



Report on UKCS DP shuttle tanker incidents 1998 - August 2004

Prepared by **Global Maritime Consultancy Ltd**
for the Health and Safety Executive 2005

RESEARCH REPORT 348



Report on UKCS DP shuttle tanker incidents 1998 - August 2004

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This report reviews the status of tanker offtake on the UKCS for the period 1998 to August 2004. It is an update on a previous report (www.hse.gov.uk/research/rrhtm/rr111.htm), which covered the period 1998 to 2001.

Incidents involving shuttle tankers had previously been studied in the IMCA, JIP Report M150 Quantified Frequency of Shuttle Tanker Collision During Offtake Operations (Ref. 1) and this report uses a similar approach.

The report provides an overview of the data collected, a calculation of the hours of exposure and the frequencies of incident types. The report concludes that during the period under consideration there was a 74% reduction in the frequency of collision between a shuttle tanker and an FPSO/FSU. Nevertheless there is clearly under-reporting of the near miss information and blurring of the lines between normal operational procedures and emergency procedures on some vessels with respect to emergency disconnection.

This report and the work it describes were funded by the Health and Safety Executive (HSE). Its contents, including any opinions and/or conclusions expressed, are those of the authors alone and do not necessarily reflect HSE policy.

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First published 2005

ISBN 0 7176 6110 5

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SUMMARY

This report reviews the status of tanker offtake on the UKCS for the period 1998 to August 2004. It is an update on a previous report (www.hse.gov.uk/research/rrhtm/rr111.htm), which covered the period 1998 to 2001.

Incidents involving shuttle tankers had previously been studied in the IMCA, JIP Report M150 Quantified Frequency of Shuttle Tanker Collision During Offtake Operations (Ref. 1) and this report uses a similar approach.

The report provides an overview of the data collected, a calculation of the hours of exposure and the frequencies of incident types. The report concludes that during the period under consideration there was a 74% reduction in the frequency of collision between a shuttle tanker and an FPSO/FSU. Nevertheless there is clearly under-reporting of the near miss information and blurring of the lines between normal operational procedures and emergency procedures on some vessels with respect to emergency disconnection.

The HSE originally set out to reduce the number of station keeping incidents from the expectations of Ref. 1 (7 per vessel per year). This report concludes that this is not a useful measure and that it is better to focus on level two incidents that are RIDDOR reportable (Ref. 2) and/or UKOOA reportable under their Tandem Loading Guidelines (Ref. 3).

The total time up to August 2004 is 68,829 hrs. During the period there was a total of 19 Type II incidents. Consequently the frequency of the type 2 incident was 2.76×10^{-4} , a 53% reduction.

KEYWORDS

IMCA	SHUTTLE	OFFTAKE	COLLISION
DP VESSELS	DRIFT OFF	DRIVE OFF	POSITION LOSS

1. INTRODUCTION

1.1 Contract

Global Maritime was originally awarded a small study to examine the progress made with tanker offtake operations in terms of safety to independently assess the improvement and trends made since the 1997/8 report entitled “Quantified Frequency of Shuttle Tanker Collision During Offtake Operations” published by IMCA in 1998.

The original work used data from IMCA, HSE, UKOOA members and tanker owners and operators to various degrees with heavy reliance on the former.

In 2004 HSE awarded a further contract to Global Maritime to update the original study to take into account incidents up to end August 2004.

1.1.1 The work has been executed under contract agreement No. D6047.

1.2 Background

Tanker offtake using conventional tankers with bow loading has a long history but offtake from FPSOs rather than loading points in a fairly recent development. In 1997 there were eight FPSOs operating in Northern Europe with stern tanker offtake. Over the four years being considered the following have been operating in the UKCS.

Maersk Curlew	(Shell)
Triton	(Amerada Hess)
Bleo Holm Ross/Blake	(Talisman)
Uisge Gorm (Fife)	(Amerada Hess)
Gryphon A	(Kerr McGee)
Global Producer III	(Kerr McGee)
Schiehallion	(BP Amoco)
Petrojarl Foinhaven	(BP Amoco) (PGS)
Anasuria	(Shell)
Captain	(Texaco)
Alba	(Chevron)
Banff	(PGS) (Nordic Apollo)
Haewene Brim	(Enterprise) Pierce
Liverpool Bay	(BHP)
Glas Dowl	(Shell) (Dowl/Dauntless)

However the Glas Dowl ceased operation in April 1999.

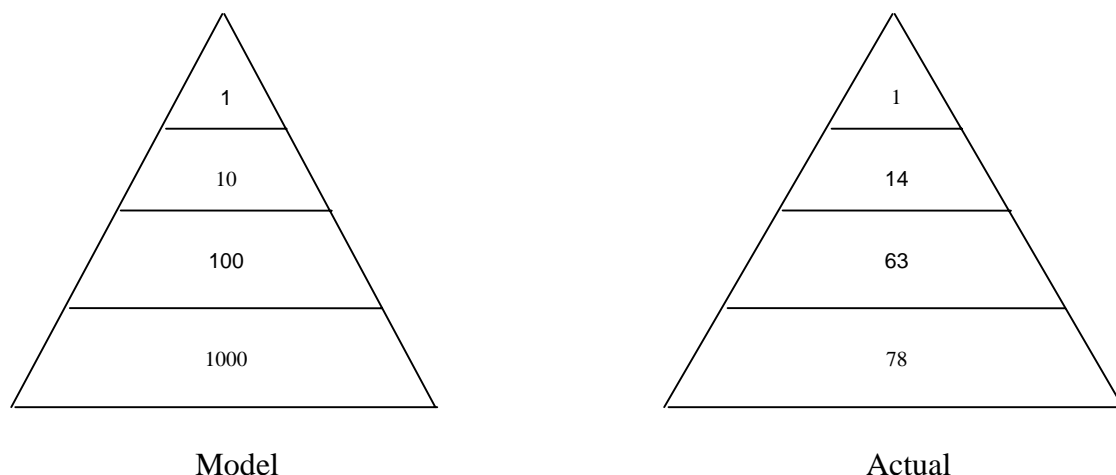
The Banff is included since the use of the Nordic Apollo as an FSU. There are several loading points that are excluded because they are remote from the installation.

The provision of incident data (on the basis of confidentially) by the industry, which allowed this report to be compiled, is greatly appreciated.

2. STARTING POINT

2.1 Expected Reporting

In the earlier work (Ref. 1) there was clear evidence of under reporting and an allowance was made for this. The sources for making the model included reporting profiles before and after a significant incident like a collision. The following “H.W. Heinrich” pyramids were published. (Page 44 Ref. 1)



The four levels represented four types of incident

- I Loss of Position and Loss of Life or major pollution
- II Loss of Position and collision with loading point (or very high hawser tension) emergency disconnection minor pollution.
- III Position Excursion causing ESD, near miss, or high hawser tension.
- IV Station keeping problem causing concern to operator

2.2 Expected Frequencies

Based on the above the expected frequencies per DP hour for each type of incident were as follows: -

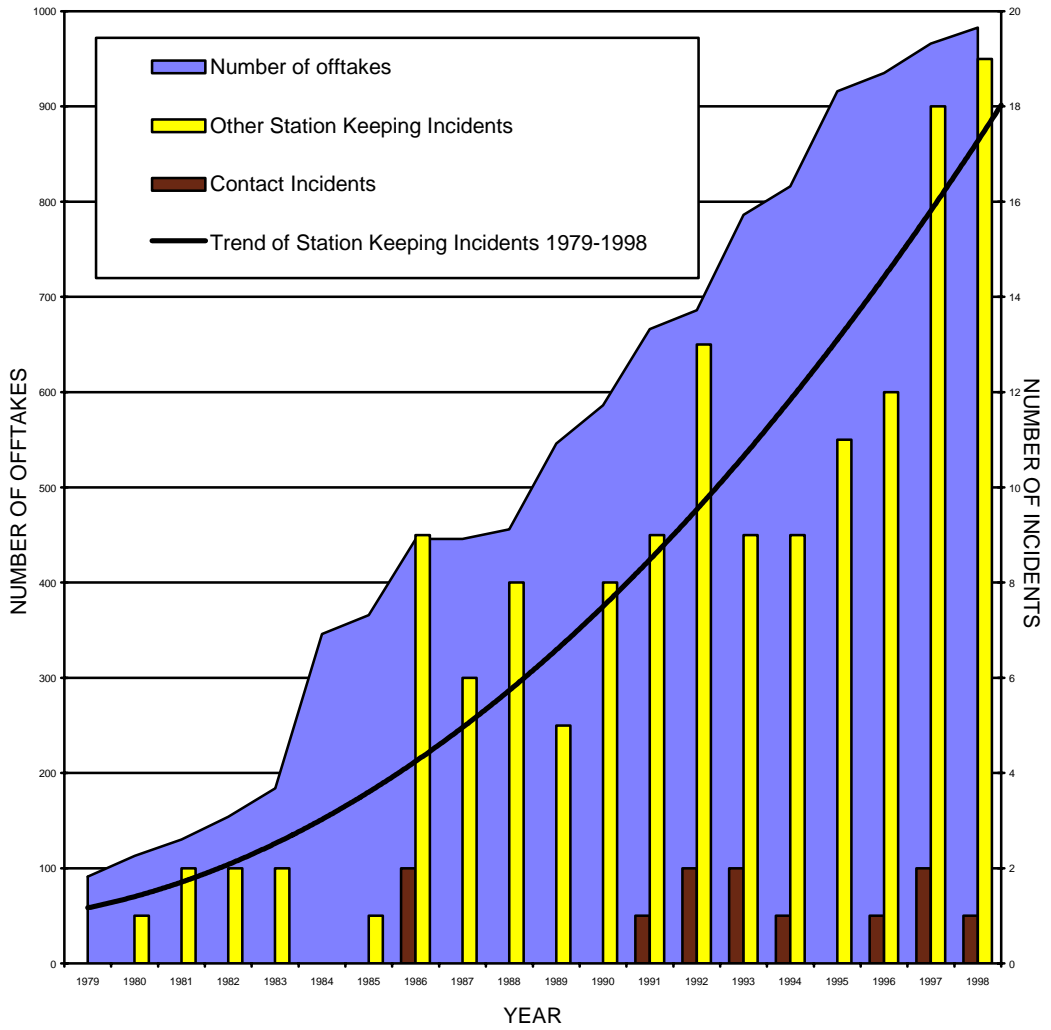
Type I	3.92×10^{-6}
Type II	5.89×10^{-5}
Type III	4.94×10^{-4}
Type IV	3.06×10^{-3}

On the above basis and assuming 80 loadings of 24 hours per year the number of incidents reported would be about 7 per tanker per year. This incident frequency was quantified to encourage reporting. Shuttle Tankers that reported this number were to be considered as normal.

2.3 Published Trend

The figure reproduced below shows the trend at the time of publishing and before all the 1998 data was available. Generally the increase in incidents followed the increase in number of offtakes.

OFFSHORE OFFTAKE TANKER OPERATIONS - NUMBERS OF COLLISIONS and
OTHER STATION KEEPING INCIDENTS BY YEAR 1979 - 1998



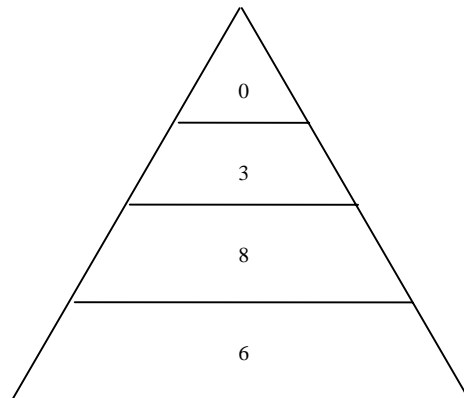
3. OFFTAKE INCIDENTS

3.1 YEAR 1998

After the exercise to collect data for the collision frequency report (Ref. 1) there was a reduction in reporting generally in 1998. The focus of the tanker owners' reports is related to incidents that need technical assistance and incidents that cause delay (downtime). This is a trend generally and the effect is that operator errors that require no technical changes and cause no downtime or acceptable downtime (rough weather) are unlikely to be recorded as incidents.

The data available was reviewed and it was clear that to get value from it the four levels might have to be modified. The principle reason for this is that there was only one collision but several positioning problems. Thus all serious positioning problems were placed in level 2 irrespective of whether there was a collision. We considered them reportable even if they were not reported to HSE.

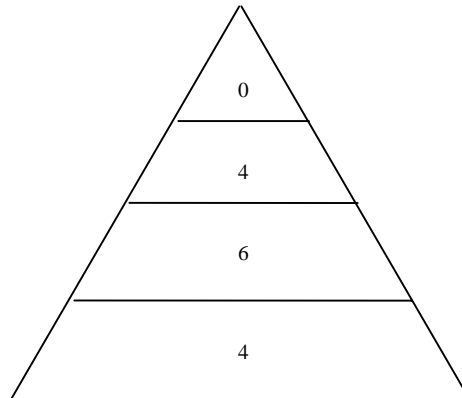
There are 17 incidents reported by 5 different tankers in 1998 of these 4 were mistakes or problems from the FPSO and not the tanker. We have placed these at level 4 along with the telemetry problems reported.



In level 3 there are eight reports the majority of which were high hawser tension, mostly from tankers using the taut hawser mode. In level 2 there are three reported incidents. One is the failure of the breakaway coupling causing a minor spill. The second is the loss of control of the main propeller (CPP). The third is a loss of position and collision that included a small oil spill. If only the tankers from which reports are available from are included then the average number of reports per tanker is 2.6.

3.2 YEAR 1999

In this year there are 14 incidents reported by 5 different tankers. Of these three are unclear and considered of a minor nature and hence given level 4 together with the report of DARPS failure causing an ESD1.



There are 6 incidents rated at level 3, half of these are high hawser tension while the remaining three comprise: -

- main engine failure and ESD2
- misalignment and ESD2
- hawser release and ESD2

Four incidents are rated at level 2 and these comprise: -

- DP drive off and ESD2
- Blackout and ESD2
- Hawser part and ESD2
- Position in red zone and ESD2

If the number of incidents is divided by just the tankers from which feedback has been collected then the average is 2.8 per tanker for 1999.

3.3 YEAR 2000

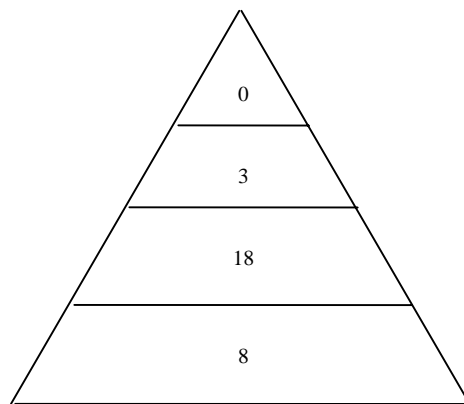
There are more reports for 2000, 29 in all but only 6 tankers reporting and over half of the reports coming from the tanker that was under close attention (strict procedures) because of earlier experience. (This was a major feature of Ref. 1 that after an incident reporting increased significantly).

There are 8 reports that we consider to be level 4 because they are not causing a position problem as far as we can tell from the data e.g. DARPS fault, DP fault, and PMS fault. The problem is that these events sometimes cause an ESD2 but this has been explained as a precautionary (non-emergency disconnection). This has been a major problem with

the data. Some FPSOs have never had an ESD2 while others log them as a normal procedure. Every effort has been made to make sure this difference in reporting and practice does not distort the results of this study. It may also be true that the practice on some facilities is to execute an ESD and log it as a normal disconnection even if the weather is marginal and prevents attendance forward of the tanker and aft on the FPSO.

There are 18 reports that are considered to be level 3 typically these comprise:

- high hawser tension
- misalignment and ESD1
- insufficient power and ESD2
- position excursion causing distance alarm



The 3 remaining incidents comprise three emergency disconnections, where it appears that there was a serious position problem one that caused very high hawser tension, one that was recorded as a sudden deterioration in the weather and one that was recorded as uncontrollable fishtailing. The average reporting for this year is 4.8 per tanker per year but one could argue that this was a better year with better reports.

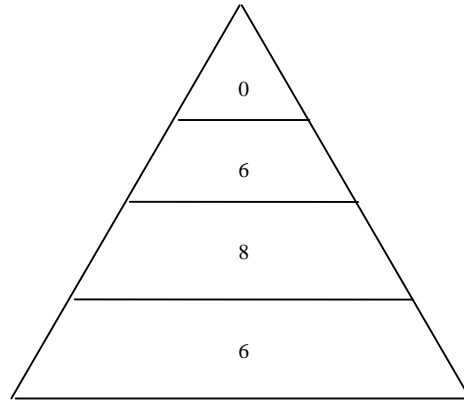
3.4 YEAR 2001

For this year 20 incidents have been collected again from only 5 tankers. Of these 6 are considered level 4, three of which were FPSO problems like blackout and power loss. It is unclear if this had a positioning element but based on the fact that there was only an ESD1 we have assumed there was not.

There are 8 reports that have been given a level 3 rating, they again comprise: -

- High hawser tension
- Misalignment and ESD1
- Fishtailing that was controlled (tension increase)
- Minor coupling leak

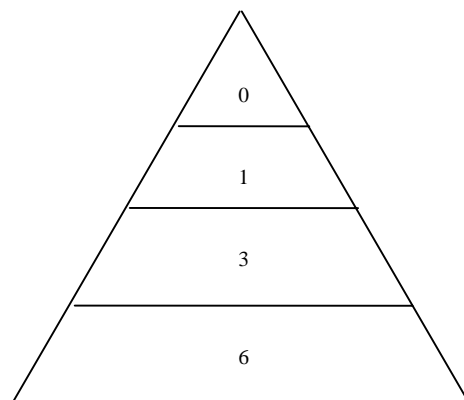
The remaining 6 incidents are placed at level 2 because they all had a serious positioning problem with five out of six resulting in an emergency disconnection. The remaining one had the standby boat connected to stop the fishtailing so loading could be completed.



The average number of incident recorded/collected per tanker per year for 2001 was 3.4.

3.5 YEAR 2002

There were a total of 10 incidents reported by 5 different tankers/FPSO. The bulk of the incidents were weather related. The most serious was a level 2 where during a sudden change in weather the hose and mooring lines stayed connected, but caused damage to the offloading equipment but no pollution. There were three level 3 incidents where sudden adverse weather caused the shuttle tankers to disconnect. There were six level 4 incidents; three of which were weather related, one was a blackout on the FPSO, one due to a thruster problem on the tanker and one due to position keeping difficulties. The average number of incident recorded/collected per tanker per year for 2002 was 2. which is significantly lower than the expected 7 per year. This does not necessarily show a reduction in the frequency of events that are significant it may just show that many events are not seen as incidents. This certainly becomes the case when an incident to some is seen as an everyday event to others until it all goes horribly wrong.

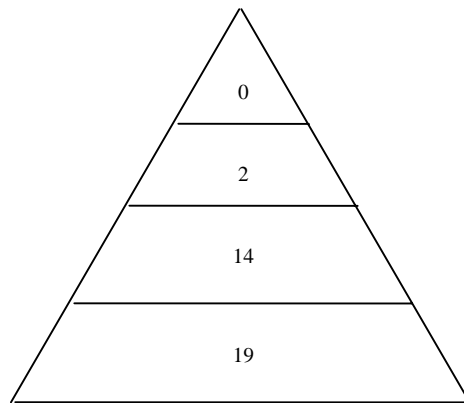


3.6 YEAR 2003

There were a total of 35 incidents reported by 9 different tankers/FPSO. Two level 2 incidents occurred, both of which were the result of adverse weather. One, where as a result of large waves, the chaff chain parted at 30% below it's design breaking strain and the other where excessively high waves parted the vessels and hawser.

A total of fourteen level 3 incidents occurred, seven were the result of problems on the tanker (one incident was caused by human error / poor procedures), three due to adverse weather, two due to poor station keeping and two due to problems on the FPSO.

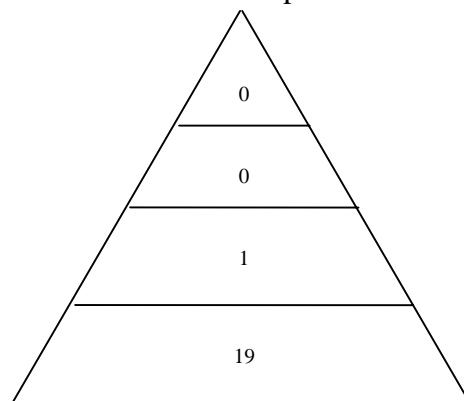
Of the nineteen level 4 incidents reported, eight were weather related; eight were poor station keeping and three were problems on the tanker.



The average number of incident recorded/collected per tanker per year for 2003 was 3.9.

3.7 YEAR 2004 to August 31st.

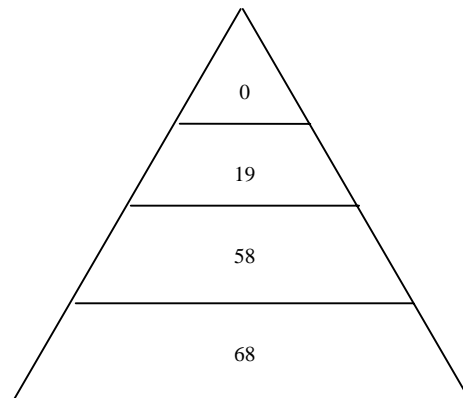
There were a total of 20 incidents reported from six tanker/FPSOs. One level 3 incident was as a result of beam seas when heading into the wind. All the remaining nineteen incidents were level 4, of which five were due to sudden adverse weather, five were due to problems on the FPSO (two of which were blackouts), seven were due to position keeping problems and two were due to problems on the tanker.



The average number of reports per tanker to the end of August 2004 was 3.3.

3.8 YEARS 1998-August 2004

If all the data is combined then the following representation applies:



The number of different tankers reporting is however only ten and two of these provide about half the data. The incidents which were reported to HSE under RIDDOR (Ref. 2) as dangerous occurrences comprise 6 of the 16 from the previous report. RIDDOR data for the period 2002 – 2004 is not available. Nevertheless the wording is open to interpretation and the author has not seen enough data on many of these incidents to be certain of the level. What is certain is that these 19 were of a different and more serious level than the population at level 3 and created circumstances that the operators would wish to always avoid in the future. They would all rate as reportable under the UKOOA guidelines (Ref. 3). They would have been rated as a loss of position 1 under the IMCA reporting scheme, which is equal to that in Ref. 3.

The reporting of incidents, or “events” as they are probably called, is low from the vessels, which the author had no direct contact with. The average of the average for each year is 3.4, which is nearly exactly half the expectation based on Ref. 1. If only the vessels that were under close scrutiny are considered then the figure of 7 reports per vessel per year is about right. This does not mean that there are more frequent level 2 incidents, it means that management does not have all the information it should (at least in writing) on the operations that are being carried out.

3.9 General Incident Average

The average of the averages for the full year’s data available (1998 to end 2003) is 3.25.

4. EXPOSURE

4.1 1998 Exposure

In this year the following facilities have a combined exposure time of 7,757 hours: -

- Curlew
- Uisge Gorm
- Captain
- Glas Dowr
- Liverpool
- Alba
- Gryphon
- Schiehallion
- Foinaven
- Anasuria

4.2 1999 Exposure

In this year the UKCS facilities have a combined exposure time of 9,989 hours. The facilities using tankers increased in this year and the following additional units were exporting.

- Haewene Brim
- BLEO Holm

4.3 2000 Exposure

In this year exposure hours increased to 11,713 hours and Triton commence exporting by shuttle tanker. In addition, Banff started exporting via an FSU (Nordic Apollo).

- Triton
- Banff

4.4 2001 Exposure

The exposure increased to 12,179 hours in 2001. There was no increase in the export facilities but the Glas Down ceased and the Global Producer 3 commenced.

- Global Producer 3

4.5 2002 Exposure

The exposure of the reporting vessels was 10,496 hours in 2002. The apparent reduction in exposure is due in part to the failure of operators to provide data and only five facilities reported incidents.

4.6 2003 Exposure

The exposure of the reporting vessels increased slightly in 2003 to 10,511 hours in 2003. Once again the apparent reduction in exposure is due in part to the failure of operators to provide data. A total of ten facilities reported incidents.

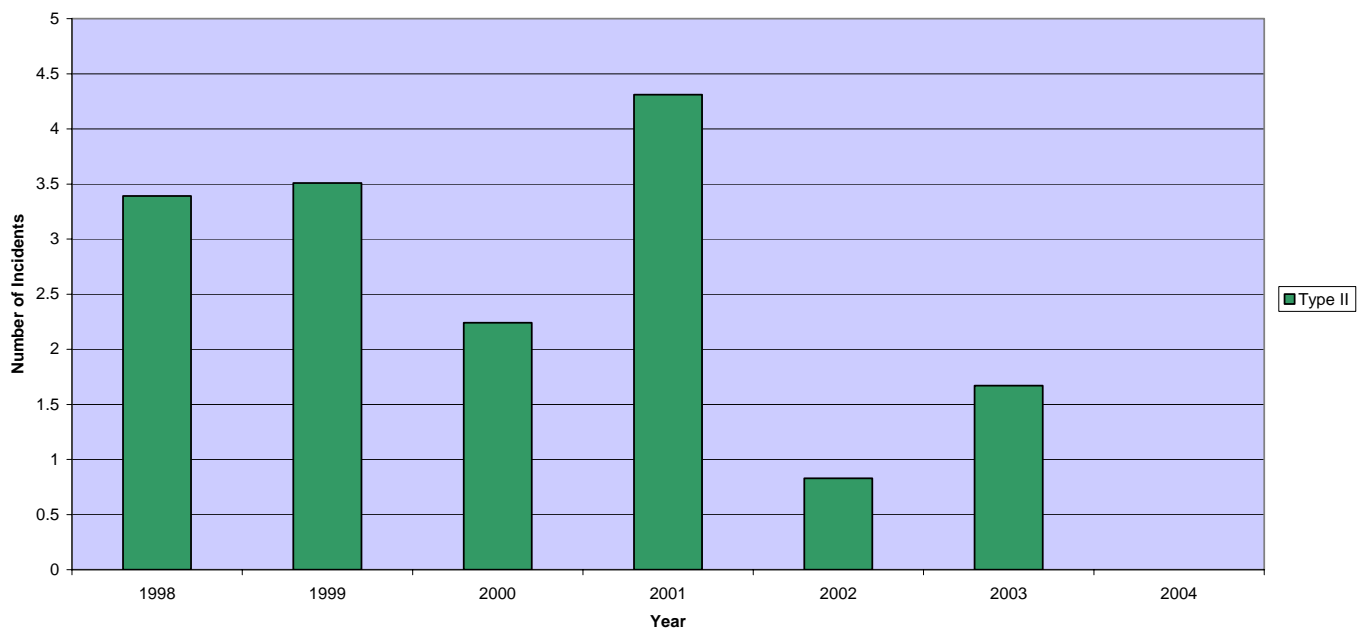
4.7 2004 Exposure

The exposure of the reporting vessels to the end of August 2004 was 6,184 hours. The apparent reduction in exposure is due in part to the failure of operators to provide exposure data. Only four sites reported incidents.

4.8 Total Exposure 1998 – August 2004

The total time up to August 2004 is 68,829 hrs. During the period there was a total of 19 Type II incidents. Consequently the frequency of the type 2 incident was 2.76×10^{-4} , a 53% reduction.

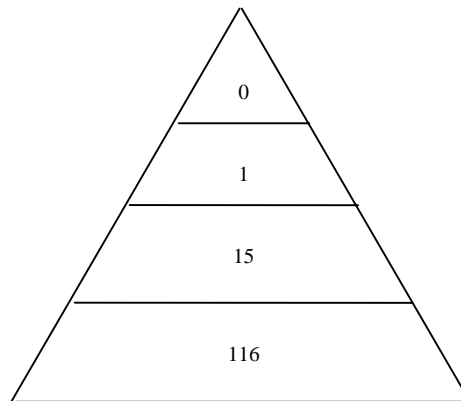
Distribution of Type II Incidents 1998 to August 2004



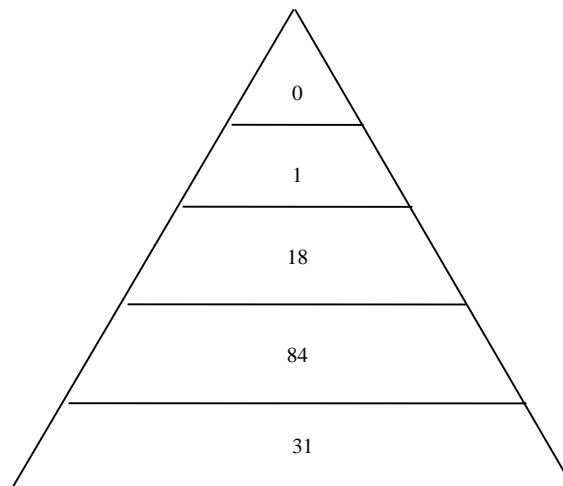
5. DISCUSSION OF RESULTS

5.1 Collision Frequency 1998 – August 2004

Revisiting Ref. 1, shows that all the type 2 incidents were collisions, the 1998-2004 data could be displayed as follows:



Alternatively the 31 reports of FPSO problems and minor equipment failure could be set aside as downtime events. The preference is to leave them included for consistency.

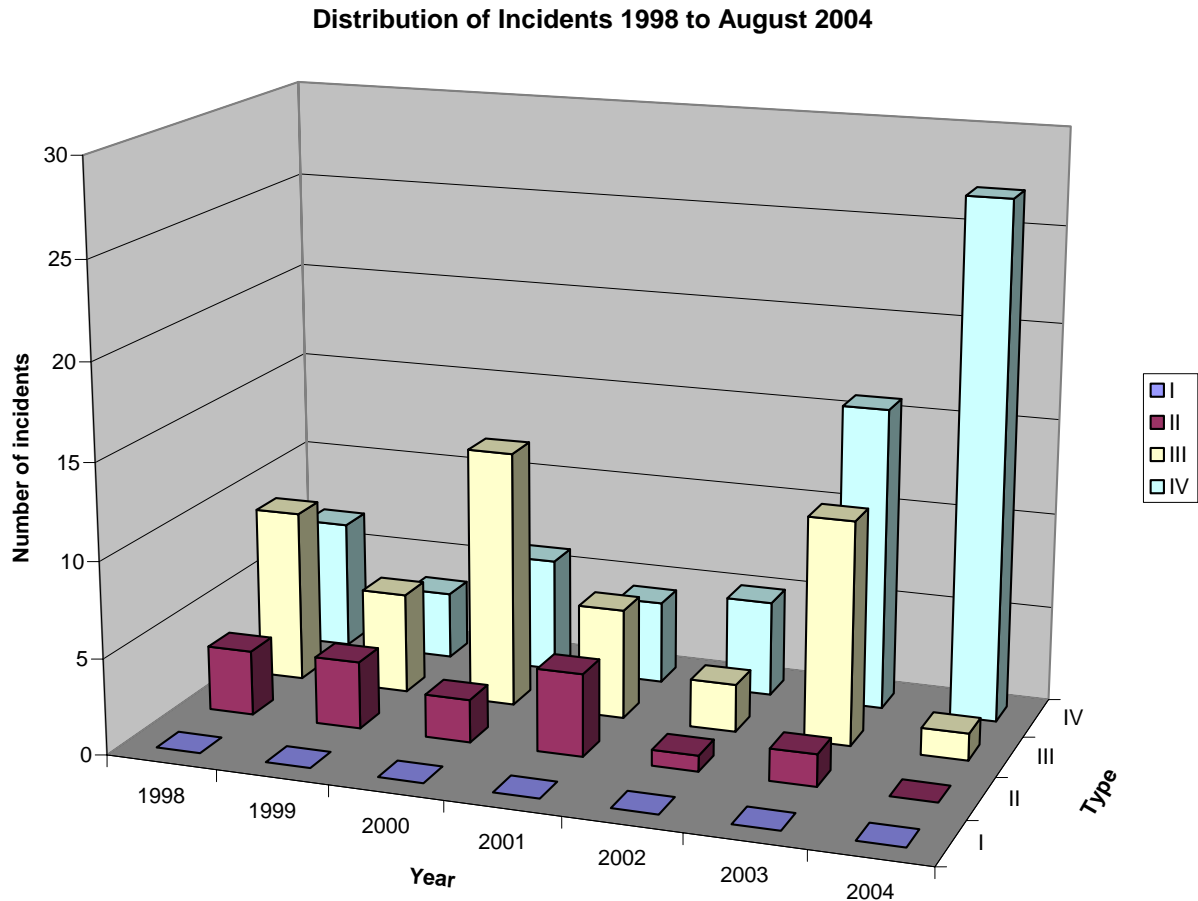


Thus to compare correctly with Ref. 1 the frequencies for type 2 and type 3 are 1.45×10^{-5} and 2.6×10^{-4} respectively showing a 75% improvement in the first and 45% improvement in the second, over the full period.

The problem with this relatively small sample of data is that if the three incidents involving the parting of the hawser (very high hawser tension) are included as type 2 incidents then the frequency becomes 5.81×10^{-5} which represents a reduction of 1.3% below the original level of Ref. 1. They have not been included because for two of the incidents the reports suggest they parted at well below the minimum break load. Similarly, if all the loading points were included (Kittiwake KLB) then another collision would be included and the effect would be to give a frequency of 7.26×10^{-5} an increase in frequency of 23% in respect of Ref. 1.

5.2 Trend 1998 - August 2004

Using the levels described in section three and normalising them per 8,760 hours (1 year) we can see the relative progress:



Clear trends are apparent. To date there has been no level 1 incidents and the frequency of level 2 incidents has been significantly reduced. The general trend for level 3 incidents is downwards while that of level 4 is a gradual increase up to 2003, with significant increases for subsequent years. This should be considered positive as it shows more reporting and greater awareness.

5.3 Pollution Frequency

During the period, there have been six reports involving hydrocarbon leakage all minor and only two causing noticeable pollution in the sea. One of these was also the collision incident, the other was the unexpected operation of the breakaway coupling. Thus for the period from 1998 to August 2004 the frequency for a minor pollution incident was 2.9×10^{-5}

5.4 High Hawser Tension

During the period 1998 to 2001, there were numerous recordings of high hawser tension > 150t and the reasons for this are likely to be: -

- More use of taut hawser mode
- Hawser alarms set at 150t and available to tanker and FPSO
- Practice of staying connected and accepting the occasional alarm for high tension
- Familiarity with the method from extended periods of offtake

These are all reasonably positive reasons; the difficulty is to separate these alarms from the occasions (if any) when there was a risk of the hawser parting. Many present tanker marine personnel are unaware that it was a hawser parting and the subsequent fire forward that triggered the move to DP control systems for shuttle tanker. There are several incidents where the high tension and the emergency disconnection were not part of an orderly procedure.

During the period 2002 to August 2004 there were no reported incidents of high hawser tension however there were two incidences of the mooring hawser parting at a tension well below its design strength.

5.5 Emergency Disconnection

The frequency of emergency disconnections is also very difficult to analyse because for many this is the normal procedure. The automatic system is used because it is safer and quicker especially in deteriorating weather. Even in vessel log books the term ESD2 or ESD3 is used sometimes whereas in bad weather when disconnection is forced by station keeping problems just “disconnection” is logged without mention of whether the ESD system was used. So some facilities have frequent ESD2s whereas others, throughout the period studied have none.

One must conclude that the situation is similar to that of high hawser tension in that the normal situation is difficult to separate from the abnormal or emergency situation.

5.6 Thruster and/or Main Engine Problems

During the period 1998 to August 2004, there were twelve incidents involving thrusters, main engines or generators, of these three were main engine pitch control, three were main engine failures causing disconnection and one was a thruster failure. The frequencies of these events are as follows: -

- | | |
|---------------------------|-------------------------|
| • CPP / Thruster Control | 4.35 x 10 ⁻⁵ |
| • Main Engine / Generator | 4.35 x 10 ⁻⁵ |
| • Thruster Failure | 1.45 x 10 ⁻⁵ |

Note all frequencies in this report are per DP hour.

5.7 Misalignment

During the period 1998 to August 2004, there are nine reports of misalignment, all of which come from two vessels (3 FPSOs). Five caused an ESD1 as a precaution. One caused an ESD1 until the standby boat was hooked up. Only two caused an ESD2 or persuaded the operators that it would be prudent to disconnect. No data on whether the operations manual's limits were exceeded were available.

5.8 DP Problems

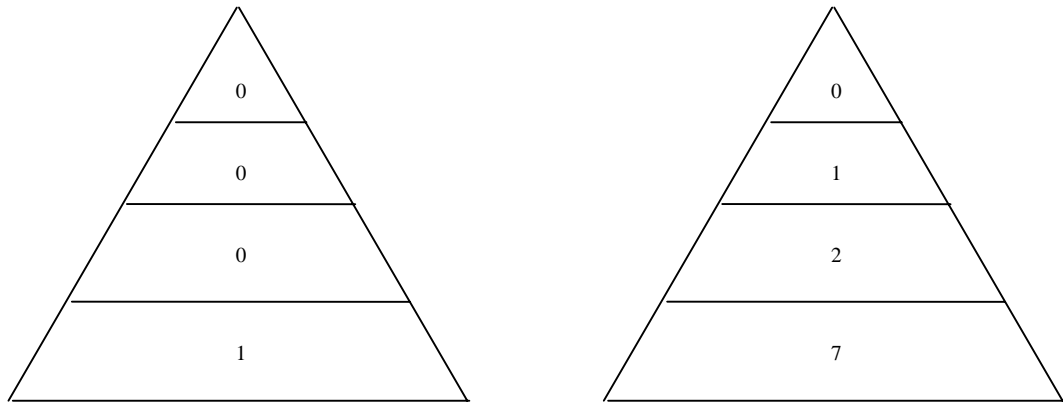
During the period 1998 to August 2004, there was one collision that was attributed to a DP control problem. There are ten other DP problems in the data but of course many others may have taken place to cause misalignment, insufficient power or even high hawser tension but they were not logged as a DP problem. Four involved position reference failure but no data is provided in consequence unless downtime occurred. Two were from poor positioning in deteriorating weather, one incident involved operator error / poor procedures which caused the unplanned transfer of DP control to standby mode, while the remainder were DP control problems. There were nine reports of problems with station keeping, which results in ESD

5.9 Weather

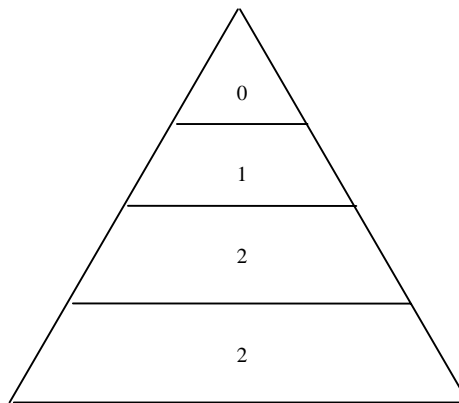
There were a further 27 incidents where it was decided to disconnect due to adverse weather, frequently the weather was reported to be in excess of Force 9.

5.10 Reporting Profiles

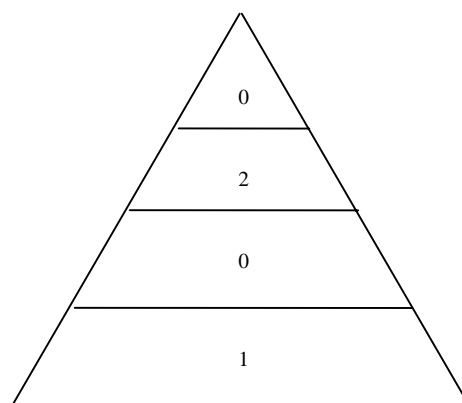
In Ref. 1 two reports profiles were shown for a vessel prior to a collision and after a collision (Figs 3.1.51 and 3.1.52). Following the collision a more strict reporting regime is evident. These are shown below:



This same vessel has continued good reporting in comparison to other vessels of her type and for the four year period has the following reporting profile:



This needs to be compared to another similar vessel, which has the following profile:



One would normally expect an increased number of level 3 and level 4 incidents with a corresponding decrease in the number of level 1 and 2 incidents. By recording minor incidents management are kept informed thereby reducing the possibility of minor incidents being ignored and developing into major ones.

As mentioned earlier the expectation from Ref. 1 was that there would be about 7 reportable events per full year per tanker and the average is 3.4. Nothing in the data collected for this study changes the expectation of 7 because some shuttle tankers have exceeded this level. It is a measure of the reporting culture rather than the safety. Each tanker should be expected to report 2-3 level 3 events and 4-5 level 4 events. The occurrence of one level 2 event say once every five years might also be expected. This would mean that this study would have 28 level 2 events if there were 20 shuttle tankers reporting over the seven-year period.

References

- 1 IMCA Report M150 Quantified Frequency of Shuttle Tanker Collision During Offtake Operations.
- 2 RIDDOR Report of Injuries, Diseases and Dangerous Occurrences Regulations 1995.
- 3 UK00A FPSO Committee Tandem Loading Guidelines 2001.

6. CONCLUSIONS

6.1 Conclusions

- 6.1.1 There has been a significant reduction in the frequency of collisions between tankers and FPSO / FSU in the last five years and using reasonable judgement the improvement can be quantified as 53%.
- 6.1.2 There have been no fatalities or injuries to personnel from tanker offtake operations and only two incidents of minor pollution to the sea.
- 6.1.3 The collection of data, particularly near miss data is difficult and the detail in the data collected is sparse. There was only one incident recorded, attributable to operator error.
- 6.1.4 There is preference for the use of the taut hawser mode of operation on some vessels, which might be in part because these vessels often connect for extended periods (weeks rather than < 24 hours) for offtake.
- 6.1.5 It is not possible to distinguish serious situations involving high hawser tension from non-serious high-tension alarms from the data available.
- 6.1.6 It is not possible to distinguish ESD2s that are Emergencies from ESD2s that are part of normal operation.
- 6.1.7 About half the data collected comes from just two vessels and only about half of the shuttle tankers operating in the UKCS have reported anything.
- 6.1.8 The expectation of 7 reports per tanker per year has not been met and the average from the tankers from which data was obtained was 3.25 per vessel per year. While this might be seen as a sign of an improvement in safety there is little to support this. The original idea of having a reporting average was to show vessel operators and owners what to expect as normal and hence encourage reporting with no recrimination.



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