HSE
Health & Safety Executive

Report on trends in shuttle tanker incidents 1998 – 2001

Prepared by **Global Maritime Consultancy Limited**
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RESEARCH REPORT 111

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Health & Safety Executive

Report on trends in shuttle tanker incidents 1998 – 2001

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This report reviews the status of tanker offtake on the UKCS as of 1997/8 from a report produced at this time (Ref 1) and uses this approach to analyse data from 1998 to 2001.

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 there has been a 59% reduction in the expected frequency of collision between a shuttle tanker and an FPSO/FSU. Nevertheless there is clearly underreporting and blurring of the lines between normal operational procedures and emergency procedures on some vessels with respect to emergency disconnection.

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SUMMARY

This report reviews the status of tanker offtake on the UKCS as of 1997/8 from a report produced at this time (Ref 1) and uses this approach to analyse data from 1998 to 2001.

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 there has been a 59% reduction in the expected frequency of collision between a shuttle tanker and an FPSO/FSU. Nevertheless there is clearly under-reporting and blurring of the lines between normal operational procedures and emergency procedures on some vessels with respect to emergency disconnection.

The HSE set out to reduce the number of station keeping incidents from the expectations of Ref 1 (7 per vessel per year). The 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 report recommends the work is extended to include all loading points in Northern Europe so that progress can be better compared with Ref 1.

1. INTRODUCTION

1.1 Contract

Global Maritime were 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 work uses data from IMCA, HSE, UKOOA members and tanker owners and operators to various degrees with heavy reliance on the former, most of which has come from Navion.

1.1.1 The work has been executed under contract agreement No. D4012.

1.2 Background

Tanker offtake using conventional tankers with bow loading has a long history but offtake from FPSOs rather than loading points is 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 (Leadon)	(Kerr McGee)
Schiehallion	(BP Amoco)
Petrojarl Foinhaven	(BP Amoco) (PGS)
Anasuria	(Shell)
Captain	(Texaco)
Alba	(Chevron)
Banff	(PGS) (Nordic Apollo)
Haervene Brim	(Enterprise) Pierce
Liverpool Bay	(BHP)
Glas Dowr	(Shell) (Dowr/Dauntless)

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.

In addition to the above the following also operated tandem offtake offshore Norway.

Balder	(Exxonmobil)
Jotun A	(Exxonmobil)
Petrojarl 1	(Statoil)
Petrojarl Varg	(Norske Hydro)
Asgard	(Statoil)
Norne	(Statoil)
Heidrun	(Conoco)

The latter uses tandem offtake occasionally.

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)

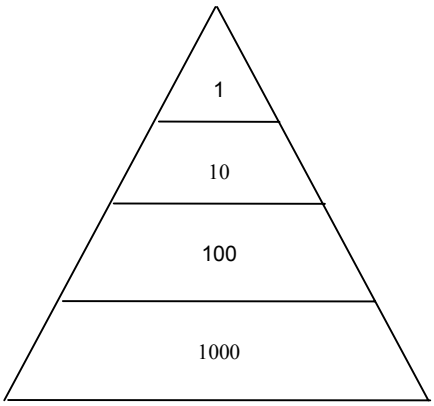

Fig. 1

Model

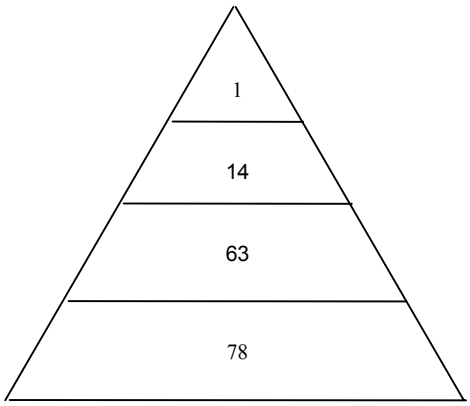

Fig. 2

Actual

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.

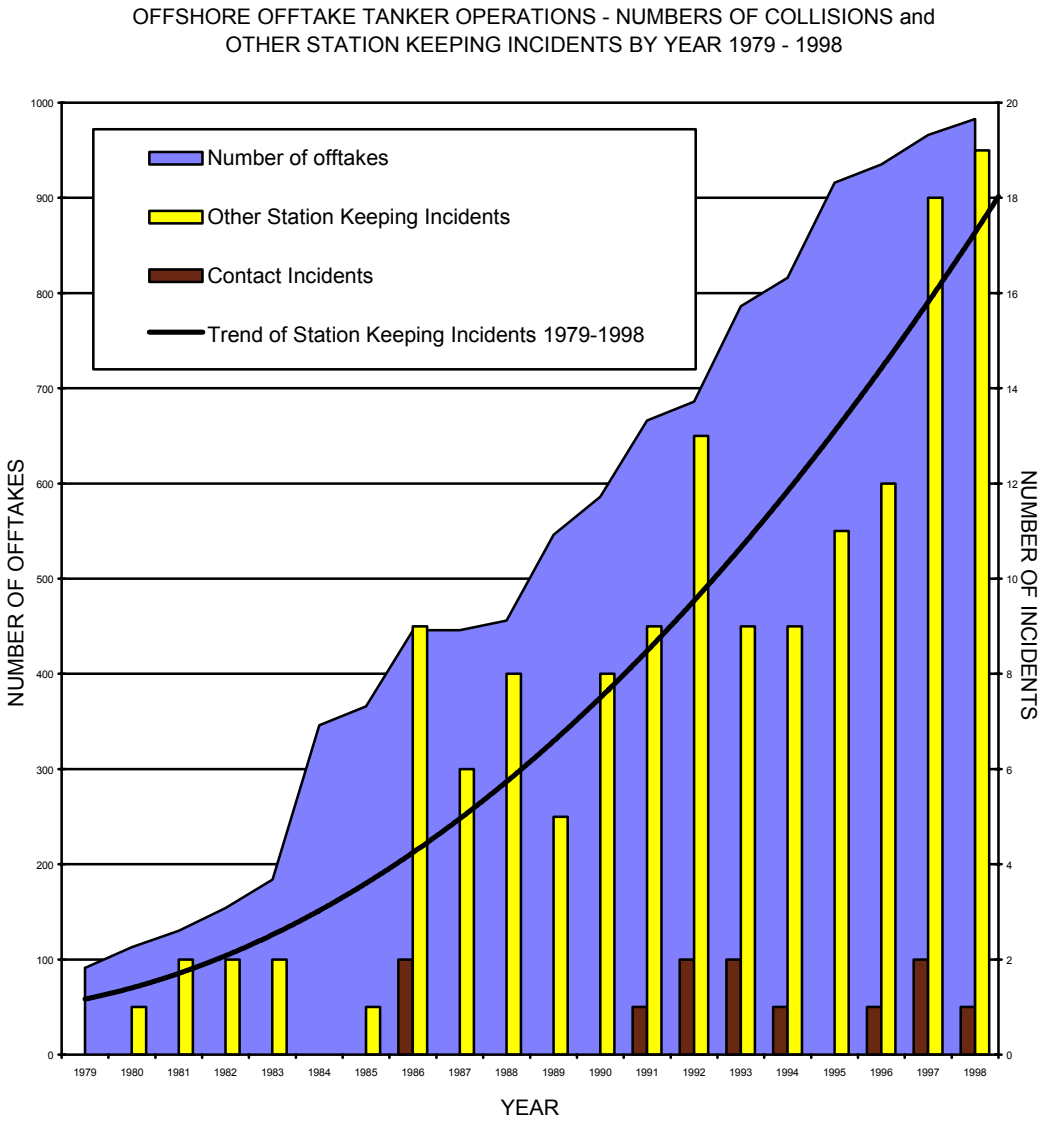

Fig. 3

3. OFFTAKE INCIDENTS

3.1 1998

After the exercise to collect data for the collision frequency report (Ref 1) there was a reduction in reporting generally in 1998 and also the database used by Navion was changed. 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.

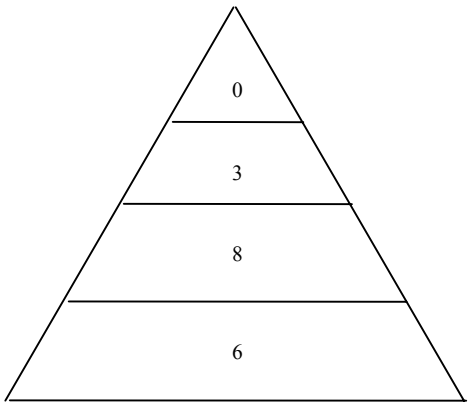

Fig. 4

In level 3 there are eight reports the majority of which are 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.

3.2 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.

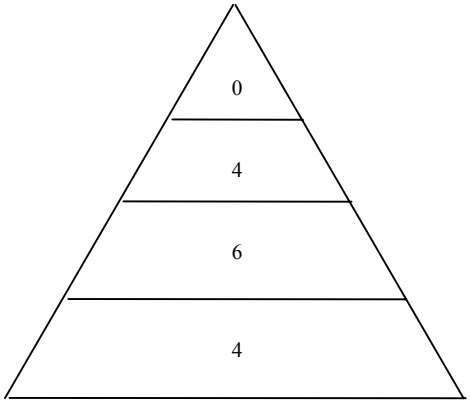

Fig. 5

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

3.3 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, 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

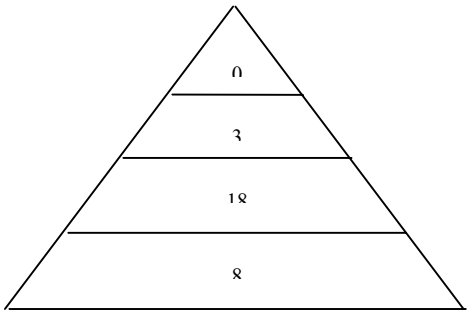

Fig. 6

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.

3.4 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.

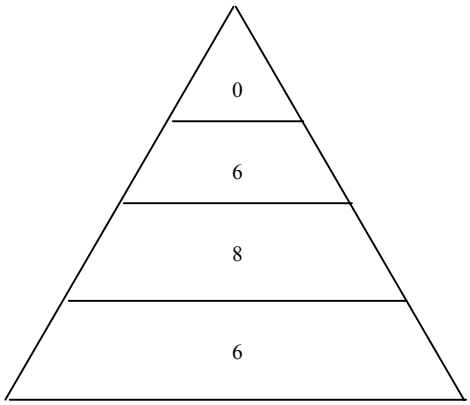

Fig. 7

3.5 1998-2001

If the four years of data is combined then the following representation applies:

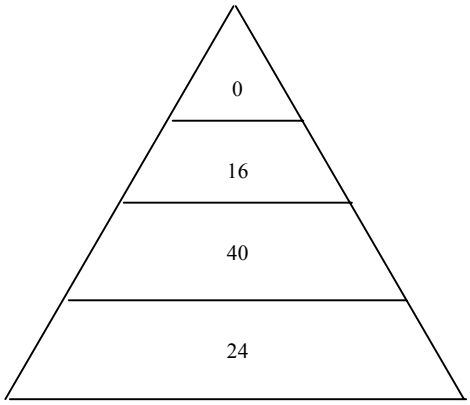

Fig. 8

The number of different tankers reporting is however only ten and two of these provide about half the data. The incidents that were reported to HSE under RIDDOR (Ref. 2) as a dangerous occurrence comprise 12 of the 16. So only 75% were reported. 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 16 were of a different and more serious level than the population at level 4 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 rated as a loss of position 1 under the IMCA reporting scheme which is equal to that in Ref. 3.

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 commenced 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 Downr ceased and the Leadon commenced.

- Leadon

4.5 Total Exposure

The total time for the four years is 41,638 hours. This makes the frequency of the type 2 incident 3.84×10^{-4}.

5. DISCUSSION OF RESULTS

5.1 Collision Frequency

Revisiting Ref 1 shows that all the type 2 incidents were in fact collisions. So the 1998-2001 data could be displayed as follows:

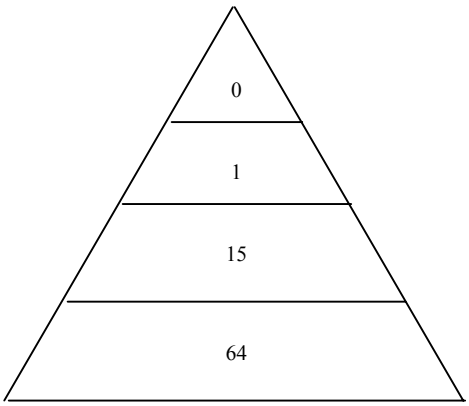

Fig. 9

Alternatively the 24 reports of FPSO problems and minor equipment failure could be set aside as downtime events.

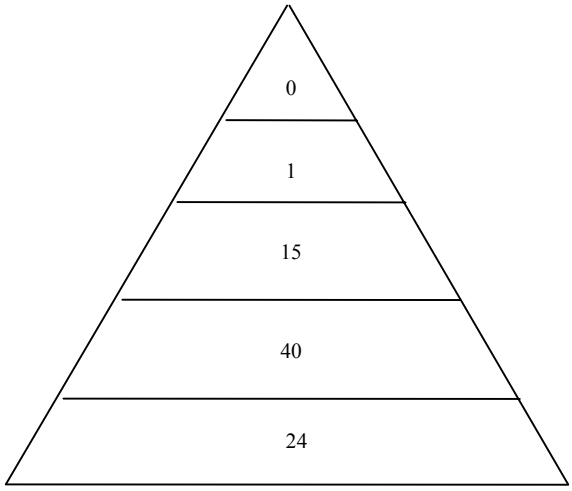

Fig. 10

The preference is to leave them included because they caused concern to the operator. Thus to compare correctly with Ref. 1 the frequencies for type 2 and type 3 are 2.4×10^{-5} and 3.6×10^{-4} respectively showing a 59% improvement in the first and 27% improvement in the second.

The problem with this relatively small sample of data is that if the incident involving the parting of the hawser (very high hawser tension) is included as a level 2 incident then the percentage improvement will decrease to only 17%. It has not been included because the report suggests it 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 the same (or worse if there were three level 2 incidents).

5.2 Trend 1998-2001

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

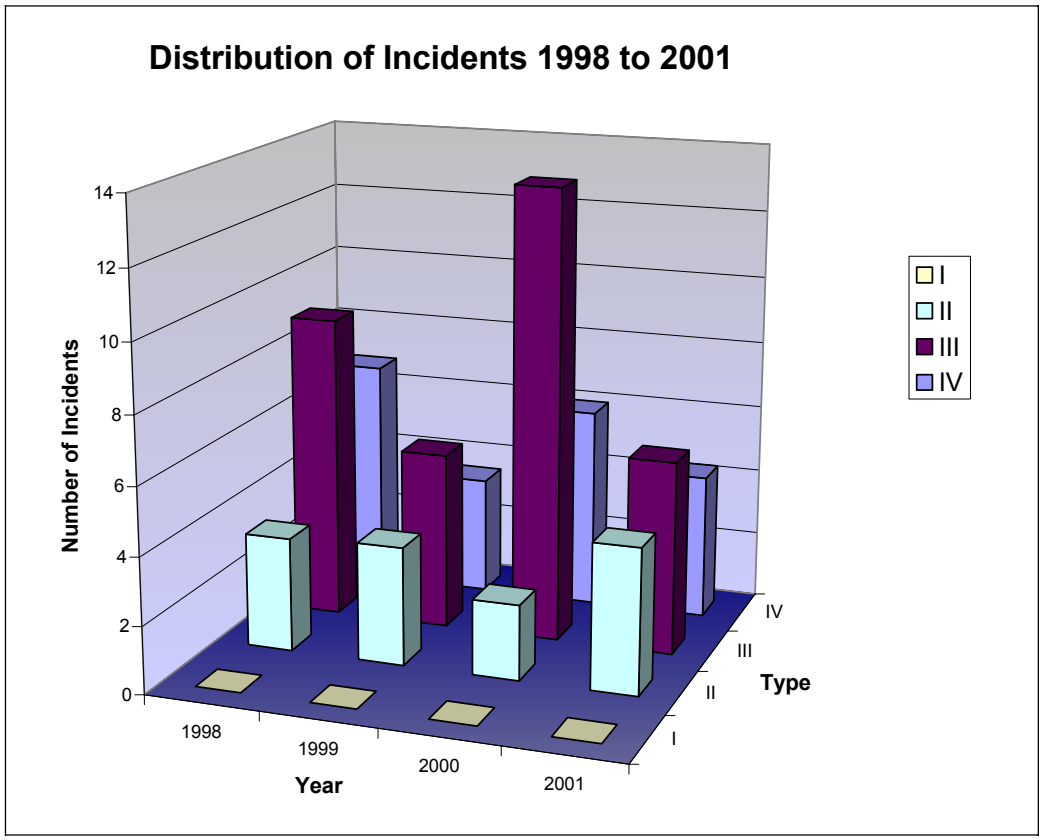

Fig. 11

No clear conclusion can be made except perhaps that the variation is small especially for the level 2 incidents. The measurement of success should be in level 1 and level 2. An increase in level 3 and level 4 would be positive if it showed more reporting and greater awareness.

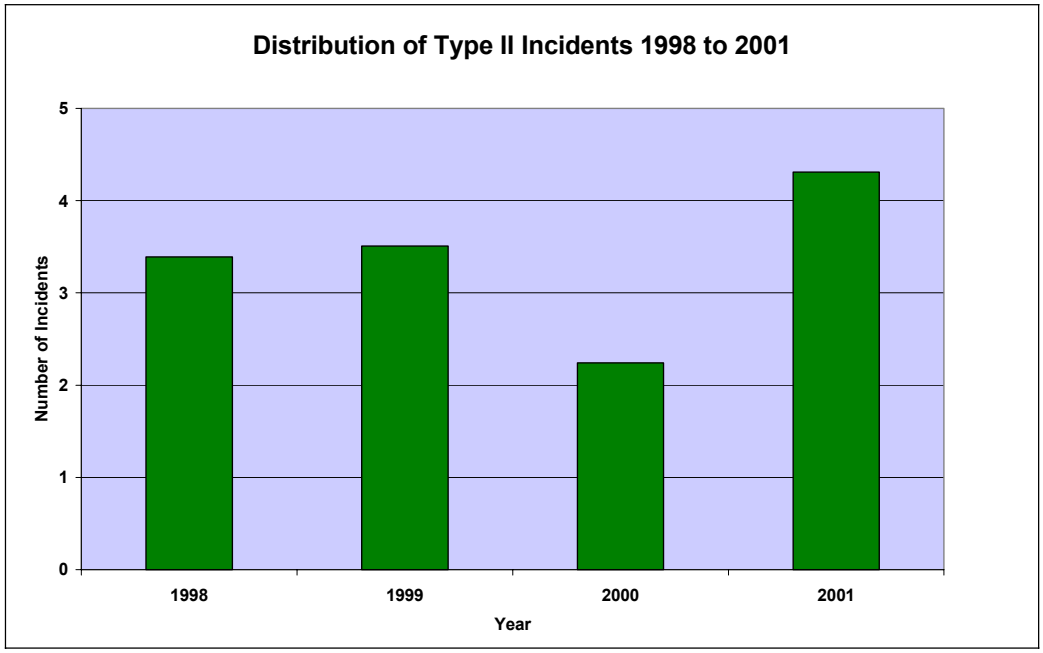

Fig. 12

5.3 Pollution Frequency

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 the frequency of a minor pollution incident has been 4.8×10^{-5}.

5.4 High Hawser Tension

There has been 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 a couple of incidents where the high tension and the emergency disconnection were not part of an orderly procedure.

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 four years, 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

There have been nine incidents involving thrusters or main engines, of these two were main engine pitch control and three were main engine failure causing, disconnection, ESD2 and ESD3. The frequencies of these events are as follows:-

- CPP Control 4.8×10^{-5}
- Main Engine Failure 7.2×10^{-5}

Note all frequencies in this report are per DP hour.

5.7 Misalignment

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

The one collision is attributed to a DP control problem. There are nine 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 involve position reference failure but no data is provided in consequence unless downtime occurred. Two were from poor positioning in deteriorating weather while the remainder were DP control problems.

5.9 Reporting Profiles

In Ref 1 two reporting profiles were shown for a vessel prior to a collision and after a collision (Figs 3.1.51 and 3.1.52). These are shown below:

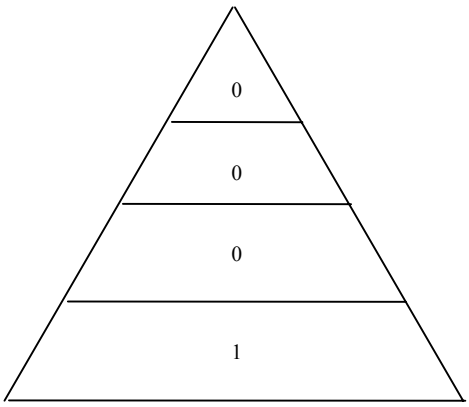

Fig. 13

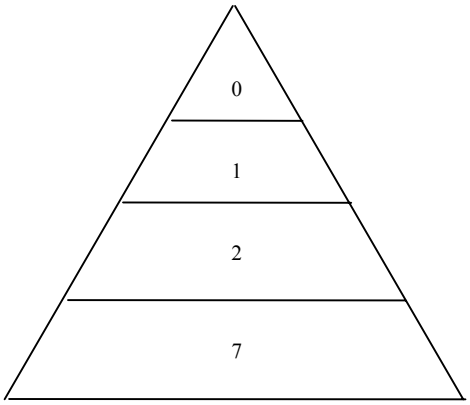

Fig. 14

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:

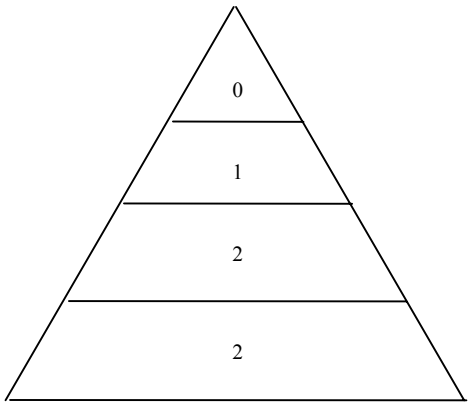

Fig. 15

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

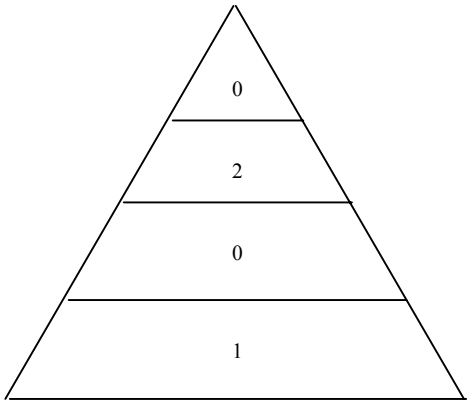

Fig. 16

The expectation from Ref 1 was that there would be about 7 reportable events per full year per tanker. Nothing in the data collected for this study changes this expectation 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 16 level 2 events if there were 20 shuttle tankers reporting over the four year period.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

6.1.1 The collection of data is difficult and the detail in the data collected is sparse and difficult to assess. There are zero incidents recorded, attributable to operator error.

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 Using reasonable judgement it is possible to show that there has been a 59% decrease in the frequency of collision when just considering FPSO/FPSUs in the UKCS with Ref 1. However, Ref 1 covered all loading points and the Norwegian offtake operations.

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 for the Navion database.

6.2 Recommendations

6.2.1 Extend the study to cover all loading points in Northern Europe so that the exposure hours are greater and more of the available data is used effectively.

6.2.2 Promote the logging of Emergency disconnections differently from planned disconnection using the ESD system.

7. REFERENCES

1 IMCA Report M150 Quantified Frequency of Shuttle Tanker Collision During Offtake Operations.

2 RIDDOR Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995.

3 UKOOA FPSO Committee Tandem Loading Guidelines 2001.

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