Short Hand Practice Jeopardizes Ship's Safety: Application of crew endurance management systems on board supply boats to mitigate fatigue related factors and for better working environment

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Abstract:

In an era where ships registry is a source of national income, new flexible management systems may be adopted to attract flagging-in. There are public/social responsibilities and safety culture promotion among the industry's stakeholders, inter alia. In contrast, by strictly applying the safety/legal obligations, flagging-out most likely would occur unless a compromise on safety would take place.

This paper aims to show some of the challenges facing Administrations e.g. the absence of an international agreement regarding the criteria of safe manning. Maritime Administration must accept challenges by applying newly proved success theories as applied in other developed countries. It would improve the safety culture of seafarers and shipping companies, in parallel. Crew Endurance Management studies maybe adopted for better working environment. Particularly, fatigue related factors, such as the short hand practices or the 6-hours-on, 6-hours-off watches particularly on board supply boats serving the offshore industry that are a root cause of chronic fatigue, which may lead to accidents, may be studied and new solutions could be adopted.

1. Introduction:

The 6-hour on and 6-hour off watches or the short hand practice on board ships was always a point of complain among seafarers that can be considered a root cause of accidents, which is one of the hot topics nowadays. That practice was normally called the short hand watch that have been practiced in case of absence of one of the ship's crew personnel. The remaining of the ship's crew at those times would carry on the jobs of the absent member; nowadays it became a normal practice for some ships especially coastal, offshore or the small tonnage cargo ships, to reduce ship's operation cost.

Actually, in the absence of an obligatory international instrument to set the minimum manning level of a ship, regardless to its tonnage or nature of work, the role of the maritime administration in adjusting this issue becomes relatively weak as they may be horrified from ships to flag out if strict manning standards were applied (Chowdhury, 2007). For example, the Swedish administration choose to support the safety as opposed to the commercial profitability and they didn't care about the reduction of the number of the Swedish ships in respect to the high quality service they maintain (Mejia, 2007).

Plenty of countries showed more flexibility for the registry requirements to the shipowners, which leaded to significant change from a continuous reduction in the Dead Weight Tonnage during 1990's to significant increase during the 2000's (Ma, 2007 derived from ISL, 2006). In other words, the maritime administration may relinquish some aspects in order to increase or at least to keep its fleets. Otherwise, it may find itself forced to withdraw from the maritime transport market if it keeps its strict legislation requirements (Hughes, 1998). In much the same way, it may ease its safety requirements for the same reason; for example, relaxation in the manning standard may be practiced on board its ships, in a way to give more opportunity for companies to gain higher profits by reducing the manning cost and they may also reduce taxes. Therefore, many administrations might compromise strict requirements to keep its fleet. Figure 1 illustrates a boom increase in ships registry in developed countries after a significant dip that ended in the beginning of 21st century compared to the escalated increase in open flag administrations since 1988. New attracting registration policies were applied in the developed countries especially in the Organization for Economic Co-operation and Development (OECD) ones that include relaxed manning and tax requirements, *inter alia* (Ma, 2007 derived from ISL, 2006).

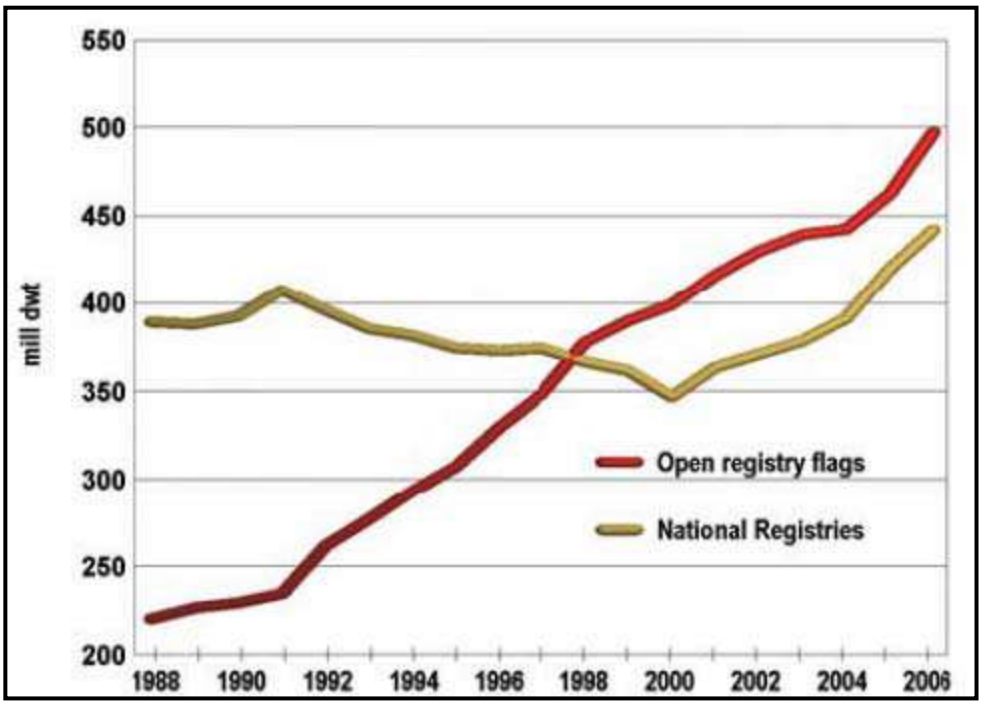

Figure 1: Total world merchant fleet by OECD countries national/secondary and open registries as of January 1st 1988-2006.

Source: Ma, 2007 derived from ISL, 2006.

Some newly applied crew endurance management systems that studied the endurance of the ships' crew and the reasons behind chronic fatigue may illustrate solutions to reduced number of crew members. Perhaps by applying better work/rest schedules, the performance of a seafarer would be promoted.

2. Short Hand Practice on Board Ships: Needs and implementation

As per the traditional seamanship, three officers are in each deck and engine department on board a ship, who are supposed to carry out the normal duties on board a ship including navigational watches. Reduction of the number of the crew may be considered as a violation of the safety rules; a reduction in the number of the officers by 50% that compromises the safety of course. At least, there will be insufficient officers to conduct a navigational watch properly and maintain, at the same time, the minimum required resting hours. Perhaps, applying a Crew Endurance Management System (CEMS) including studying of the quality of the living environment on board a ship would be of crucial importance to promote the safety on board and reduce risk related factors, particularly, if there was no possibility to increase the manning power of a ship.

In order to prove that, personal interviews had been held with seafarers and management personnel. Furthermore, the CEMS applied on board US coast gaud boats is studied and perhaps it is seen as a temporarily solution for the problem.

3. Focusing on the Problem

3.1. On board a traditional cargo ship:

The ordinary practice is to have three officers, in addition to, a master on board the ship, and in much the same way there would be three engineers, in addition to, a chief engineer. In both cases, there would be an opportunity for each officer or engineer to have 4 hours on watch and to rest for 8 hours. That leaves master and chief engineer without watch duties and assist in creating better concentration environment that needed for further work such as maneuvering the ship.

However, in some cases, a chief officer would be under call for 24 hours during loading or discharging, at those times he/she would be released from duties and the two remaining officers would hold the duties for 6-hours per each. That means each officer would have only two pairs of 6-hour of rest periods in between duties, which are not even enough to comply with the minimum requirements of rest period. At that time, the net sleeping period would be even less than 6 hours. There are about 1 hrs would be consumed for food and preparing for the next watch leaving only 5 hrs of net sleeping time. In addition, the other resting 6-hour period can be consumed in other personal purposes e.g. preparing for the coming voyage, as shown in Table 1. However, applying this work schedule may meet the STCW code, requirements, with regard to the minimum rest period, but it would never apply the minimum required sleeping hours. In particular, Chapter VIII – Section A-VIII/1 of the code requires at least 10 hours of rest per day. These 10 hours can be divided into no more than 2 periods, one of which must not be less than 6 hours in length.

Table 1: A rest period and net sleeping hours.

6 hours rest period	0.5 hrs preper for sleep
	5 net hours of sleep
	0.5 hours of prepering for watch

3.2. On board a supply boat:

Similarly, short hand practice can be applied on board offshore vessels causing fatigue that may cause accidents due to the accumulated fatigue (Tantawy, 2007). A ship may run in these cases with only a captain and a mate. A supply boat may be operated only by a chief engineer and a second engineer (Essallamy, 2007). That means more work load and less resting periods. Therefore, it can be considered a violation to the international requirements of the minimum resting and the maximum working periods in the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978 (STCW). Particularly, a captain of a supply boat may stay in the bridge during anchor handling and snatching operations for long periods of time that may extend to the time of his/her new duty time. Anchor handling can be extended for 4 to 20 hours (Essallamy, 2007; Tantawy, 2007).

4. The difficulty in doing a corrective action

Tantawy complains about the 6-hour practice he held on board ships during his seafaring service, but he didn't take any corrective action when he became a manager. There is no compulsory rule to be applied regarding increase the manning level of a ship; he can't do that on his own, compromising the company revenues. Furthermore, he says:

"Even if it is obligatory requirement, as per the flag state, to increase the number of officers on board, the company would find another more flexible registration, which would ask more relaxed requirements. Particularly, if there is no violation to the requirements of other stockholders, such as the classification societies, insurance companies and charterers.'' (Tantawy, 2007).

On the whole, it seems like the company profiting policy is the most important to follow, which may negatively affect the safety culture of the employees who are considering only asking for additional crew member as a kind of threat to their positions in their companies (Patraiko, 2007).

5. Case study:

The grounding of the dry bulk carrier "Pentland", manned with only a captain and a chief mate, on 7 Dec. 1998 was investigated by the Marine Accident Investigation Branch (MAIB) in July 1999 after completing loading 1165 tons of coal at 1330 on 4 Dec. 1999 in Amsterdam to be transported to Inverness port. The wind force was 7/8 with 5 meters swell during the passage, which made the ship's actual speed only 5 knots and allowed none of the crew to get sufficient amount of sleep (MAIB, 1999).

The direct cause of the accident was the failure to alter course in the correct time, yet, other contributing causes were behind the grounding case e.g. the captain's failure to withstand alert on the bridge due to his fatigue. In addition, there was neither additional person in watch in the night time on the bridge, nor a bridge watch alarm. The presence of an additional watch keeping officer on board the ship, night watch AB and bridge watch alarm would help in preventing such accidents (MAIB, 1999). In fact, the "Pentland" is not the only accident for its operating company.

The Torbulk shipping company operating the ship had similar two cases. First, the "Sea Humber" ran aground on 24 October 1997 for the same reason, asleep captain. Second, the "Oakland" ran aground on 6 February 1998 due to the inability of the master to helm the ship successfully without helmsman assistance, in violation to the provisions of the STCW. Accordingly, the UK government submitted a paper to the International Maritime Organization (IMO), which highlighted these accidents contributing factors (MAIB, 1999).

To conclude, all of the cases listed in the MAIB report occurred at night in the presence of a solely watch keeper and the absence of a look out. There is clear evidence that fatigue resulted from the 6-hour practice leaded to accidents. Consequently, an increasing number of companies in the UK fitted their ships with watch alarms as a

precaution to alert watch-keepers (MAIB, 1999). That is a temporary solution while the contributing reason, the 6-hours practice, still needs to be solved. Perhaps CEMS may help, if properly applied, in finding a better working environment on board such ships.

6. Crew Endurance Management System - CEMS:

Crew endurance means the ability of the crew to perform safely while conducting job-related physiological, psychological, and environmental challenges. CEMS is the process of managing the risk factors that can lead to human error and performance degradation in maritime work environments. CEMS is crucially important because unchecked endurance risk factors negatively affect performance and long-term health of crews, which affect the safety and effectiveness of maritime operations (Dahl, 2008).

CEMS is a non-regulatory solution, which provides a practical way for management to address crew endurance issues and concerns e.g. biological clock, quantity and quality of sleep that developed by a leading expert in the field of Crew Endurance. Moreover, CEMS gives scientific knowledge to be used in promoting the living and working environment of crew. Consequently, CEMS provides proactive measures for better operational safety and mission effectiveness (Dahl, 2008).

6.1. Ways of Performance Promotion and Fatigue Degradation:

Safe performance depends on both a person's biological clock and the amount and quality of sleep that person obtains each day. In addition to these two risk factors, there are number of other endurance risk factors that affect a person's ability to maintain a safe level of performance. These include physical conditioning, work schedules, motion sickness, environmental stressors, health & nutrition, and stress, *inter alia*.

6.1.1. Shifting biological clock through proper light management

Safety performance and well-being depend on the level of energy and factors such as nutrition, hydration, oxygen or sleep those are important for us to get energy. For example, the difficulty in maintaining a safe level of alertness between 10 PM and 4 AM correlates with the dramatic dip of the energy and alertness curve. The reason for

that dramatic dip is the human biological clock, which by nature are designed for us to work during the day and sleep during the night. The only way to prevent performance degradation during the night is by shifting our biological clocks so that sleep occurs during daytime hours and energy is available for work during the night, which must include some light management. Changing sleep and work schedule does not by itself reset this clock mechanism. Resetting biological clocks is possible only through proper light management to keep the body awake during watch and avoiding the same input to help the body fall asleep (Dahl, 2008).

6.1.2. Sufficient amounts of uninterrupted sleep

In addition to resetting the biological clock, there is another very important factor that goes in parallel and affects night/daytime performance and can prevent performance degradation. That factor is the quantity and quality of sleep that a person obtains each day. Scientific research has shown that human brains need approximately 7 to 8 hours of uninterrupted sleep each day. Getting less than 6.5 hours of uninterrupted sleep per day over several consecutive days will result in sleep debt and the development of chronic fatigue. CEMS attempts to recognize this scientific fact and develop mitigating strategies to be applied on board a ship. Figure 2, shows the energy and alertness dip and peaks curve levels during a day, whereas, the arow reprisents the dip energy zone (Dahl, 2008).

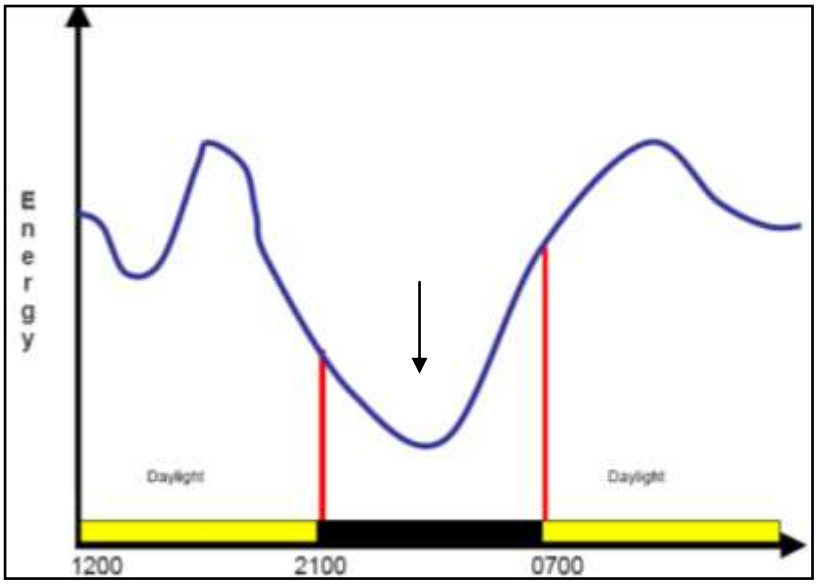

Figure 2: Energy and Alertness Levels during the Day.

Source: USCG, 2003.

6.2. Processing a CEMS

There is a three-phase process required to be implemented that starts with program development, deployment and assessment in CEMS on board vessel.

The first stage is Program Development that includes developing a Crew Endurance Plan for a specific vessel, which requires the formation of a Working Group from all levels of the company. A coach, company personnel who are tasked with the introduction and implementation of CEMS at the vessel/crewmember level, will be needed to train the Working Group on the science and process of CEMS. Consequently, the Working Group, with facilitation provided by the coach, assesses the current situation on the specific vessel, identifying endurance risk factors of concern. Finally, the Working Group draws up, implement and manage a Crew Endurance Plan for the vessel. The working group may plan for better CEMS-generated vessel improvements for areas such as:

- Blocking Out Light Intrusion
- Noise Reduction
- Air Cleaners (reduce Carbon Monoxide)
- Lighting Improvement
- Nighttime Adaptation
- Watch Schedule Changes
- Day Room Improvements
- Nutritional content of Meals Improvements
- Napping Policies / Better Mattresses & Pillows
- Air Flow / Temperature (Dahl, 2008).

The second phase is Program Deployment, the implementation of the Crew Endurance Plan on the vessel. In this phase, the coach, with the assistance of Working Group members from the vessel crew, educates all crewmembers on the science and process of CEMS. And, that is followed by implementation of the Crew Endurance Plan. Implementation requires enlisting the support of the entire crew, making the recommended system modifications based on the Plan, and then coaching the crew toward consistent implementation of those changes. For successful implementation, first, a full commitment of management at all levels is required. Second, the identification and training of CEMS coaches are really needed (Dahl, 2008).

Figure 2 shows an example of CEMS gnerated vessel improvements, particularly, blocking out light intrusion in a cabin. This way of light management would assist in

adjusting the biological clock and allow better sleep quality even during day time.

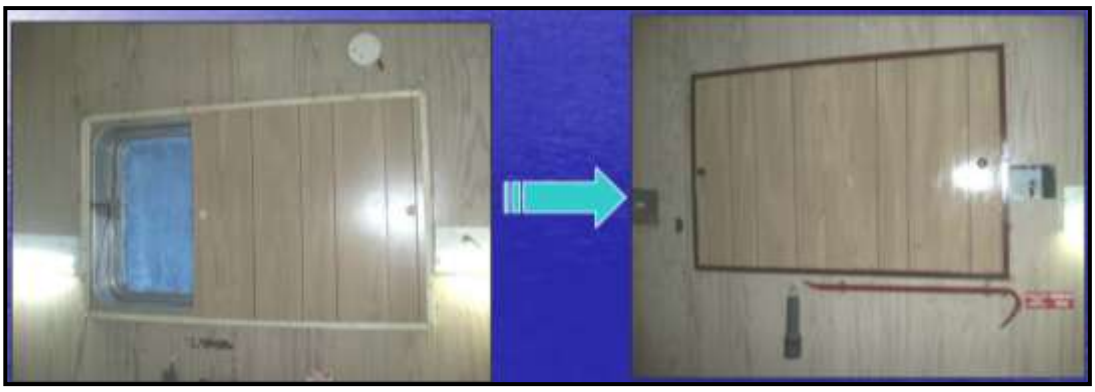

Figure 3: Example of CEMS - Generated Vessel Improvements – Blocking out light Intrusion.

Source: USCG, 2003.

Figure 3 shows also a noise reduction CEMS generated example. Noise reduction barriers were used in the doors' vents not to allow for noise in the ship's alleyways to disturb a seafarer during his/her sleep even during working hours of other colleagues.

Figure 4: Noise reduction CEMS Generated Example.

Source: USCG, 2003.

The third and final phase is Program Assessment, monitoring and reviewing the implemented plan periodically. This phase is as important as the first two because it is ongoing attention that makes CEMS dynamic and robust. This last phase ensures that the implemented Crew Endurance Plan continues to be relevant and effective in an environment that changes over time, for example, an aging vessel, or a new operational profile. Figure 4 shows the overall process and stages of applying the CEMS (Dahl, 2008).

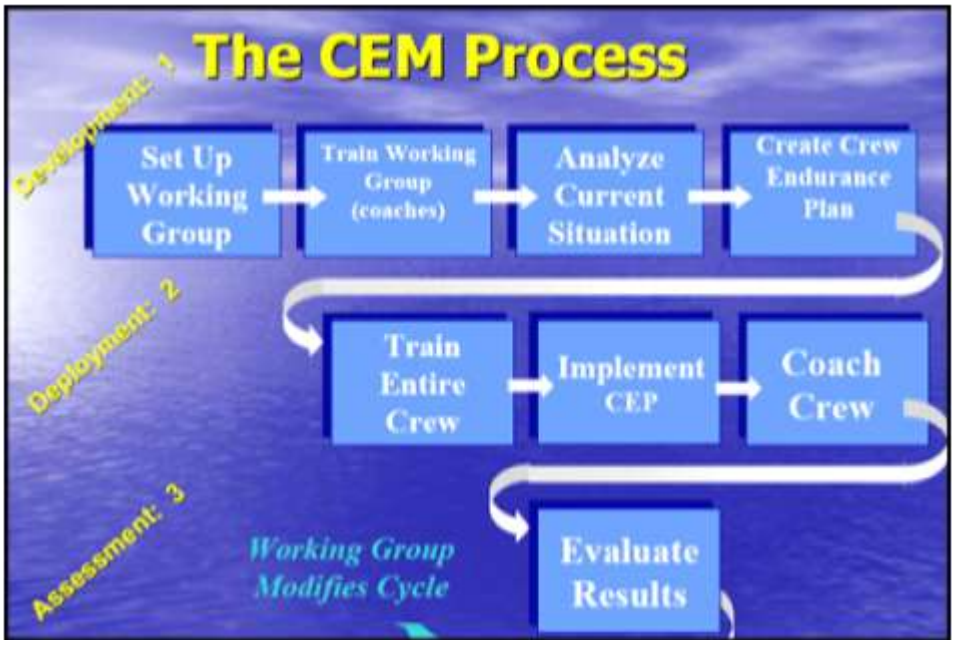

Figure 5: The CEMS 3 stages process.

Source: Dahl, 2008.

Figure 6 shows how the CEMS managed shifting the Red Zone into full daylight hours. The three arrows indicate the amount of relative shift realized by applying light-management techniques over three different periods of time. It takes about five or six days of consistent light management to shift the Red Zone fully from a nighttime orientation over to a daylight (morning) orientation.

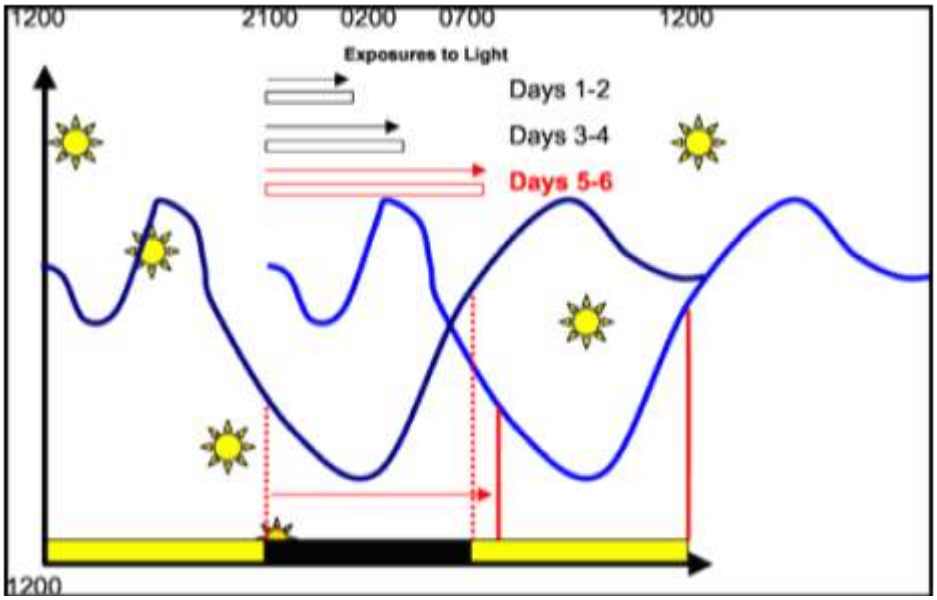

Figure 6: The shift in biological clock after the CEMS.

Source: USCG, 2003.

7. Better Work Schedules Solution:

The 8/8/4/4 is one example of watches that would allow both of the officers a rest period of 8 hours and in total will get 12 hours of rest each day (USCG, 2007). Therefore, by applying this work schedule a watch keeper would have more than 6 uninterrupted sleep hours per day. Table 2 shows the distribution of working and resting hours per day for a master and a mate, as an example. Unlike, the ordinary 6/6 watches which would allow only 6 hours of rest in between watches that illustrated in Table 3, which would not allow 6 uninterrupted hours of sleep.

Table 2: 8/8/4/4 Work Schedule for a Master and a Mate.

Watch	Master	Mate
0000-0800	8 on	8 off
0800-1600	8 off	8 on
1600-2000	4 on	4 off
2000-2400	4 off	4 on
Total for the 1st 24 hours	**12 on** **12 off**	**12 on** **12 off**
0000-0800	8 on	8 off
0800-1600	8 off	8 on
1600-2000	4 on	4 off
2000-2400	4 off	4 on
Total	**12 on** **12 off**	**12 on** **12 off**

Source: After USCG 2007.

Table 3: The ordinary 6/6 watches.

Watch	Master	Mate
0000 – 0600	6 on	6 off
0600 – 1200	6 off	6 on
1200 – 1800	6 on	6 off
1800 – 2400	6 off	6 on
Total	**12 on** **12 off**	**12 on** **12 off**

8. Conclusion:

Maritime administrations may practice strict rules regarding safety rules on board its national ships; consequently, they may face a flag out phenomenon. In absence of an international agreement regarding the criteria of safe manning, some maritime administrations may show flexibility with regard to safety aspects such as minimum manning level, *inter alia*. Shipowners are eager to reduce their ships operating cost; short hand practices are increasingly used on board ships especially costal and offshore ships. Perhaps, crew endurance management studies maybe adopted for better working environment, particularly, fatigue related factors e.g. the 6-hours-on, 6-hours-off watches. That are a root cause of chronic fatigue, which may lead to accidents, may be studied further and new solutions could be adopted.

9. Recommendations:

The IMO may amend the STCW convention and code with regard to two main issues: a new rule to regulate the minimum net sleeping hours to meet the minimum uninterrupted sleeping hours as per the CEMS, and to increase the minimum manning level on board ships as per its trade routes and tonnage. They may also encourage classification societies to implement those manning recommendations and apply better new work schedules on their ships. Moreover, insurance companies can also encourage shipowners applying those rules by reducing the insurance premiums.

In addition to that, maritime administrations are to emphasize the need to strictly implement the international requirements regarding the lookout post, particularly during night watches; resume the promotion of the carriage requirement for watch alarms and to seek international agreement on the specific number of qualified watch keeping officers, considering the ships tonnage and nature of work, to be carried out when determining minimum safe manning levels.

From its side, States can vote for the IMO excepted resolution considering the new rules regulating the minimum manning of the company. While domestically, they may use accidents like "Pentland", "Sea Humber", and "Oakland", *inter alia*, to amplify its consequences in motivating the shipping society to follow the rules of the minimum manning and to quit the six on - six off practice. Moreover, they can amplify the

problem by using the media to emphasize the one man command, especially during night times in bridge.

Media can be considered as a potential 'amplification station', which may increase the information volume about an event. Maritime administrations can also use media in emphasizing the ripple effects, which may be resulted from such accidents. Media can amplify also the environmental consequences due to the pollution that can happen due to accidents at sea. In fact, the environment aspect is very critical and can attract the attention of the society including the green piece groups and the political parties as it can affect the tourism and many other careers as well as the public health.

Moreover, the maritime administration may encourage the recognized education and training institutes to educate young generations and the seafarers sufficiently about the dangers they may face in case of committing a violation to the international requirements regarding the minimum rest periods and the maximum work hours to promote their safety culture. It may also encourage the use of other alternatives practices instead of the 6-hour on and 6-hour off e.g. 8/8/4/4 work schedule. In this way, both of the master and the mate, for example, would have better resting periods, and would allow them to comply with the international regulations in STCW.

If the maritime administration could do all of that it would succeed in promoting the safety culture of the whole maritime industry.

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