International Journal of Mechanical
Engineering (IJME)
ISSN(P): 2319-2240; ISSN(E): 2319-2259
Vol. 4, Issue 4, Jun - Jul 2015, 9-14

International Academy of Science, Engineering and Technology
Connecting Researchers; Nurturing Innovations

IMPACT OF FATIGUE ON MARITIME ACCIDENTS A CASE STUDY: GROUNDING OF FRI OCEAN

HANY SOBHY IBRAHIM ISMAIL

Arab Academy for Science and Technology and Maritime Transport, Al Iskandariyah, Egypt

ABSTRACT

This study analyzes maritime fatigue as one of the main reasons of marine accidents. Several reasons were found to be causing fatigue, such as working hours and conditions. Thus, a case study of Fri Ocean merchant vessel is reported to discuss how fatigue plays an important role in the accident. The accident is investigated and how avoiding fatigue could prevent from such accidents is presented.

KEYWORDS: Fatigue, Maritime Fatigue, Marine, Marine Safety, Marine Accidents, Safety Settings, Marine Training, Fri Ocean

INTRODUCTION

Fatigue had been defined in several ways. One of those definitions is the one found by Smith et al, 2007, when he said that a person may feel fatigued, in a way which causes deterioration in his/her performance and in turn the body's physiological functioning may be affected. These three outcomes, subjective perceptions, performance and physiological change are usually recognised as the core symptoms of acute fatigue. He mentioned that estimates of the prevalence of fatigue will vary depending on which aspect of the fatigue process one uses as the indicator of fatigue. [1]

Maritime fatigue has several problems, which may lead to marine accidents and losses. It had been mentioned by Centre for Occupational and Health Psychology, Cardiff University, that a combination of minimal manning, sequences of rapid turnarounds and short sea passages, adverse weather and traffic conditions, finds seafarers working long hours with insufficient opportunities for recuperative rest. [2]

In these circumstances, fatigue and reduced performance can lead to environmental damage, ill health and reduced lifespan among highly skilled seafarers who are in short supply. Accordingly, it becomes necessary to check the effects of stress and health factors associated with long periods away from home, limited communication and consistently high workloads on seafarers. [2]

One main reason of fatigue observed by the Centre for Occupational and Health Psychology is the adequate crewing. It could be claimed that sufficient crew will prevent the crew from suffering of fatigue. Within the same concern, it had been mentioned by Smith et al, 2007 that doing shift work is a risk factor for fatigue and one might use the number of workers doing shift work as an indicator of prevalence. However, this is based on the assumption that shift work automatically leads to fatigue which one finds is not always the case. [3]

It is also notable from the research that the cumulative effect of fatigue-inducing factors has an exponentially negative impact on the seafarers concerned. A long history of research into working hours and conditions and their performance effects in process industries, road transport and civil aviation, where safety is a primary concern, can be usefully compared to the situation in commercial shipping. Because prevention and management of fatigue are more advanced in these other sectors, it should be possible to “fast-track” the approach to maritime fatigue. The extensive research and evidence base from other industries can be extrapolated to apply to seafarers' fatigue. [3]

It was claimed that there are types of fatigue; one of which is called Acute Fatigue. It may be induced by a number of factors: lack of or poor quality sleep, long working hours, working at times of low alertness (e.g. the early hours of the morning), prolonged work, insufficient rest between 2 work periods, excessive workload, noise and vibration, motion, medical conditions and acute illnesses. Another type of fatigue is the one called Chronic Fatigue. It can either be due to repeated exposure to acute fatigue or can represent a failure of rest and recuperation to remove fatigue. Many working patterns induce acute fatigue and also lead to more chronic patterns. For example, working at night is associated with reduced alertness during the shift and may also produce cumulative problems because of poor sleep during the day. Risk factors for fatigue have been widely documented and can be split into factors which reflect the organisation of work, like working hours, task demands, the physical environment and characteristics of the individual. Many of the established risk factors for fatigue are highly relevant to seafarers. [2]

RESEARCH PROBLEM

Marine accidents happening every now and then result in losses of life and/or financial losses. One of the causes for such accidents is marine fatigue, which may be due to long working hours and/or health factors. Thus, a case study of Fri Ocean merchant vessel is analyzed to put a hand on marine fatigue impact on having an accidents, as well as how to avoid accidents by preventing crew from being exposed to fatigue in any of its forms.

ACCIDENT REVIEW

Through this study, an analysis of the accident that happened by Fri Ocean on June, 2013 will be handled. Fri Ocean was a 2,218gt general cargo vessel managed by Kopervik Ship Management AS. At the time of the accident, the navigation equipment in use included relevant paper charts; as the primary means of navigation, an ECS with a cross-track limit for deviation from the planned route set at 0.3 mile, and a GPS with a cross-track limit for deviation from the planned route set at 0.5 mile and a distance-to-waypoint alert set at 0.2 mile. on 14 June 2013, the general cargo vessel Fri Ocean ran aground at about 10.5 knots, 2½ miles south of Tobermory, Isle of Mull, while on passage from Corpach in Scotland to Varberg in Sweden. The vessel’s bow shell plating and frames were damaged, which resulted in flooding to the bow thruster room. The crew carried out a temporary repair, and the vessel was re-floated at 2120. After inspection at Oban, Fri Ocean proceeded to Liverpool for permanent repair. [4]

The MAIB report identified that investigation identified that the second officer, who was alone on watch, fell asleep, largely through lack of stimulation possibly exacerbated by fatigue, shortly after making a course alteration. It was found that none of the alarms fitted to the GPS2 and ECS3 were loud enough to wake the sleeping officer, and a bridge navigational watch alarm system (BNWAS) that could have alerted the crew to the second officer sleeping was probably not in use. [4]

It should be highlighted that Fri Ocean arrived in Belfast on 11 June 2013, to unload during the day, suspended overnight, and then resumed again the following morning and completed by midday. Then, Fri Ocean departed, in ballast, for Corpach. During the voyage to Corpach, the master, chief officer and second officer maintained their normal navigation watches. On 13 June 2013, the chief officer took over the duties of the bridge watch keeper, and the second officer went to his cabin. He went to bed and fell asleep. Fri Ocean arrived alongside in Corpach, where noise from the mooring winches woke the second officer earlier than his normal routine. He got out of bed and then went to the main deck to start his cargo watch. A cargo of wood chips was loaded and stowed in Fri Ocean's cargo hold by shore stevedores under crew supervision. The chief officer then proceeded ashore to complete a draught survey.[4]

The vessel was shifted along the berth, the hatch covers were closed, and the second officer, chief engineer, 2 ABs and AB/cook then fitted stanchions on either side of the hatch in preparation for loading and securing a deck cargo of logs. With the stanchions in place, loading of the logs was started by shore stevedores. During the afternoon, the second officer completed a passage plan and prepared the bridge equipment for the intended voyage from Corpach to Varberg. Loading was completed, and the crew started to secure the deck cargo while the chief officer proceeded ashore to complete a second draught survey. There is conflicting evidence as to whether or not the second officer assisted in securing the deck cargo and was then sent to rest at some time. The deck cargo had been secured and the chief officer had gone to rest, while the second officer was woken by his alarm clock. He and an AB proceeded to the forward mooring station to prepare for the vessel's departure. At that time, the second AB and the AB/cook were stationed aft, and the master was on the bridge. Fri Ocean sailed from Corpach, as planned. [4]

It should be mentioned that in 2004, the MAIB published a Bridge Watch keeping Safety Study, which confirmed that watch keeper manning levels, fatigue and a master's ability to discharge his/her duties are major causal factors in collisions and groundings. The study highlighted a number of accidental groundings in which no lookout had been posted, the autopilot was engaged, a BNWAS was either not fitted or not used and the unaccompanied watch keeper had fallen asleep. Since 2004, the MAIB has regularly investigated groundings of small cargo vessels, most recently that of Beaumont9, in which similar causal factors have been identified.[4]

CASE STUDY ANALYSIS

Through this section, a case study of Fri Ocean accident on June, 2013 will be investigated to realize the negative impact of maritime fatigue on maritime safety, and how it might cause accidents.

By investigating the problems faced during the accident, it had been observed that several errors had happened, which was mainly caused by falling asleep. One main error starts by a decision of the master that there is no need for the AB assigned and that he would not be required for lookout duties. This decision let the two ABs and the AB/cook to stand down for the night. Moreover, the master himself left the bridge to rest, where *Fri Ocean* reached a waypoint adjacent to Eileanan Glasa. Of course, such a decision means that Fri Ocean on that time have a fewer number of crew standing for monitoring by night. In other words, the above mentioned decision means that the vessel was not well enough monitored so that control was lost when the second officer fell asleep. [4]

The master decision might be considered a main cause of a second error, which happened by the second officer when he adjusted the vessel's course and went out to the starboard bridge wing. After he returned to the wheelhouse, he secured the starboard bridge door in the fully open position and sit in the port bridge chair. After doing such procedures, and being relaxed on the chair, the second officer fell asleep, so that the vessel passed the next planned waypoint and maintained her course for just over 2½ miles, at about 10.5 knots, until the second officer then woke up.

During the grounding, another series of errors happened which may be due to lack of concentration, which again is due to fatigue. It was found that the master, who had been woken by the resulting noise and vibration, was already on his way to the bridge when the second officer attempted to call him using the vessel's talk-back system. The BNWAS audio alarm was not sounding and there is conflicting evidence as to whether or not the master switched off the BNWAS when he arrived on the bridge. In any event, he used the talk-back system to muster the crew. [4]

The STCW states that the OOW may be the sole lookout in daylight provided "*the situation has been carefully assessed and it has been established without doubt that it is safe to do so, full account has been taken of all relevant factors… and assistance is immediately available to be summoned to the bridge when any change in the situation so requires*". Most Flag administrations understand from this that at all times when a vessel is underway at night, a separate dedicated lookout is required in addition to the OOW. [5]

When analyzing the errors stated above and investigating the factors that lead to such errors, it was found that several factors had played an important role in leading to such errors. One main factor was the "Bridge design". It was found that *Fri Ocean*'s bridge layout was designed to enable an OOW to monitor the vessel's position using electronic navigational aids while seated in the port bridge chair. It was also possible to adjust the vessel's course, using either manual or automatic steering, without leaving the chair. While ergonomically efficient, the design enabled the second officer to conduct much of his watch sitting down, which increased the potential for him to fall asleep.

Another important factor was found to be "Method of navigation", where the traditional navigation techniques; such as charts used as a primary means of navigation, require an OOW to regularly plot a series of historical positions from which to project the vessel's track. On the other hand, the ECS system provided on Fri Ocean was able in some means to help in officers situational awareness of the OOW by displaying the vessel's charted position at any time without the need for frequent plotting. This means that the second officer can monitor the vessel's position using the ECS and GPS and depend on the cross-track limit alarm to alert him to an unacceptable deviation from the planned route. This method of navigation in turn provided little stimulation, as it gives the chance for the second officer to remain inactive for longer periods, which further increased the potential for him to fall asleep. [6]

A third factor considered in the errors happened is the "Environmental conditions" faced in sea. It could be observed that warm temperature by that time, in addition to the smooth movement of the vessel in sea water are considered as a nice chance for sleeping. [4]

A fourth factor considered in the errors happened is the "Lookout", as the regular absence of a lookout on watch at night without incident would have reinforced a belief that it was safe to operate the vessel in that way, and would have influenced the master's decision not to employ a lookout on this occasion. A lookout should be considered an integral part of the bridge team and should be utilised to the fullest extent. The lack of a lookout in this accident removed a valuable control measure in that his interaction with the second officer might have prevented the latter from falling asleep.

Finally, the vessel's policy of assigning two ABs lookout duties on a 4 hours on / 4 hours off basis was contrary to STCW hours of rest requirements. The inclusion of the AB/cook on the duty roster, even if his lookout responsibilities were less than those of the other ABs, would have provided more flexibility and helped ensure the crew achieved the required periods of rest.

Observing the factors mentioned above, it could be claimed that such factors are all linked with one keyword, which is "Fatigue". Being fatigued, the second officer fall asleep but if he was getting the enough rest with the supposed conditions, he was supposed to remain awake all over his shift. Observing what happened, it was found that in the days leading up to the accident, the second officer's work and rest pattern complied with STCW hours of rest requirements. However, his normal sleeping routine had been disturbed during the vessel's call at Belfast. He slept only 30 minutes before being woken in preparation for the vessel's departure. Additionally, his extended working hours and physical activity during the day in Corpach meant that, despite feeling normal and capable of keeping his watch, the second officer was fatigued when he arrived on the bridge.

CONCLUSIONS AND RECOMMENDATION

It could be easily observed that the master and other officers long working hours in some times of the vessel trip let the master decided to leave the second officer in his shift of watch and go to take some rest, which let the environment around the second officer calm and quiet.

Also, the second officer disturbance in his periods of rest assigned by STCW let him tired by the time he was supposed to keep on watch. This means that long working hours and insufficient rest are main causes of the Fri Ocean grounding. Despite the fact that this accident specifically does not sound in a dramatic loss, but this might easily happens due to fatigue. With the case of fatigue and remaining long time with no lookout might cause severe losses even in life. So, it should be highly considered to provide the enough crew so that they are not forced to keep on working for long hours. Also, the crew should take the enough rest according to STCW policy, to be able to continue working in their normal shifts with full efficiency. So, it had been obvious that it is necessary to apply fatigue management and navigational requirements.

Recommendations to the case under study include the required change in the bridge design which encourage the second officer to sit down and increased the potential for him to fall asleep. Also, the second officer's method of navigation provided little stimulation and allowed him to remain inactive for extended periods of time which further increased the potential for him to fall asleep. In addition, the second officer was possibly fatigued when he arrived on the bridge for his watch. This means that guidance on fatigue management and the effective use of crew should be provided. Finally, it had been shown important to give the chance to masters to detail their own specific requirements with regard to passage planning and monitoring, including the extent to which particular electronic navigational aids should be used.

REFERENCES

1. Barger, LK, Cade, BE, Ayas, NT, Cronin, JW, Rosner, B, Speizer, FE, and Czeisler, CA (2005). Extended work shifts and the risk of motor vehicle crashes among interns. N. Engl. J. Med. Vol 352, pp 125-134.
2. Costa, G (2003). Shift work and occupational medicine: an overview. Occupational Medicine, Vol 53 No 2, pp 83-88.
3. International Maritime Organization. (2009). SOLAS, consolidated edition, 2009: consolidated text of the International Convention for the Safety of Life at Sea, 1974, and its Protocol of 1988: articles, annexes and certificates. London, International Maritime Organization.
4. Marine Accident Investigation Branch, 2013. REPORT NO 26/2013, Report on the Grounding of Fri Ocean 2½ milessouth of Tobermory on 14 June 2013.
5. IMO/ILO Document for guidance: An international maritime training guide, 1985 (London, 1987)

6. Dawson, D, and Fletcher, A (2001). A quantitative model of work-related fatigue: background and definition. Ergonomics, Vol, 44, pp 144-163.
7. Booth-Bourdeau, J, Marcil, I, Lawrence, M, McCulloch, K, and Dawson, D (2006). Development of fatigue risk management systems for the Canadian Aviation Industry. International conference on fatigue management in transportation operations.
8. Emergency procedures for ships carrying dangerous goods (EmS) (London, 1991). International code for the safe carriage of grain in bulk (International Grain Code) (London, 1991).
9. International Convention for Safe Containers (CSC) (London, 1992).
10. International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (MARPOL 73/78), consolidated edition (London, 1991).
11. International Convention for the Safety of Life at Sea (SOLAS) (London, latest consolidated text).
12. International Convention on Standards of Training, Certification and Watch keeping for Seafarers
13. Folkard, S, and Tucker, P (2003). Shift work, safety and productivity. Occupational Medicine, Vol, 53, No.2, pp 95-101.
14. Leone, S, Huibers, M, Kant, I, van Schayck, C, Bleijenberg, G, and Knottnerus, J (2006). Long-term predictors of outcome in fatigued employees in sick leave: a 4-year follow-up study. Psychological Medicine.