Proceedings of the ASME 2011 30th International Conference on Ocean, Offshore and Arctic Engineering
OMAE2011
June 19-24, 2011, Rotterdam, The Netherlands

OMAE2011-49897

COLLISIONS BETWEEN PLATFORMS AND SHIPS IN NORWAY IN THE PERIOD 2001-2010

Arne Kvitrud
Petroleum Safety Authority (PSA)
Professor Olav Hanssens vei 10
NO-4003 Stavanger, Norway

ABSTRACT

Since 1982, 115 collisions have been reported on the Norwegian Continental Shelf, with varying degree of severity. In the period 2001-2010 there have been 26 reported collisions. None of the collisions has caused loss of lives or personnel injuries. The economic consequences however have been significant, especially one collision in 2009.

This paper will give statistical summaries of the events, and compare the development of events with previous periods. The focus will be on the six most severe cases, describing each case, the damage and emphasise the most common causes of these events.

INTRODUCTION

The paper is divided into four sections. The first section gives an overview of the present regulations and guidelines. The second provides a statistical overview of the collisions, and testing of some hypotheses. The third section is a review of the six events which from the authors point of view, is the most onerous the last decade. The last section ("Summary and conclusions") will discuss the need for improvement.

Data on ship collisions in Norway have previously been reported at several occasions, as in Hamre et al (1991), Kvitrud (1994), Kvitrud et al (2008), PSA (2010) and Kvitrud (2010). Collisions at the UK continental shelf are reported by HSE (2001) including incidents up to October 2001. From the UKCS data, five supply or standby vessel collisions have resulted in severe damage (Lilleaker, 2010).

Most of the platforms are monitored from the traffic control centres at Ekofisk (ConocoPhillips) and Sandsli (Statoil). The traffic control centre at Ekofisk has in 2010 been duplicated to the shore base in Tananger. Only four production platforms and a few more mobile units are monitoring the ship traffic themselves.

REGULATIONS AND GUIDELINES

The vessels

Our regulations apply to health, environment and safety in the petroleum activities. As regards whether or not the petroleum regulations will apply on vessels, the decisive factor is the term "petroleum activity". Consequently, the petroleum regulations do not apply to supply vessels, as such, neither prior to nor during the execution of the activity. For conditions on board the supply vessels, maritime legislation will apply.

On the other hand, the activity regulation (PSA et al, 2010) section 90 gives requirements on positioning: "*When carrying out maritime operations, the responsible party shall implement necessary measures so that those who participate in the operations, are not injured, and so that the probability of hazard and accident situations is reduced. Requirements shall be set for maintaining the position of vessels and facilities when conducting such operations, and criteria shall be set for start-up and interruption,*

...." The requirement is further detailed in the guidance to this regulation. In order to fulfil the requirement to marine operations a set on equipment classes should be used for vessels with dynamic positioning as diving vessels, support vessels for diving operations, lifting vessels or pipe laying vessels in the vicinity of the platform, shuttle tankers and vessels performing shallow drilling. As an example shuttle tankers loading from facilities handling hydrocarbons (as FPSOs), should have an equipment class 2 with reference to IMO/MSC (1994).

Norwegian guidelines for safe operations of vessels visiting platforms were first developed by the Norwegian Oil Industry Association (OLF). The guidelines for Safe Management of Offshore Supply and Rig Move Operations (NW European Area) were then issued in 2006 as a joint project between maritime and offshore organizations in Denmark, Netherlands, Norway and the UK. It was updated in June 2009. Best practice and experience exchange are basis for the guidelines. These guidelines are referred to by the operators, and are the common basis for safe operations of vessels visiting platforms in Norway.

The platforms

For the design of structures exposed to ship collisions the facility regulation (PSA et al, 2010) section 11 on loads, load effects and resistance applies: "*The loads that can affect facilities or parts of facilities, shall be determined. Accidental loads and natural loads with an annual probability greater than or equal to 1x10-4, shall not result in loss of a main safety function*". Five main safety functions are described in Section 7, and one of them is "maintaining the capacity of load-bearing structures until the facility has been evacuated*"*.

For production platforms the NORSOK N-003 section 8.3.2 requires "*In the early phases of platform design, the mass of supply ships should normally not be selected less than 5000 tons and the speed not less than 0.5 m/s and 2 m/s for ULS and ALS design checks, respectively. A* *hydrodynamic (added) mass of 40 % for sideways and 10 % for bow and stern impact can be assumed*."

With regard to mobile facilities registered in a national register of shipping, and which follow a maritime operational concept, relevant technical requirements contained in rules and regulations of the Norwegian Maritime Directorate, together with supplementary classification rules issued by Det Norske Veritas, or international flag state rules with supplementary classification rules achieving the same level of safety, may be used as an alternative to the technical requirements in the facility regulations. In these cases a requirement of a collision with 5000 tons and a velocity of 2 m/s should be applied. In additions, the management regulation Section 6 requires that the "*operator shall set acceptance criteria for major accident risk and environmental risk*". These criteria are frequently stipulated in accordance with the requirements stipulated in the facility regulation § 10, as referred above.

A STATISTICAL OVERVIEW

Passing vessels collision risk

Only two collisions with passing vessels have been reported, a submarine collision with Oseberg B jacket in 1988, and a vessel collided with the booster platform H-7 in German waters in 1995.

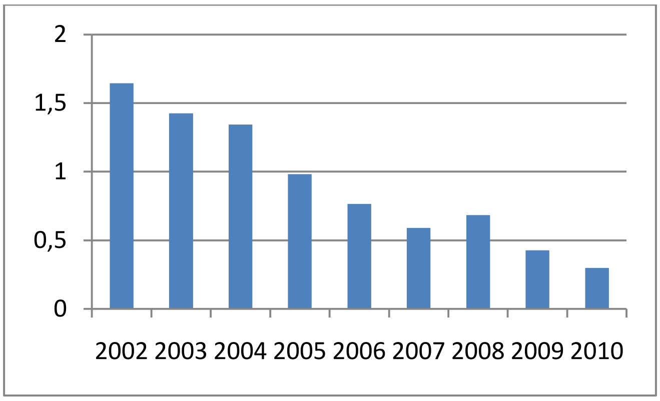

Figure 1: The annual number of ships on collision course, divided with the number of platforms surveyed. All the data are observed from Sandsli Maritime Control Centre. The figure is made from data collected by Jan Erik Vinnem (PSA, 2011).

To monitor the ship collision risk from passing vessels, the number of vessels on collision course is counted annually from the Statoil Maritime Control centre at Sandsli. These are situations where the direction of the vessel is inside the safety zone, and no contact has been establish with the vessel within 25 minutes before a possible hit, or vessels or helicopters are mobilized against the approaching vessel. Fishing vessels in low speed and small ships (as sailing ships) are not counted. Since the number of platforms surveyed is not constant, the number of vessels on collision course is normalized with the number of platforms surveyed. As demonstrated in figure 1, the relative number of ships on collision course has improved for several years, with a factor of about four since 2002. The number of violations of the safety zones is also low (figure 2).

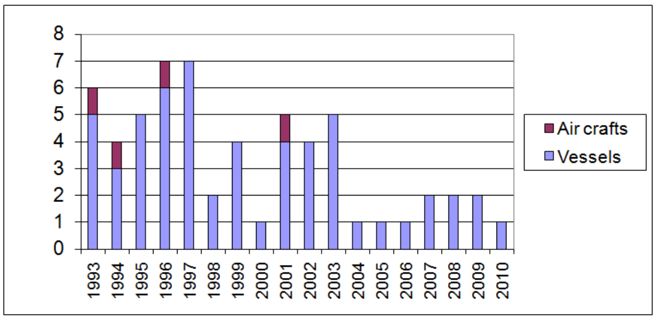

Figure 2: The annual number of violations of the safety zones in Norway 1993-2010.

Collisions with visiting vessels and tankers

Except for the two collisions with passing vessels mentioned above, all the collisions in figure 3 have been with visiting vessels.

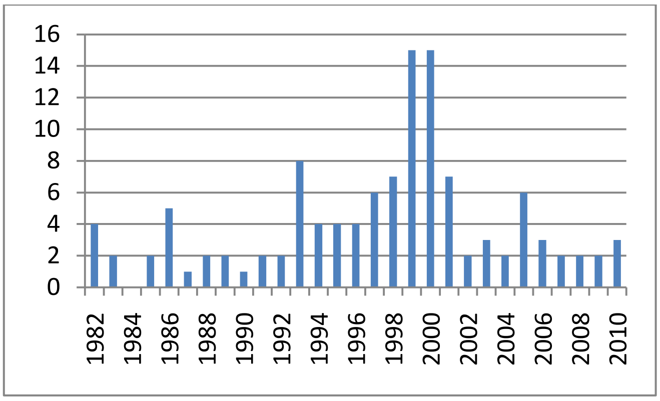

Figure 3: The annual number of collisions between vessels and platforms in the period 1982-2010.

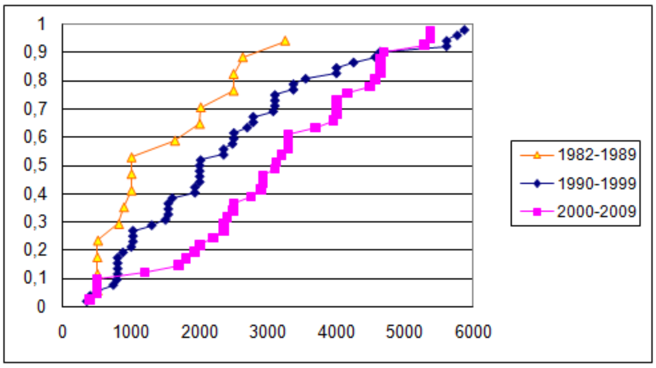

Figure 4: Cumulative distribution of size of vessels (excluding tankers) in deadweight tons that have collided from 1982 to 2009.

Comparing the sizes of the colliding vessels, we can see from Figure 4 that the average size of vessels has increased by about 100 tons a year since the 1980s. Collision energy increases proportionally with the size of the vessels, causing the average vessel to be capable of causing much more damage than 20 years ago. The collisions with tankers are not included in the figure.

No particular trend (Bang, 2010) has been found when distributing the collisions versus time of the day or season, nor a correlation between the collisions caused by technical errors and ages of involved vessels. But some vessel owners have more frequent violations of procedures than others.

There are major differences in collision frequencies on different platform types, as shown in figure 5. Field centres and mobile platforms have the highest collision frequencies. A field centre consists of two or more bridge connected platforms, but in the statistics they are calculated as one unit.

Of the manned platforms, the fixed production platforms have the lowest collision frequency.

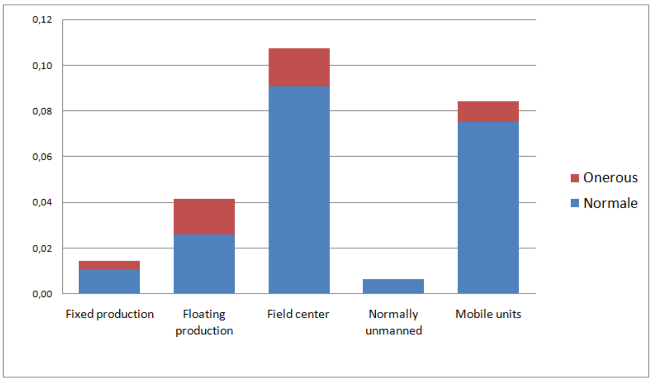

Figure 5: Collisions per platform year as function of type of platform from 2000 to 2010. The onerous collisions are the collisions described in the next chapter.

THE MOST ONEROUS COLLISIONS

What is probably the most onerous incident occurred on November 6th 1966 when the supply vessel Smith Lloyd 8 collided with the semisubmersible (semi) Ocean Traveller, and made holes in two columns. A list of eight degrees occurred within a few minutes. 47 men jumped either into the sea or into life rafts. Everyone was saved (Stavanger byrett, 1967). From the author's point of view, the most onerous events the last decade are the collisions with the West Venture semi in 2004, the Ekofisk 2/4-P jacket in 2005, the Njord B FSU in 2006, the Grane jacket in 2007, the Ekofisk 2/4-W tripod jacket in 2009 and Songa Dee semi in 2010. These events will be described in some detail:

Far Symphony collision with West Venture semi on March 7th 2004

The Far Symphony hit West Venture while running on autopilot. The vessel was about three months old, and the crew had insufficient training and understanding of the vessel's manoeuvring systems. The two persons on the bridge were unaware that the vessel was on autopilot when entering the safety zone and their attempt to stop the vessel resulted in increased forward speed. In compliance with the procedure, the platform was not waypoint for the autopilot, even though waves and wind brought the vessel on collision course. The supply vessel hit the column of the semi five meter above sea level. Both the supply vessel and the semi were able to go to shore for repairs. The collision occurred at 3.7 m/s speed. The mass of Far Symphony was about 5000 tons, and the collision energy 39 MJ (Munch-Søegaard and Pettersen, 2004).

The main causes of the accident according to Munch-Søegaard and Pettersen (2004) were: • Procedures were not followed by entering the 500-meter zone. • The direction of the vessel was not corrected. • Lack of training on emergency procedures. • The tasks of the two on the bridge were poorly defined. • Insufficient time to make themselves known on the new vessel. Farstad (2004) had a conclusion similar to the first two of Munch-Søegaard and Pettersen.

Ocean Carrier collision with the bridge at Ekofisk 2/4-P jacket on June 2nd 2005

An officer manoeuvred the Ocean Carrier against Ekofisk in dense fog. The visibility was estimated at about 100-150 meters. The captain came on the bridge. There was lack of communication on who was then responsible for the navigation, ending up with no one been responsible. It had a speed of approximately 5.5 m/s when it passed the 500-meter zone. When the captain saw the platform, he slowed down, but too late. The collision velocity was about 3 m/s (Rovde, 2005). The bridge suffered minor damage. Ocean Carrier had substantial damage in the bridge area, and damage to the bow. Ocean Carrier was built in 1996and has 4.679 dead weight tons. The collision energy was more than 20 MJ.

The main causes of the accident according to Rovde (2005) were: • Unfortunate practice by the handover of command. • The operator did not follow his own procedures. • Inadequate communication on the bridge. • Use of short-term contracts. • Violation of maritime rules. ConnocoPhillips (2005) concluded: • Inadequate communication on the bridge, due to changes in procedures at Ekofisk. • Lack of communication at the handover of command on the bridge, roles and responsibilities. • Weakness in navigation practices with bad visibility. • Incomplete compliance with governing documents in relation to the safe zone.

Navion Hispania collision with Njord B FSU on November 13th 2006

The accident happened when the shuttle tanker Navion Hispania got black-out when connecting to Njord Bravo. As a result, most propellers stopped. Contaminated fuel and clogged filters caused the black-out, and system errors led to escalation. Navion Hispania tried to avoid a collision, but hit Njord Bravo at a speed of 1.2 m/s (Teekay, 2006). Navion Hispania suffered injuries in the bow, while Njord Bravo suffered damage in the aft. Navion Hispania was built in 1999 and has 126.183 dead weight tons and 72.753 gross register tons. The collision energy was about 61 MJ.

The investigation report (Teekay, 2006) highlighted a total of 24 immediate causes for the incident. Some of the main causes of the accident according to the report were: • Excessive contamination of the fuel system. • Clogged Filters. • Inadequate knowledge of the Dynamic Positioning system. • Error feedback in the control systems for propellers. • Incorrect signal wiring • DP maintained in "Autopos" mode even after severe thruster failures. • During blackout there is a cacophony of alarms on the bridge. • Inadequate training in the DP failure modes. • Lack of compliance with procedures. • Error in procedures. • Inadequate maintenance.

Bourbon Surf collision with Grane jacket on July 18th 2007

In the vicinity of Grane, both the officers left the bridge on the supply vessel Bourbon Surf. When returning to the bridge, it was too late to stop the vessel, but they managed to reduce the speed before it hit the Grane. The investigation concluded with a velocity between 1 and 3.5 m/s, but probably significant less than 3.5 m/s, since the velocity was reduced before the collision (Norsk Hydro, 2007). Bourbon Surf was built in 2003 and has 3.117 deadweight tons. The collision energy was low, but with great potential for a more serious incident.

The main causes of the accident according to the investigation report (Norsk Hydro, 2007) were: • The master did not keep lookout at the bridge. • The master misjudged the ship's speed and distance to the platform. • The platform was used as a target for the "way-point" setting. • The ship continued on autopilot directly to the platform after passing the 500m zone. • A culture that not sufficiently emphasize compliance with procedures.

Big Orange XVIII collision with Ekofisk 2/4-W tripod jacket on June 8th 2009

Big Orange XVIII (with displacement of about 6.000 tonnes) was en route to the 2/4-X-platform on the Ekofisk field to perform well stimulation. The autopilot had not been deactivated prior to the vessel's entering the safety zone and since the autopilot was still active during the approach the planned change of course failed to take place as expected. The vessel managed to avoid colliding with Ekofisk 2/4-X and Ekofisk 2/4-C, and passed under the bridge between these platforms. It also avoided colliding with the jack-up flotel COSLRigmar, but ultimately collided with the unmanned water injection platform Ekofisk 2/4-W. At the time of impact Big Orange XVIII had a speed of 4.5-4.8 m/s (ConocoPhillips, 2009) and the energy about 70 MJ.

No personnel suffered physical injury; however, there was significant material damage, both to the platform and the vessel. Big Orange XVIII was damaged on the bridge, and the bow of the vessel was compressed by about two metres. Ekofisk 2/4-W was pushed partly out of position due to several failed braces, the connection between the deck and substructure were partly separated, and extensive damage was discovered to some of the legs under the sea surface. In addition, a water injection riser was extensively bent, and several wellheads were displaced. The bridge connecting Ekofisk 2/4-W and bridge support BS01 were also pushed far out of position. Production from Ekofisk 2/4-A had to be shut down and the bridges to Ekofisk 2/4-W removed. All the wells have been plugged, and Ekofisk 2/4-W is planned to be removed in 2011.

The main causes of the accident according to the PSA inquiry report (Leonhardsen et al, 2009) were: • insufficient monitoring of the vessel. • Inadequate measures were taken after the Ocean Carrier collision June 2nd 2005. • Lack of follow-up of management system and internal requirements. The main causes of the accident according to the ConocoPhillips report (2009) were: • The captain takes "manual steering/local control" but the system is on autopilot. • The captain left the steering position and went in to the "old" radio room to take a telephone call. • The captain did not use the "emergency push buttons" for emergency steering. • No DP tests were performed prior to entering the 500 meter zone. • The control panel had been updated without autopilot alarms etc. • The procedure for familiarization and vessel specific training was not followed. • The 2nd officer observed the situation without taking an active role. Schlumberger (2007) concluded that the main root cause for this accident was the inadequate capability and poor coordination on the bridge of the vessel. The Captain failed to read and comprehend the controls on the marine control panel, particularly the fact that the autopilot was switched on during the entire approach. As a result of the autopilot being on, all attempts to maneuver the vessel using manual steering failed. They also have a list of 29 root causes.

Far Grimshader collision with Songa Dee semi on January 18th 2010

The supply vessel Far Grimshader worked close to the platform on the leeward side. The crane on the platform failed and the vessel had to be moved to the opposite side to use another crane. During the manoeuvring, the propeller on the vessel got stuck in a wire in the anchoring system of the platform. The vessel lost control of manoeuvring, and hit repeatedly the Songa Dee for two hours, when it was towed away by another vessel. Songa Dee suffered damage in two columns and had one hole. The vessel had six holes in the cargo and ballast tanks, and water intrusion into the machinery room. Far Grimshader was built in 1983 and has 2.528 gross registered tons. Collision energy of each impact was low, but the number of collisions may have been several hundred.

The investigation team (Marathon Oil, 2010) identified five main causes for the incident and several root causes. The main causes identified are: • Lack of awareness and use of relevant procedures and guidelines. Relevant standards and procedures were not sufficiently known by those involved, and as a result, they were not adhered to. • The failure of the platform's starboard crane. • The starboard crane has suffered recent failures and therefore the risk level of the loading operations increased as the alternative was the weather side crane. • Manoeuvring the vessel to the weather side choosing a drift on route. Other and safer options were available. • Manoeuvring too close to the platform and excessive speed of the operation. Again safer options were available. • Incorrect interpretation of the deck flood lights going out. The deck lights went out due to voltage fluctuations – and that the full vessel propulsion power was available throughout.

SUMMARY AND CONCLUSIONS

Common causes of collisions

The underlying causes of collisions in Norway according to Hope and Vikse (2000) were:

a) The safety culture in the vessel industry is not good enough – procedures are not followed.

b) The vessels get more sophisticated technical equipment on the bridge, not all crew were adequately trained to use it. In many cases the causes are related to faulty or incorrect use of automatic positioning systems (DP). The crew have great confidence in the systems, and when an error occurs, they are not sufficiently attentive to correct errors in time.

c) High turnover of personnel. The reason is, among other things, large salary differentials between vessel and platform management, and the heavy workload. The vessels often serve as training sites for young personnel before they get a job at a platform. Young navigators are too inexperienced with waves and currents.

d) Very close sailing program and little opportunity for recovery between long shifts. The work programs also invite to take chances to keep the routes. The captains feel pressured to deliver at schedule not to lose the contract. Collisions at the end of the work period of the persons on the bridge are common.

e) Short-loading hoses and poor pumping capacity increase the time in close vicinity to the platforms, and the concentration on the task disappear.

Several of the causes described by Hope and Vikse are still valid, but improvements have been implemented, especially with the less onerous collisions. These conclusions were also a basis for the guidelines (OLF, 2003 and NWEA, 2006). But still the a) and b) are frequently found as the major causes of the incidents. All of the major incidents the last decade have been subject to investigations by the vessel owner, the platform owner or the operator, and for one of the collisions (Ekofisk 2/4-W) also by PSA. There has been an improvement in the number of collisions since 1998-2001, but the number of serious incidents in the period

2004-2010 has increased. A general impression is that several of the incidents could have ended with a significantly more severe accident.

From the author's point of view the following causes are the most important, as a modification of the Hope and Vikse (2000) summary:

a) The safety culture in the vessel industry is not good enough – procedures are not followed.

b) The vessels get more sophisticated technical equipment on the bridge, not all crew on the bridge are adequately trained to use it. The crew has too much confidence in the DP systems, and when errors occur the bridge crew are not sufficiently attentive to correct errors in time. The NWEA guidelines call for two persons on the bridge, but the authority levels on the bridge cause problems.

c) Equipment is not sufficiently adjusted to the needs of the users, and has inadequate barriers. A tendency is that the bridge equipment becomes more and more complex, and more difficult to use correctly.

d) The platform owners do not monitor the ships entering the safety zone sufficiently.

The basis for improvements

The parties in the industry are responsible for the safety of their own vessels and their platforms. The regulatory philosophy is based on the legislated expectation that those who conduct petroleum activities are responsible for complying with the requirements of the acts and regulations. Furthermore, the regulations require a management system that systematically probes and ensures such compliance at any time.

PSA have for several years had meetings with the responsible for collisions, and produce annual updates on the statistics of collision events. In 2009 a formal inquiry was performed related to the Big Orange collision (Leonhardsen et al, 2009), and it was followed up in 2010 by a supervisory activity. In 2010 a presentation was given at the Norwegian Petroleum Society seminar (Kvitrud, 2010). In January 2011 a press release requesting improvements in the industry was issued, and a request is made to the Norwegian standardization organization to review the requirements in NORSOK N-003.

REFERENCES

Bang Ambjørn Dahle: Kollisjonshendelser - perioden 2000-2010, internal PSA report, 2010. In Norwegian only.

ConocoPhillips: Granskningsrapport Ocean Carrier Kolliderte med broen mellom EKOP og EKOT. Stavanger, 2005. In Norwegian only.

ConocoPhillips: Investigation Report "Big Orange XVIII" Collision with 2/4 W Date 08.06.2009 IMPACT No: 101117, Stavanger, 20.8.2009.

Farstad: Oppsummering av gransking etter kollisjon mellom Far Symphony og West Venture, 07.03.04. Undated.

Hamre Reidar, Kvitrud Arne and Tesdal Kåre: In service experience of fixed offshore structures in Norway, Proc. OMAE, volume I B, Stavanger, 1991.

Hope Tormod and Tor Martin Vikse: Statements in the meeting between Statoil and Norwegian Petroleum Directorate regarding vessel-rig collisions, 01.11.2000. In Norwegian only. The minutes of meeting was written by Bjørn Ringstrøm.

HSE Research Report 053: Ship/platform collision incident database (2001), HSE 2003. http://www.hse.gov.uk/research/rrpdf/rr053.pdf.

IMO/MSC circular 645 Guidelines for vessels with dynamic positioning systems, June 6th 1994.

Kvitrud Arne: Båtkollisjoner fase 1, Norwegian Petroleum Directorate report OD-94-50, 1994. In Norwegian only.

Kvitrud Arne, Gerhard Ersdal and Jan Erik Vinnem: Risk indicators for major accidents on load bearing structures and maritime systems in the Petroleum industry, OMAE, Estoril, 2008.

Kvitrud Arne: Erfaringer med båtstøt på norsk sokkel, The Norwegian Petroleum Society (NPF), Bergen, 2010. In Norwegian only.

Leonhardsen Roger L., Sigurd Robert Jacobsen and Reidar Hamre: Investigation of Big Orange XVIII's collision with Ekofisk 2/4-W 8 June 2009, PSA, 2009. The report is available on http://www.psa.no.

Lilleaker Consulting: TRA of Valemon, Appendix C; Vessel collision risk, Appendix C, Vessel collision risk, 10. March 2010.

Marathon Oil: Investigation Report: Far Grimshader - Songa Dee Collision on the 18th of January 2010, dated 23.2.2010.

Munch-Søegaard Lars and Erik Pettersen: West Venture Collision, A study of the collision between West Venture and Far Symphony, 7.3.2004.

Norsk Hydro: Sammenstøt Bourbon Surf – Grane 09.07.07. Investigation report dated 26.9.2007. In Norwegian only.

NORSOK standard N-003: Actions and action effects, Edition 2, September 2007.

The North West European Area (NWEA) Guidelines for the Safe Management of Offshore Supply and Anchor Handling Operations, updated June 2009 - The guidelines are available on http://www.psa.no.

Norwegian Oil Industry Association (OLF): OLF/NSA guidelines 061 for safe operation of offshore service vessels, 2003.

Petroleumstilsynet (PSA): Risikonivå i petroleumsvirksomheten. Hovedrapport, utviklingstrekk 2010, norsk sokkel, Stavanger, 2011. In Norwegian only. The report is available on http://www.psa.no.

Petroleum safety Authority (PSA) and others: The activity regulations + the framework regulation + the facility regulation, all of them from 2010. Available on http://www.psa.no.

Petroleum safety Authority (PSA): Risk of collisions with visiting vessels. Press release 5.1.2011. Available on www.psa.no.

Rovde Shipping: M/V Ocean Carrier contact damage Ekofisk 02.06.2005. Rovde, 2005.

Schlumberger: Big Orange XVIII Collision with Ekofisk 2/4 W Platform June 8, 2009, July 22, 2009

Stavanger Byrett: Notat fra frivillig bevisopptak 29. og 30. november 1966 i anledning av uhell og sammenstøt på boreplattformen "Ocean Traveler" 6. november 1966. Dated 3.7.1967. *Witness statements*.

Teekay Shipping Ltd. Significant Incident Investigation: Navion Hispania DP Incident on Njord Bravo 13th November 2006. Version 8. Stavanger, 2006.