

**Executive summary:** This document summarizes the activities and conclusions of the Inter-Industry Working Group (IIWG) formed to investigate fires and explosions on chemical and product tankers. It reports on measures intended to prevent recurrences of such incidents being taken by the industry and proposes measures for consideration by the Committee

**Action to be taken:** Paragraph 18

**Related documents:** MSC 79/22/8; MSC 79/23; FSI 13/23; MSC 80/24; and resolution A.971(24), annex, part 1, high-level actions 5.2.2 and 5.2.3

#### Background

1 The Maritime Safety Committee, at its seventy-ninth session (1 to 10 December 2004), considered document MSC 79/22/8, submitted by France, summarizing the findings of the casualty investigation into the explosion on board the **Chassiron** and making certain recommendations with regard to operational practices and equipment for smaller tankers. MSC 79 noted that industry associations were investigating a number of similar incidents and invited ICS to submit the results of its work to the Organization at the earliest opportunity.

2 ICS, IAPH, IACS, CEFIC, OCIMF, INTERTANKO and IPTA, as part of the Inter-Industry Working Group (IIWG), formed a steering committee in January 2005, which appointed a working group drawn from members of the individual organizations together with the International Group of P&I Clubs. From a database of incidents that have occurred over the past 25 years the IIWG identified 35 occurrences that involved fires and explosions in cargo areas of chemical and product tankers. The Group set itself the task of identifying the root causes and establishing whether there were any common factors, with the objective of identifying corrective actions that would prevent any further similar incidents. In order to achieve this objective a number of task groups were formed to study different issues and potential corrective measures.

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## Discussion

3 A letter was sent on behalf of the IIWG to the owners and/or operators of the ships involved in the incidents identified, requesting that they provide any information they might have to the Group. Data provided on the various incidents was of variable quantity and quality, although the Group felt that some value was derived from all the data received. Despite the invitation made by MSC 80 to the relevant Administrations to provide further information on the findings of the investigations into recent casualties, little new information was provided to the IIWG.

4 While the limited availability of casualty investigation reports hindered the work of the IIG, the data received from various sources was sufficient to enable a number of conclusions to be reached.

5 The incident analysis revealed that:

- .1 the majority of incidents involved ships of less than 20,000 dwt and occurred at sea;
- .2 in the majority of cases the ship was tank cleaning, venting or gas freeing when the incidents occurred;
- .3 the personnel was directly involved in many of the incidents;
- .4 failure to follow established procedures was observed in a significant number of incidents;
- .5 in several cases the tank atmosphere had apparently not been evaluated or was not being monitored;
- .6 in most cases ignition occurred within a tank;
- .7 none of the incidents occurred during the use or operation of inert gas; and
- .8 the majority of incidents involved cargoes covered by MARPOL Annex II.

Further information on the analysis of incidents will be submitted to MSC 81 as an information paper.

6 Based on the work of the various task groups established, the IIWG concluded that:

- .1 the analysis did not identify as a cause for the fires and explosions any technical or operational factors not previously recognized;
- .2 the most significant contribution to the incidents in question was a failure to follow cargo operation guidelines and procedures (at both shipboard and ship management level). This would point toward a failure within the companies' safety culture;
- .3 manning levels were not considered a material factor. Questions were raised however, regarding crew's competence and training in a number of cases;

- .4 the incident investigation reports reviewed did not indicate any contradictions or discrepancies within the existing International Safety Guide for Oil Tankers and Terminals (ISGOTT) or the ICS Tanker Safety Guide (Chemicals) or between these guides and SOLAS;
- .5 industry practices such as chemical spraying or steaming, which can be undertaken safely under certain circumstances if controlled safety procedures are followed, were contributory causes to a number of incidents, with static electricity noted as a possible ignition source in association with such practices;
- .6 in-tank pump failure was identified as a causal factor in at least one incident and other mechanical sources of ignition, such as from rotating equipment within a cargo tank, might have been the cause in a small number of incidents;
- .7 establishing and maintaining known tank atmospheres have been shown to be problematic and this has been a contributory factor in many of the incidents;
- .8 confusion over the exact nature of a particular cargo, due to provision of the wrong Material Safety Data Sheets (MSDS) information, contributed to one incident; and
- .9 the provision of inert gas to product tankers under 20,000 dwt chemical tankers is technically feasible. However a number of safety, operational, environmental and other implications have been identified in association with its application to such ships.

### **Industry measures**

7 Having concluded that the failure to follow procedures was the primary cause of the incidents in question, the industry has established a task group on human factors to enhance efforts to identify and address factors influencing procedural compliance on board tankers.

8 As an early initiative the IIWG has identified the ICS publication “Safety in Chemical Tankers” as one vehicle for producing general guidance and this will be updated to promote best industry guidelines and practices.

9 The Group noted an apparent limited understanding within the industry of the causes, dangers and potential consequences of static electricity, which many reports identified as a possible ignition source. Measures will be sought through ongoing work on human element-related issues to raise awareness of this issue at all levels. This will include the revision of the relevant section of the ICS publication referred to above.

10 Prior to the formation of the IIWG the co-authors of ISGOTT (i.e. IAPH, ICS and OCIMF) had begun a review of the guide. This review has been completed and amendments to the text include enhanced guidance with regard to safe cargo operations.

11 The industry is considering the establishment of a group to review cargo-related operational practices to meet shippers’ requirements, to the extent that they may have contributed to some of the incidents, with a view to providing further guidance.

12 A proposal has been submitted through the Evaluation of Safety and Pollution Hazards (ESPH) Working Group and the BLG Sub-Committee that an MSC circular be issued emphasizing the importance of the use of the Proper Shipping Name for the carriage of IBC Code products. The IIWG would commend this to the Committee.

### **Recommendations**

13 The IIWG recommends that the MSC/MEPC Working Group on the Human Element take note of the findings of the IIWG with regard to the failure to follow established procedures and endorse the efforts of the industry referred to in paragraph 7.

14 Although the prime cause of the incidents was a failure to follow procedures and a number of the incidents occurred during periods when the vessel was incorrectly assumed to be gas-free, the IIWG nevertheless recommends that as an additional safety measure the Committee give consideration to amending SOLAS to provide for the application of inert gas to new oil tankers of less than 20,000 DWT and to new chemical tankers. If the Committee wishes to consider the application of inert gas to existing ships, the IIWG would suggest that this should be based on the principles of resolution A.900(21) on Objectives of the Organization in the 2000s including a Formal Safety Assessment (FSA) study, and a cost/benefit analysis. The industry confirms its commitment to participate fully in any such studies.

15 In considering the above the IIWG would recommend that the Committee take note of the complexity inherent in operational procedures on chemical tankers.

16 The Group recommends that international safety standards be developed in relation to the design and operation of in-tank pumps. IACS has expressed its willingness to develop a Unified Requirement on the subject, which has the support of the industry.

17 The IIWG believes that the anonymous sharing of data relating to incidents and near misses should be encouraged and would recommend the promotion and enhancement of appropriate systems to this end.

### **Action requested of the Committee**

18 The Committee is invited to give consideration to the above and to take action as appropriate.

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MARITIME SAFETY COMMITTEE  
81st session  
Agenda item 8

MSC 81/INF.8  
9 February 2006  
ENGLISH ONLY

## FLAG STATE IMPLEMENTATION

### Study on incidents of explosions on chemical and product tankers

#### Report of the activities of the Inter-Industry Working Group (IIWG): Incident Review Analysis

Submitted by ICS, IAPH, IACS, CEFIC, OCIMF, INTERTANKO and IPTA

#### SUMMARY

**Executive summary:** This document, which should be read in conjunction with MSC 81/8/1, provides information regarding the analysis of thirty five incidents conducted by the Inter-Industry Working Group (IIWG) formed to investigate fires and explosions on chemical and product tankers. The analysis concludes that the most significant contributory factor to the incident causes was a failure to follow or understand cargo operation guidelines and procedures (at both shipboard and ship management level)

**Action to be taken:** Paragraph 4

**Related documents:** MSC 79/22/8; MSC 79/23; MSC 80/24; FSI 13/23; A 24/18(b)/Add.1, annex, sections 5.2.2 and 5.2.3 and MSC 81/8/1

1 Following a series of fires and explosions on chemical and product tankers, ICS, IAPH, IACS, CEFIC, OCIMF, INTERTANKO and IPTA formed a steering committee in January 2005, which appointed a working group drawn from members of the individual organizations together with the International Group of P&I Clubs. From a database of incidents that have occurred over the past 25 years the IIWG identified 35 occurrences that involved fires and explosions in cargo areas of chemical and product tankers. The findings and recommendations of the Group have been submitted to MSC 81 as MSC 81/8/1.

2 As part of its detailed study the IIWG established a Task Group to review incident reports and analyse data, provide feedback to the Group and present data in a format to allow a review of trends and common indicators and the development of recommendations.

3 The report of the Incident Review Task Group is attached.

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**Action requested of the Committee**

4 The Committee is invited to note the above information.

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**ANNEX**

**IIWG**

**INCIDENT REVIEW TASK GROUP FINAL REPORT**

**4 OCTOBER 2005**

**CONTENTS**

- 1. MEMBERSHIP, TERMS OF REFERENCE, SCOPE AND INTRODUCTION**
- 2. WORK METHOD**
- 3. INCIDENT REVIEW**
- 4. RESULTS**
- 5. CONCLUSIONS**
- 6. ANNEX A**

## IIWG

### INCIDENT REVIEW TASK GROUP FINAL REPORT

#### 1. MEMBERSHIP, TERMS OF REFERENCE, SCOPE AND INTRODUCTION

##### 1.1 Task Group Members were drawn from the following associations:

CEFIC  
IACS  
ICS  
IPTA  
INTERTANKO  
OCIMF

##### 1.2 Terms of Reference (TOR) approved for Task Groups by the Inter-Industry Work Group (IIWG)

1.2.1 Task groups may be established, as necessary, under the auspices of **The Group** to evaluate specific areas of concern. For example it is envisaged that task groups may be established to undertake work on the following areas:

Data gathering and analysis of causal factors and areas for further investigation.

A review of mechanical issues such as sources of ignition or the role of cargo pumps and tank washing machine in some events.

Procedural compliance and human factors. Included in this may be a review of the industry guidance (IAPH/ICS/OCIMF ISGOTT and ICS Tanker Safety Guide (Chemicals)) where it is identified that guidance can be enhanced.

##### 1.3 Scope of work approved for the Incident Review Task Group by the Inter-Industry Work Group (IIWG)

1.3.1 Review Owners' responses and analyse data. Provide feedback at next meeting and present data in a format to allow review of trends and common indicators and development of recommendations.

##### 1.4 The Inter-Industry Work Group (IIWG) passed outline details relating to fire or explosion incidents (FEI) on thirty five ships to the Incident Review Task Group. The IIWG having previously considered that these incidents met agreed criteria for further investigation, had requested detailed reports from the ship owner/operators who had interest in these ships at the time of the incidents.

1.4.1 At MSC 79 and MSC 80, the Committee encouraged Member States to forward to the IMO Secretariat appropriate incident investigation reports that would be forwarded to the IIWG for consideration and review.

1.4.2 The Task Group completed the task of assessing reports on 11 July. Three (3) IMO Member State reports had been made available to the IIWG. The IIWG continues to invite IMO Member States to forward incident investigation reports. Rigorous investigation and subsequent reports produced by IMO Member States are considered to be valuable to the Task Group investigation. Such reports



provide important data and also serve to benchmark and validate other incident investigation reports.

- 1.4.3 ***The low number of IMO Member State reports available to the Task Group is of concern. The Task Group sought to achieve a balanced view by considering incident investigation reports from a variety of available sources.***
- 1.5 Responses from several ship owner/operators to requests for incident investigation reports indicated that particular ship(s) had either been lost during or as a consequence of an incident or were subsequently sold, and that records including incident investigation reports relating to the ship(s) had not been retained. ***The Task Group considered that a requirement for records and incident investigation reports to be retained would facilitate any retrospective incident investigations.***
- 1.6 The incident investigation reports considered inevitably related to events that had already occurred and which had caused combinations of structural damage, injury, death and environmental pollution. The Task Group noted the availability of a limited number of ‘near miss’ incident investigation reports where major FEI had not occurred but had been avoided, possibly only by fortunate circumstances. ***It was considered that the value of collated incident investigation and near miss information was substantial and that establishing an industry-wide mechanism for such collation and subsequent review was worthy of consideration.***
- 1.7 In addition to consideration of incident investigation and near miss reports, at paragraph 1.6, the Task Group noted the existence of a small number of FEI investigation reports relating to circumstances not immediately relevant to the work of the Task Group, e.g. incidents involving cargo vapours outside the cargo area. ***Appropriate review of these ‘other circumstance incidents’ may be considered in the future but were outside the remit of the Task Group.***

## 2. WORK METHOD

- 2.1 The Task Group considered that its report should objectively analyse and reflect information included within the incident investigation reports. It was considered important for the Task Group itself to avoid conducting further investigation based on analysis of the reports.
- 2.1.1 Where the opinion of the Task Group has been recorded, this has been shown by the context used.
- 2.1.2 Throughout this report, where the Task Group felt that there was sufficient information available to make comment for the attention of the IIWG, such comments have been identified using ***bold italic*** text.
- 2.1.3 To aid understanding of the Task Group’s process, the two conditions ‘In Port’ and ‘At Sea’ are considered in this report to have the following meanings:

In Port - When a ship is either alongside, at anchor or otherwise within the jurisdiction of a port authority or elsewhere when shore personnel may be expected to be aboard a ship or otherwise have influence regarding shipboard activity.

At Sea - When a ship is either at sea or at anchor (whether or not within port limits) and when shipboard operations and procedures would be anticipated to be primarily those of a ship operating autonomously and without the direct presence or influence of shore-based personnel.

- 2.2 The term, 'competence' was considered appropriate to describe the individual capacity required to demonstrate the skills and abilities necessary to perform a task safely and efficiently. In training terms, such competence is dependent on underpinning by appropriate knowledge, skills and understanding. Where a lack of competence has been identified, this does not relate to the possession or otherwise by an individual of a duly authorized STCW certificate.
- 2.3 When addressing 'atmosphere', the Task Group considered it appropriate within the Analysis Spreadsheet (Annex A) to identify the atmosphere (as defined within ISGOTT) that the ship's crew believed existed in a tank prior to an incident. ISGOTT identifies procedures to be followed during tank washing/cleaning dependent on the atmosphere in a tank. A breach of procedures, if recorded, relates to procedures including those within ISGOTT appropriate for tank washing/cleaning or other shipboard activity.
- 2.4 Having identified key factors relating to FEI the Task Group developed tables enabling incident data to be recorded against key factors. The Analysis Spreadsheet identifies recurring key factors, and text tables record additional considerations of the Task Group in respect of incidents reviewed.

- 2.4.1 The Analysis Spreadsheet key factors relating to FEI form subsets of the following nine topics:

Vessel Details  
Conditions  
Atmosphere  
Ignition Sources  
Ignition Location  
Personnel  
Cargo  
Hardware and  
Management.

The Analysis Spreadsheet forms Annex A.

- 2.4.2 Text tables, (not attached) were also developed for the following key factors relating to FEI and form subsets of the following nine topics:

Hardware  
External Influences/Factors  
Human Element including Training  
Management Systems  
Ship/Shore Interface  
Incompatible Goals

Cargo  
Maintenance and  
Environmental Conditions.

- 2.5 The Task Group decided that the conclusions recorded in section 5 should **not** be listed in order of priority. The task of creating a list would have involved a degree of subjective assessment that could have adversely affected possible further consideration by other task groups.

### 3. INCIDENT REVIEW

- 3.1 With regard to 23 of the 35 incident investigations, the Task Group considered that:

3.1.1 Incomplete data had been received and consequently comprehensive analysis had yet to be completed, or

3.1.2 More extensive reports than those currently available, were anticipated.

- 3.2 Communication with ship owners/operators indicates that further data relating to a number of incident investigations may be made available in the future.

- 3.3 IMO Member State investigations relating to a number of the identified incident investigations are understood to be close to completion and a number are being translated into English.

- 3.4 Very few (3) IMO Member State reports have been made available to the IIWG. ***The lack of Member State reports has hampered the work of the Task Group.***

- 3.5 Incident investigation reports considered by the Task Group varied in both scope and detail. In general, reports relating to more recent incidents were found to be more comprehensive than those conducted more than five years ago.

3.5.1 The reports reviewed varied in approach, scope and depth. The Task Group considered that valuable information had been extracted from all reports and that all reports had contributed to establishing an understanding of significant aspects found to be common to many of the incidents.

3.5.2 A number of reports related to ships that had sunk following an FEI. For a number of these ships, much significant evidence was destroyed or lost at the time of the incident.

3.5.3 A number of ships have since been sold or companies have ceased to trade and the reports relating to these incidents were usually of limited scope.

### 4. RESULTS

Analysis of key factors has shown that two distinct trends emerged:

- Certain key factors were shown to be present in many or most cases
- Other key factors were rarely recorded.

This distinction reflects that, in many cases a clear pattern emerged. Despite the relatively small number of incidents assessed, the Task Group considered that clear conclusions could be reached.

#### 4.1 Vessel Details

- Of the incidents reviewed, the majority were experienced by ships at sea and of less than 20,000 tonnes DWT.

#### 4.2 Conditions

- In several of the incidents, multiple work activities were being carried out.
- In the majority of incidents, the ship was tank cleaning, venting or gas-freeing.
- In a number of incidents, crew members were working in the affected tank.
- Other activities taking place at the time of incidents included discharging, tank steaming, cargo sampling and maintenance operations on the cargo deck area.

#### 4.3 Atmosphere

- In several incidents, the ship had been operating with a tank atmosphere that was not evaluated or monitored and consequently appropriate precautions were not taken.
- In some incidents, the crew had considered the tank atmosphere to be 'gas free'.
- A lack of clarity was noted in company practices and procedures for gas testing of tanks prior to and during tank cleaning.
- The influence of oxygen was not reported as being a factor in incidents.
- None of the incidents occurred during the use or operation of Inert Gas (IG) plant.

#### 4.4 Ignition Sources

- All potential ignition sources were found to be causal, although static electricity and sparks/friction were found to be the most common causal factors.
- The Task Group noted a tendency to identify static as a probable ignition source when no absolute source was identified.

#### 4.5 Ignition Location

- The most common ignition location was in tank.

#### 4.6 Personnel

- The direct involvement of personnel in many of these incidents was recorded and the Task Group noted that competence and training issues were frequently causal factors. ***The latter two factors warrant further consideration to determine where the failure(s) identified had occurred.***
- In one incident, a lack of sufficient crew members could have been a factor, but was otherwise not recorded as being causal.

#### 4.7 Cargo

- The majority of incidents involved the carriage of cargoes referenced under MARPOL Annex II. Incidents occurred on ships that were loaded, part loaded or had discharged cargoes and only retained cargo residues onboard.

#### 4.8 Hardware

- The reports considered contained little information regarding hardware.
- There was no evidence that incidents were related to tank washing machine failure.
- In one case cargo pump failure was identified as the most probable causal factor.

#### 4.9 Management

- Reports reviewed indicate a significant number of incidents were associated with a failure to follow established industry procedures and regulations. In a number of cases, the management systems involved did not have sufficient documented procedures for the activities being conducted.
- Some reports indicate that the role of management related to training and competence was not clear. Where there has been a failure of either of these two factors, it was considered that a failure of management had occurred.

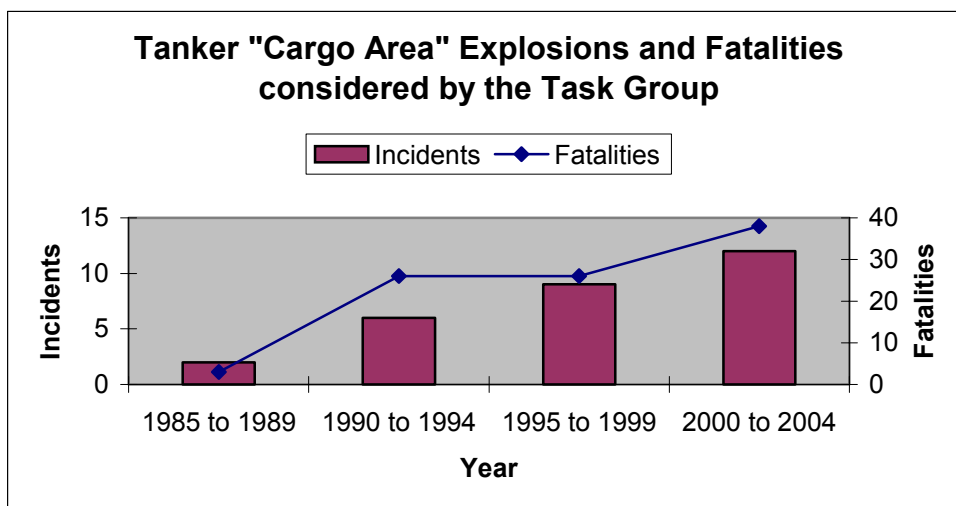
#### 4.10 Regulation

- Sections 16.2.1 – 16.2.3 of the IBC Code specifies that CARGO INFORMATION shall be on board for the safe carriage of cargo. This is usually interpreted as being a requirement for the supply of Material Safety Data Sheets (MSDS) prior to loading MARPOL Annex II cargoes. An MSC circular has been approved by both MSC and MEPC (MSC/Circ.1100 - MEPC/Circ.407) on the format that such information should take (e.g. in line with the Globally Harmonized System of Classification and Labelling of Chemicals).

- Resolution MSC.150(77) makes recommendations regarding the provision of MSDS for MARPOL Annex I Cargoes.
- Discrepancies between the MSDS provided and the cargo specification advised to one ship contributed to confusion on board regarding requirements for the inerting of cargo tanks.

## 5. CONCLUSIONS

- 5.1 The most significant contributory factor to the incident causes was a failure to follow or understand cargo operation guidelines and procedures (at both shipboard and ship management level). *Had the above guidelines been followed, many incidents may have been avoided.*
- 5.2 The Incident investigation reports reviewed did not indicate any failures or discrepancies within the existing ISGOTT or the ICS Tanker Safety Guide (Chemicals) guidelines.
- 5.3 The 35 reviewed incident investigations show the following (unadjusted) trend since 1985.



- 5.4 The Task Group considered it probable that the noted improvement in the standard of incident reporting was due to effective application of the ISM Code. This was reflected in more recent reports showing greater reporting (and awareness) of human element and procedural issues.
- 5.5 *Of concern was the failure, in some cases, to establish an effective safety culture throughout the safety management system.*
- 5.6 Common current industry practices, e.g. chemical spraying or steaming, were contributory causes to a number of incidents. *The continuation and justification of these practices should be investigated.*
- 5.7 Static electricity has been identified as a factor (ignition source) in association with chemical spraying and steaming. *The Task Group considered that there was a limited understanding of the causes, dangers and potential consequences of static electricity within the industry, which many reports identified as a possible ignition source.*

- 5.8 Reports that identified static electricity as a possible ignition source when an alternative was not positively identified may be misleading.
- 5.9 ***In-tank pump failure, identified as a causal factor in at least one incident, was noted as a possible cause in a small number of incidents and requires further investigation.***
- 5.10 Reports reviewed were not specific regarding planning for concurrent operations. The Task Group consider effective planning for such operations to be an important safety consideration.
- 5.11 Establishing and maintaining known tank atmospheres has been shown to be problematic and this has been a contributory factor in many of the incidents. **Further consideration should be given to effective methods and procedures to establish and control tank atmospheres.**
- 5.12 There is potential for confusion if MSDS information advised to ships differs from the cargo loaded (and the specification advised on loading).

## 6. Annex

### 6.1 Annex A - Analysis Spreadsheet

- The data presented relates to 35 ship incidents selected for review.

In a number of instances the Task Group rather than allocating a numerical value to assessed criteria marked the criteria with a question mark (?). This action records that the particular ship report did not clearly identify the particular criteria but in many cases identified a most likely criteria and this has been recorded accordingly.

Analysis Spreadsheet - IIG Incident Task Group Report

Report Number	Identification					Conditions										Atmosphere					Ignition Source					Ignition			
	Green indicates ship fitted with IG.	Red indicates limited data, further information sought	Vessel over 20000 DWT	Vessel under 20000 DWT	In Port	At Sea	Loading	Discharging	Ballasting cargo tanks	Venting/gas freeing	Tank cleaning	Crew in tank	Steam	Sampling	Maintenance in progress	Simultaneous operation	Undefined atmosphere - other operations	Undefined atmosphere - washing	Lean atmosphere	Gas free	Influence of oxygen	Static electricity	Overheated body	Sparks/friction	Use of Unsafe apparatus		Introduction of foreign body	Ignition on deck	Ignition in cargo tank
1			1		1					1		1															1		
2		1			1				1			1									1				1			1	
3																													
4		1			1			1	1							1								1				1	
5			1							1	1																	1	
6		1			1				1							1								1			1	1	
7			1		1					1		1																	
8			1		1					1																		1	
9			1	1			1						1		1														
10			1							1																			
11			1		1					1																			
12			1	1						1	1						1				1							1	
13			1	1						1	1											1	1	?				1	
14			1		1																								
15			1		1					1																			
16			1	1									1					1								1			
17		1			1						1						1				?		?					1	
18			1		1					1																			
19		1			1																								
20			1		1																								
21			1		1								1		1												1		
22			1	1		1							1		1						1			1	1			1	
23					1					1								1/?				1	1					1	
24			1		1					1							1				?	?	?					1	
25			1		1				1			1						1			1							1	
26			1	1			1															?						1	
27		1			1				1	1	1			1							?			1	1	?	?		
28						Insufficient data available or incident considered to have other than direct link to cargo/tank cleaning operations																							
29		1			1					1								1			?	1						1	
30			1	1			1																						
31			1	1		Insufficient data available or incident considered to have other than direct link to cargo/tank cleaning operations																							
32			1		1				1	1		1							1		1							1	
33			1		1	Insufficient data available or incident considered to have other than direct link to cargo/tank cleaning operations																							
34			1	1			1			1																		1	
35		1			1				1	1	1						1					1				1		1	
Total			8	24	9	22	1	4	1	7	16	6	5	2	3	2	3	7	0	3	0	7	2	5	3	3	3	17	1



on Location		Personnel					Cargo					Hardware			Management						ID	
Ship personnel involved	Shore personnel involved	Lack of competency	Lack of training	Number of crew insufficient	No cargo on board	Full cargo on board	Part cargo on board	MARPOL Annex 1 cargo	MARPOL Annex 2 cargo	Primary product involved	Cargo pump failure	Tank cleaning machine	Maintenance	Breach of procedure	Lack of procedure	Inadequate procedure	Pressure of time	Third party influence	All procedures followed	Lack of regulations	Breach of regulations	Report Number
								1	Methanol				?									1
1		1	1		1			1	Gasoline				1									2
									Benzene													3
1		1			1				Naphtha				1								1	4
1					1			1	Benzene				?					?				5
1					1			1	Methanol				1		?							6
								1	Toluene													7
1									Benzene													8
								1	Xylene													9
							1	1	White Spirit													10
									CPP													11
1	1		1		1				Water/Ethanol				1		1		1					12
									Slops													13
									Gasoline													14
									In Ballast													15
1		1	1		1				Toluene				1									16
1						1		1	Grain Alcohol													17
								1	Gasoline													18
									Gasoline													19
					1				Gasoline													20
1		1	1		1		1		Oil Products				1	1							1	21
	1	1	1	1	1			1	Benzene				1			1	1				1	22
			1		1			1	Benzene	1		1	1									23
1					1			1	Gasoline	?	?	?										24
1		1	1				1	1	Toluene				1		1							25
								1	Benzene	?												26
1		1	1				1	1	Ethanol			1	1	1	1						1	27
								1	Methanol													28
1		1	1				1	1	Naphtha				1		1		1				1	29
1	1							1	Ethanol													30
									Gas Oil													31
1		1	1		1			1	Gasoline				1	1	1	1					1	32
								1	Gas Oil													33
							1	1	Methanol													34
1		?	1				1	1	MTBE					1	1							35
16	3	9	11	1	10	2	6	7	19	1	0	2	12	4	6	2	3	0	0	6	Total	