

Marine Pilot Fatigue Management

Proposal for the Management of
Work-Related Fatigue in Marine Port Pilots.

Submission to House of representatives Standing Committee
on Communications, Transport and the Arts.

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1. Introduction

The life of Shipmaster has been described as hours of boredom punctuated by moments of terror. To most foreign going shipmasters the arrival at port limits heralds a stressful time. They usually possess limited shiphandling experience, tend to define a close quarters situation as one where their ship will pass within two nautical miles of another, and regard a safe course as one where their track is at least three miles from the salient points of land.

Their ship will be entering an area of high traffic density and navigating in narrow channels where the banks might be less than 30 metres away, or passing other ships within 60 metres while encountering unfamiliar cross currents, tides and shoals. The master will be attempting to communicate in a foreign language with port officials. He will be assigned tugs, the performance and capabilities of which he might have little knowledge. These tugs will be assisting to berth his ship at a berth, in a port he might never before have seen. The knowledge that by far the majority of all marine incidents occur within harbour limits or the approaches to a port will be a carrion comfort.

These are the moments of terror.

The Marine Port Pilot earns his living working solely within these moments of terror. With a specialised knowledge of local conditions and a high level of shiphandling experience, the pilot provides a unique competence to head the Bridge Navigation Team while conducting the navigation of the ship through the jurisdiction of the pilotage area.

Operating at very high levels of concentration combined with a heavy workload can result in high levels of fatigue. Fatigue was identified as a contributing factor in the world's worst maritime environmental disaster - the *Exxon Valdez*. Fatigue was also identified as a major factor leading to the grounding of the *Peacock* on Pipers Reef in the Great Barrier Reef. The International Maritime Organisation has recommended minimum rest periods for watchkeepersⁱ, whether they are operating within the confines of a port or not.

Recognising fatigue as a safety issue, other transport authorities have introduced mandatory fatigue management plans (FMP)ⁱⁱ. Queensland Transport has identified fatigue as a significant contributing factor to motor vehicle accidents on the open roads. "...operators are required to schedule practices which do not expect an employee to drive unreasonable distances... without adequate rest periods."ⁱⁱⁱ

The Commonwealth of Australia's Civil Aviation Authority through Civil Aviation Orders specifically prohibit either operators requiring them to fly, or their pilots and flight crew members flying, if they are suffering from fatigue, or are likely to become fatigued, if this would impair their judgement.^{iv}

Several questions arise.

1. If it is unsafe to drive a truck when fatigued, and it is unsafe to fly an aeroplane when one is fatigued, and it is unsafe to be in charge of a navigational watch in open sea when one is fatigued, is it safe for a marine pilot to have the conduct of the navigation of a ship while fatigued?
2. Is it reasonable for a master to expect that the pilot assigned to his/her ship is adequately rested prior to commencing pilotage duties.
3. Is there evidence that allows comparison between the stress levels of an airline pilot and a marine pilot, and hence comparable rest period indicators?
4. Does a pilot, who pilots a ship without having had adequate rest, cause the ship to be operated unsafely?
5. What about the service provider? Does the port authority, pilot company, or transport department, if the transport department is the service provider, have a responsibility to ensure they have sufficiently adequately rested pilots to meet traffic demands?
6. Is there a duty of care required of the regulatory authority responsible for setting standards?

The draft AAPMA paper on pilotage standards requires that pilots should be adequately rested at the commencement of their roster period.^v What is an adequate rest period prior to commencing

pilotage duties? It is important to differentiate between work related fatigue and general fatigue brought about by lifestyle. The employer cannot control the latter but has a significant responsibility to intervene in the control of the former.

This paper will address these issues, attempt to provide some answers to these questions and make some recommendations based on existing research into these issues.

2. What is the purpose of a Pilotage Service?

The goal of any pilotage service should be that ships move through the port as quickly as is safely possible. It is about the protection of the environment, safety of life, and protection of the port infrastructure. It is about risk management.

A pilotage service is essentially a safety service of which efficiency is a major part. An experienced pilot will bring an arriving ship safely to its berth in a far shorter time than an inexperienced master with little knowledge of the port and its procedures could possibly do. With running costs of modern ships within port limits in the order of \$3000 to \$4000 per hour, a saving of just one hour in turnaround time more than pays the pilots' wages. This is just one example of how a safety service can provide substantial financial benefits.

3. Safety Legislation

Legislation addressing the question of fatigue for road and aviation transport industries has been enacted. Their requirements are summarised as follows:

3.1. Aviation Legislation^{vi}

In addition to being quite specific about acceptable hours, it is a requirement that "a flight crew member shall not fly, and an operator shall not require that person to fly if either the flight crew member is suffering from, or, considering the circumstances of the particular flight to be undertaken, is likely to suffer from, fatigue or illness which may affect judgement or performance to the extent that safety may be impaired."^{vii}

The limitations on hours are reduced where pilots are not flying solo.

There are some similarities between marine pilotage and aviation pilotage. Both transport modes operate in a fluid medium, both are similarly affected by cross winds/currents. That is where the similarities end. The aircraft has the benefit of 3 dimensions to avoid dangers, there is only one way traffic, they always "stem" the tide, no other "ships" are moving when they land or take off, they do not lose steerage when they brake, they can always stop within half the distance of the runway, when things go wrong, they can get out of trouble by going full ahead and holding their course, and they do not use smaller aircraft to push them sideways on to solid objects before they come to rest on the apron.

It is useful to examine the limitations where there are not more than two pilots, since this closely resembles the Master/Marine pilot situation.

- A rest period at home, preceding pilotage, of at least 9 hours where the 9 hours includes the period from 2200-0600 (normal sleeping hours) or at least 10 consecutive hours.
- Pilots should not be rostered for tours of duty exceeding 11 hours, but if already flying, this may be extended to 12 hours.

If flight time is extended beyond the 11 hours, then the minimum rest period must be extended by 1 hour for each 15 minutes the tour of duty is extended beyond 11 hours.

Where a tour of duty exceeds 12 hours, the pilot must be given a clear 24 hours break.

A tour of duty means the period between the time a pilot commences any duties related to his/her employment until the time he/she is relieved of all such duties. It includes standby time at airports. In other words, any pilotage duties not separated by an uninterrupted rest period at home of at least 9 hours.

Comment:

A fatigue management plan for marine pilots could safely adopt these guidelines if it could be demonstrated that workload and corresponding fatigue levels experienced by marine pilots were similar to those experienced by aviation pilots.

3.2. Road Transport Legislation (Qld)

In 1994 Queensland Transport introduced its much heralded Fatigue Management legislation and FMP Accreditation system^{viii} for truck drivers. This requires operators to educate their heavy vehicle drivers about health and fatigue. It also requires logs of driving hours to be maintained. Vehicles are to have a sleeping bunk so that drivers may pull over and have a rest when they are tired.

Driving Hours are limited as follows:

5 hours without a rest
12 hours in any 24
72 hours in any week.

Rest periods must include:

30 minutes after 5 hours.
6 hours unbroken rest in any 24 hours.
Not less than 9 hours rest in any 24 hours.
24 hours unbroken rest in any week.

Driving includes any duties related to the operation of the vehicle.

Comment:

Marine pilots do not have the opportunity to “park” their ships on the side of the channel for a 30 minute “siesta” after completing 5 hours pilotage duties.

3.3. Marine Legislation

The Queensland Government Marine Safety Act (1994) provides for severe penalties if “a person involved with a ship’s operation (including the owner, master, pilot and crew members) ...cause a ship to be operated unsafely.” Maximum penalty- 500 penalty points (about \$35 000) or imprisonment for 1 year. This increases to 5000 penalty points (about \$350 000) or imprisonment for 2 years if a person is killed or injured as a consequence of operating the ship unsafely.^{ix}

Other States have similar legislation.

Comment:

If it is possible for a fatigued pilot to be prosecuted in the event of a Marine Incident, a fatigue management plan is needed urgently. If a Marine Pilot cannot be held responsible for his/her actions when piloting while fatigued, then claiming fatigue is an excellent defence.

3.4. STCW 95

Under the section on Fitness for Duty, dealing with Bridge Watchkeeping, there is a requirement to organise watchkeeping duties so that the efficiency of the watch is not impaired by fatigue. The master has the authority to take such measures as are necessary to avoid fatigue.^x The master however, has no control over the fatigue levels of the pilot assigned to his/her ship.

Minimum rest periods are as follows:

A minimum of 10 hours rest in any 24 hour period.

Rest may be divided up into two periods, one of which must be at least 6 hours in length.

The reduction of 10 consecutive hours to 6 consecutive hours may only occur two days running.

Comment:

The STCW requirements apply to watchkeepers. The demands on a Marine Pilot and the level of alertness required to perform the job safely are far higher than one would expect for a normal lookout on board a ship. Nevertheless, they provide a good starting point from which to develop Fatigue Management Guidelines for Marine Pilots.

4. Human Factors Studies Of Marine Pilotage

4.1. Past Studies.

Fortunately, several studies have been made into the human factors of Marine Pilotage^{xv}. One study found the mortality rate among Trinity House Pilots was about 3 times higher than the general population^{xvi}. Other studies conducted in England^{xvii} and in Germany reported similar results.^{xviii}

Two Dutch studies looked at rest/work ratios for Dutch pilots^{xix} and their workloads in order pilots to determine admissible occupational stress. They found that the workload of Dutch Pilots was such that it not only jeopardised safety but severely impacted negatively on pilots' health and longevity.^{xx} A rest/work ratio of 4:3 for day work, with a greater ratio for night work was required. If a pilot worked a 12 hour day shift, then a minimum rest period of 16 hours was indicated.^{xxi}

A similar study was made in Australia by Dr Yossi Berger. His findings enjoyed significant correlation with the other studies.^{xxii}

All studies noted considerable stress experienced by Marine Pilots in carrying out their functions. Recent studies have found clear links between stress levels, long term elevated adrenaline levels, and cardiac induced morbidity. Swedish studies^{xxiii}, have been able to correlate stress levels and/or pilot morbidity with workload.

Comment:

There are sufficient studies into the human factors associated with work-related fatigue in Marine Port Pilotage. Another study is not needed. What is needed is legislation enacting recommendations based on the best research.

4.2. Stress/Fatigue

Is there a link between fatigue levels and stress? By stress we mean the physical and mental demands brought about by the nature of the work. The IMO/ILO working group examining the subject prior to making recommendations for inclusion in the STCW 95 annex seemed to think so. The group concluded: "Fatigue can be induced by prolonged periods of mental and physical activity, inadequate rest, ... physiological stress or other psychological factors."^{xxiv}

Boyle (1993) notes that research has shown that fatigue causes individuals to focus attention on what are perceived to be the most important tasks, and in so doing, ignore peripheral warnings.

Comment:

This can be disastrous for a pilot who needs to be continually assessing a multitude of indicators, ie. Draft vs depth, proximity of shallows or rocks, ship speed and deceleration, helmsman's capabilities, steering behaviour of the ship, other ships, transits, beacons, ETA at tugs, distance to breakwater, wind, tide, current, swinging room, clearance fore and aft, bridge position with relationship to wharf, rotational speed of ship, transverse and fore/aft movement of ship, helm orders, engine orders, compliance with same, communication with linesmen, wharf, port control, linesboat, tugs,... etc, etc.

Stress levels can be accurately monitored. The simplest indicator is the elevated heart beat.

4.3. Heartbeat Indicators of Task Stress Levels

Shiple (1978) did considerable monitoring of stress levels using heart rate as an indicator. The conclusions were that the more difficult the job, the higher the stress levels. The most stressful situation was the swinging of large ships in confined space, or berthing ships into confined berth

pockets. Where all other factors were equal, the larger ships were consistently more stressful to pilot.^{xxv}

“The high heart-rates that do occur under mental load may be tiring, the overnight acts are undoubtedly so. **It is most important, therefore, that adequate rest and recuperation takes place before the next assignment.**”^{xxvi}

The maximum heartbeat is in the order of 220 minus age. A 50 year old’s maximum heartbeat would therefore be in the order of 170 beats per minute. While boarding, near maximum pulse rates of up to 150 were recorded. While swinging large ships, pulse rates of up to 160 were recorded.^{xxvii} The results indicated that from time to time pilots were working at the limits of their physical ability.

Berger (1984) conducted far more detailed pathological studies of Australian Pilots (Port Philip Sea Pilots). His tests included, not only ECG monitoring at various stages of pilotage, but also took urine samples to monitor residual adrenaline levels. He found abnormal hormone excretions, a high incidence of irregular sleep patterns, and found nearly identical Cardiac Risk and morbidity results.^{xxviii}

4.4. Adrenaline Levels

Berger found, by analysing Pilot’s urine, extremely high levels of adrenaline excretion. For pilots who had been piloting around midnight, these levels were up to 7 times higher than a normal person sleeping. For pilots who then go home and “rest”, sleep would be very difficult.^{xxix} Normal levels of adrenaline only occurring up to two days later. Persistent high levels of adrenaline have been associated with arterial plaque deposits and cholesterol production.^{xxx}

Waiting for a ship movement also produced high levels of adrenaline. **“It is clear that the pilot’s anticipatory stage - with its high level of uncertainty and unpredictability and no effective control are costly ... In fact, in the waiting period, [the pilot] is already ‘working’.** **It is also evident two days following such work ([between] ... 2300 and ... 0600) are necessary to re-establish a normal pattern.**”^{xxxi}

4.5. Comparison between Marine Pilotage and Aviation Pilotage

Results of the monitoring of Airline Pilot’s heart rates and those of Air traffic controllers (ATCs) was available to obtain a comparative analysis. Marine pilots stress levels, based on operating pulse rates, were shown to be significantly higher than those of ATCs. The tasks of Airline pilots were considered to be more comparable to those of Marine Pilot, with the exception that airline pilots sit and marine pilots stand while working.

“The heart rates observed are related to the complexity and the difficulty of the task and there is evidence that some tasks may be sufficiently demanding to produce very high heart rates, levels which may indicate the pilot has reached his/her limit in terms of task difficulty. The act average values of heart rate and peak heart rate show marine pilotage to be more demanding than Industrial Management and Air Traffic Control.”

“The limited evidence available also indicates that [marine] pilotage makes greater demands on the marine pilot than long-haul flying does on the airline pilot”.^{xxxii}

Why is Marine Pilotage so demanding? Consider the following:

- The marine pilot is trying to manoeuvre the largest movable man-made objects on earth.
- They drive them down relatively narrower channels than the driver of a road transport truck is required to do.
- It is not uncommon to have an 80 000 tonne displacement vessel powered by as little as 8 000 horse power. This equates to one horse power per 10 000 kilograms. It’s a bit like having to drive a Mack truck and semi trailer powered by a lawn mower engine and then park it in a parking place with a metre clearance each end.
- Now to make it interesting, let’s simulate leeway drift by making the truck slide sideways at one kilometre per hour, and the current by making the parking place move along the road. We’ll give you two smaller ride on lawnmowers to help push the truck sideways into the kerb, but like the truck, they to are slipping and sliding.

- Sounds too easy, doesn't it? Let's add one more dimension, we won't give you any brakes, we'll make you slow the truck down by causing the wheels to spin backwards, and when you do so, you have to let go of the steering wheel, because large ships do not steer when going astern.
- Finally, if you mess it up, we'll throw you in court and make you justify why you should have a job.

4.6. Sick Leave

Shiple(1978) found that although all research from the 1950's on has indicated that pilots operate in very high stress environments, their claims on sick leave was less than 40% of the general population. Only 35% of those occasioning work-related injuries took time off. Given their generous sick leave entitlements, the reason for the low absence rates resides in their high work commitment.^{xxxiii} Berger(1984) found Australian Pilots were no less dedicated than their European colleagues:

“There is no doubt that pilots will put up with a great deal of discomfort and some injury to continue work; an attitude typical of high professionalism and a strong commitment to work.”^{xxxiv}

Is there a link between pilots' refusal to take sick leave and their high cardiac morbidity rates?

5. Current Studies into Fatigue

There are a host of research centres worldwide,^{xxxv} with NASA so concerned with Aviation safety that they now have a Fatigue Counter Measures Program. Their studies mirror the findings of other centres regarding the problems with disrupted sleep patterns.

5.1. Offshore Industry in Australia and Overseas

QUT^{xxxvi} was commissioned by AMSA^{xxxvii} to conduct a review of Health, Stress and Fatigue in the Shipping & Offshore Industries of Australia, abbreviated to “FASTOH”. The study provided no new physiological data, although it was originally intended to include non-invasive medical screening tests. The research consisted of questionnaires completed by members of the Blue Water and Offshore Industries. The study included responses from Reef Pilots but excluded Port Pilotage. As such, the study throws no new light on the issue of fatigue in Marine Port Pilotage.

A similar study is being conducted by the Batelle Seattle Research Institute in Washington but with a greater emphasis on the link between fatigue and Marine Incidents.^{xxxviii}

5.2. Comparisons between Alcohol Intoxication and Fatigue

The Centre for Sleep Research in South Australia conducted a study which equated **Performance Impairment associated with Sustained Wakefulness and Alcohol Intoxication.**^{xxxix} This study compared the performance of subjects in a randomly generated tracking task at various stages of alcohol intoxication and compared their performance when suffering from sleep deprivation. They found that for each hour of wakefulness the reduction in performance was consistent with a 0.004% rise in Blood Alcohol Content. In simple terms, a person completing a shift after 12 hours of wakefulness had the performance coordination of a person with a blood alcohol content of 0.048%.

The study found no appreciable performance deterioration until the BAC exceeded about 0.04%. Similarly, fatigue limited performance remained acceptable up to about 10 hours of work. After 12 hours, performance deteriorated quite rapidly. The study also showed that an acceptable level of performance did not occur immediately after waking but about 45 minutes later.

Comment:

What is an appropriate level of alcohol intoxication under which a Marine Pilot could safely operate? Answer that question, and you are able to determine appropriate levels of fatigue.

5.3. Risk-control Model for Fatigue

The Centre for Sleep Research in South Australia conducted a further study which found that “the hours worked between midnight and 0700 were more likely to produce higher... fatigue.” They designed a risk-control model^{xl} that can be used to assess rosters for their impact on fatigue. A fatigue score of 80 (which equated to the performance associated with a blood alcohol content of 0.05) was considered the maximum under which train drivers and electricity workers should normally be allowed to operate with increases to a score of 100 in emergencies. The model has significant advantages in that it allows actual hours worked to be used, rather than rostered hours. With modern electronic data retrieval systems, it would be relatively simple to monitor pilots hours and rest requirements.

This model is currently being used by the Adelaide Port Authority to assess its pilot rosters.

5.4. Reliability of Research Results

Research into pilotage human factors over a period of about 30 years provided a high level of correlation. Can Shipley’s findings be reliably extrapolated a further 20 years? Can Berger’s be extrapolated a further 10? Has the nature of pilotage changed that much? Given the current uncertainties regarding career futures and persisting high workloads their findings must be considered conservative. With the rapidly declining standards of training of seafarers and the aging world merchant fleet, pilots must be demonstrating higher levels of skill, managing greater workloads and dealing with higher levels of stress than ever before.

The research in all cases was disinterested, that is the researchers had no preconceived notions of the possible outcomes. The researchers were all specialists in their fields. **Their results bear such close correlation that their findings must be accepted.**

6. Responsibility

While the issues covered thus far may be true and relevant, whose responsibility is it that something is done? Workplace Health and Safety legislation provides a very clear line of responsibility.

6.1. Workplace Health & Safety Requirements

Under the Workplace Health and Safety Act, the persons in control of a workplace are obligated to minimise the risk of injury to people coming into the workplace^{xli}. This obligation extends to ensuring work practices of people other than employees of the persons in charge of the workplace are carried out in a manner that minimises risk to others.^{xlii}

The area within port limits is a workplace. Who is the person in charge of the workplace? In the case of the Port Authority, it is the CEO and Directors. The Harbour Master by definition has a statutory obligation to control the safety of navigation within his jurisdiction but this does not include monitoring the hours worked by pilots, unless the Harbour Master’s Office provides a pilotage service.

It is not possible to contract out of this obligation. While Pilotage Service Provider Companies will be bound by the provisions as a principal contractor^{xliii} and they will be able to contract out of direct liability by having individual contracts for their pilots, Port Authorities however, are not able to contract out of their obligation to ensure their contractors comply.

6.2. Duty of Care

We frequently hear of the term “Duty of Care”. What is an adequate level of care when it comes to allowing a pilot suffering from fatigue to have the conduct of the navigation of a ship?

What if the ship is a product tanker for example, carrying up to 45 million litres of premium motor spirit, some of which contains lead, along a narrow navigational channel leading through a marine park? At risk are the lives of some 20 to 30 crewmen, hundreds of millions of dollars of ship, product, port infrastructure, marine life, fisheries and tourism revenue. Should the people involved

in the navigation of the ship be allowed to do so if they are suffering from fatigue to the extent that it impaired their judgement?

The test for the required standard of care is how a reasonable person in the particular situation would have reacted. If a reasonable person would have thought that the acts in question would lead to a foreseeable risk of injury, the standard of care has been breached.^{xliv}

- Is it reasonable to expect that the controller of the workplace is aware that a risk to people's health and safety exists as a consequence of allowing pilots to perform pilotage acts while suffering from fatigue?
- Is it reasonable to assume that regulatory authority responsible for setting standards should be aware that a risk to people's health and safety exists as a consequence of allowing pilots to perform pilotage acts while suffering from fatigue?
- Is it reasonable to require that the pilots conducting the navigation of ships within the jurisdiction of a Port Authority are adequately rested and are not suffering from fatigue or illness to the extent that it impairs their judgement?

In terms of occupational workplace safety legislation, the obligation is only discharged if due diligence is exercised and reasonable precautions are taken.^{xlv}

The only reason that navigating under the influence of alcohol is illegal is because alcohol impairs one's judgement. Would it be fair to assume that a pilot who had only had a few hours sleep in the previous 24 hours might be suffering from fatigue to such an extent that it impaired the judgement? The Civil Aviation Authority seems to think it to be the case for Aviation Pilots, Road Transport Authorities seem to think it is the case for heavy vehicle drivers, IMO seems to think it is the case for Marine Watchkeepers. Are Marine Pilots significantly different?

Comment:

The only conceivable circumstance where the use of a fatigued pilot might be acceptable, is when it is judged that the risk to the ship or its crew, occasioned by leaving it alongside or at sea, would be greater than causing it to be piloted by a pilot suffering from fatigue.

7. Designing a Marine FMP -

7.1. Initial considerations

Comment:

Offering a pilot more money as an incentive to pilot when fatigued does not buy a safer, more efficient pilotage service.

"Normal psychological and physiological tendencies exist which should be factored into the design, planning, management and conduct of pilot operations. These include ... the time of day, circadian phase, time on task, fatigue, age, and the use or abuse of substances that are considered a normal part of society."^{xlvi}

Based on existing research, the following should be taken into consideration when designing a Marine Pilot Fatigue Management Program:

1. Marine Piloting is more demanding than long-haul airline piloting.
2. Rest/work ratios of at least 4:3 should be endorsed.
3. Work between the hours of midnight and 0700 is more tiring than any other period
4. For the same hours worked, more frequent rest days with shorter roster periods is safer than longer off periods after a longer roster period.^{xlvii}
5. Time on task (working) commences from when a pilot is called to service and ends when he/she is relieved of all pilot-related duties^{xlviii}
6. There is a difference between the rostered period of duty and the actual hours worked. However, the roster must indicate an adequate rest period based on the assumption that the pilot could be called on to perform pilotage duties for the entire roster period.
7. In designing rosters the following should be considered:^{xlix}
 - Forward rotating rosters provide an easy way of changing the shift worked, but it is the actual hours rest that determines the levels of accumulated fatigue.

- Long periods of shiftwork should be avoided.
- Longer shifts (9-12 hours) should be avoided.
- Adequate recovery time must be provided.
- Every shift system should include some free weekends off with at least two successive days off.
- The number of consecutive working days should be limited.

7.2. Other Issues

Pilot fatigue is not merely a consequence of too little sleep. While adequate rest is important, many other issues impact on it.

1. The efficient use of pilot resources. At present there are no penalties for ships failing to keep ETAs or ETDs. Some Agents do not bother to keep pilots informed and frequently give ETAs or ETDs they know the ship cannot make, in order to have a pilot standing by. Trying to schedule shipping in these circumstances is very difficult. Pilots are called out early and then waste time standing around waiting for ships to finish.
2. A relaxing room where pilots can lie down and rest between shipping movements at night would greatly contribute towards reducing accumulated fatigue. However, when introducing a system of "scheduled napping", the need to be awake not less than 45 minutes before performing a pilotage movement must be borne in mind.
3. Pilot physical fitness can impact on fatigue.
4. Travel to outports. Extensive travel to and from outports can be very tiring, travel at night especially so. No consideration has been given to the effect this might have on a pilot's judgement.
5. The provision of adequate rest periods does not guarantee a home environment where the pilot may obtain adequate rest. The management of the rest period however, is the pilot's responsibility and not the controller of the workplace's.

7.2.1. Management of Pilot Resource

Both Shipley and Berger commented on the problem of uncertainty, incorrect ETAs or ETDs, and the abuse of pilot resources that this causes.

"Attention should be given to demands required from Agents in relation to ETAs and ETDs. These discussions should seriously consider substantial, well-reasoned penalty costs for the misuse or abuse of a pilot's time. The degree of uncertainty and unpredictability across every aspect of a pilot's life is entirely unacceptable at any price"ⁱ

"A better system of forecasting of shipping movements would help ... Compulsory ETAs and ETDs with penalties for infringements within reasonable tolerance margins, may be a practicable answer to this problem."ⁱⁱ

Waking up a pilot to tell him/her to go back to sleep because of a change in ETA/ETD severely diminishes the rest of the pilot and directly compromises the safety of the pilotage act about to be performed. If there is insufficient shipping to justify continuous shifts and pilots' rosters are nominal and not absolute, then appropriate notification times for pilot bookings are essential and adherence should be enforced.

7.2.2. Drugs Alcohol

Dawson (1997)^{liv} found an increase in performance associated with low levels of alcohol intoxication. The study however, did not aggregate the two. It is difficult to accept the notion that a moderate level of alcohol intoxication at the commencement of a period of duty would enhance the performance of a marine pilot towards the end of the duty period. While there are laws prescribing acceptable levels of alcohol intoxication for Masters, no legislation currently applies to the Marine Pilot.

Pilots suffering from illness or taking drugs that cause drowsiness should not perform pilotage acts until fit to do so. It goes without saying that drug abuse should not be tolerated.

Finally, alcohol is known to disrupt sleep dramatically and therefore contributes to the poor quantity and quality of sleep obtained on trip nights. Alternative approaches to the use of alcohol

to unwind after duty and promote sleep should be identified and offered (eg., relaxation techniques)^{lvi}.

7.2.3. Pilot Error versus Pilot Overload

de Vries-Griever (1982a) studied the cumulative effect of pilot overload over the years of disrupted sleep patterns and high demand work periods and found: **“In particular for older pilots, the work load could become irresponsibly high, jeopardising the safety of shipping traffic”**.^{lvii}

While the pilot workload is high, the indirect workload, brought about by irregular hours, long travel, often at night, compounds the problem. Shipley concluded that it was possible that **“Pilot Error”** as an explanation for Marine Incidents, could in reality be a consequence of **“Pilot Overload.”**^{lviii}

7.2.4. Fatigue Related Marine Incidents in Marine Parks

The FASTOH study found that Reef Pilots had on average about 3.5 hours of sleep per day while conducting pilotage. It is not surprising therefore that the grounding of the *mv Peacock* on Piper’s Reef on the Great Barrier Reef occurred after the pilot fell asleep^{lix}. The cost of the resulting pollution prevention operation cost Australian taxpayers more than A\$2M.

The inquiry into the grounding of the product tanker *mv Conus* in Townsville on 12 January 1995 did not find fatigue as a contributing factor despite the fact that the pilot had been on duty conducting marine pilotage from 1900 on the previous night to 0300 on the morning of the incident, and had driven a motor vehicle 500km alone in order to perform the pilotage act in Abbot Point, the bulk loading facility operated by Mount Isa Mines. The pilot had had no more than about 5 hours effective sleep in the 48 hours before the incident!

Comment:

Until a pilot fell asleep, resulting in a grounding, it had not been a common practice during Marine Incident Inquiries involving pilots, to examine the pilots’ rest/work periods in the fortnight preceding the incident in order to determine if current work practices are allowing pilots sufficient rest. This should be the second question, after the breathalyser.

8. Conclusion

We return to the questions I asked earlier:

1. Is it safe for a marine pilot to have the conduct of the navigation of a ship, while fatigued? The answer is no.
2. Does a pilot, who pilots a ship without having had adequate rest, cause the ship to be operated unsafely? The answer is yes.
3. Is there evidence that allows comparison between the stress levels of an airline pilot and a marine pilot, and hence comparable rest period indicators? Yes.
4. Is it reasonable for a master to expect that the pilot assigned to his/her ship is adequately rested prior to commencing pilotage duties? Again, yes.
5. Does the port authority, pilot company, or transport department, if the transport department is the service provider, have a responsibility to ensure they have sufficient adequately rested pilots to meet traffic demands? Yes.
6. Is there a duty of care required of the regulatory authority responsible for setting standards? Legally no, but now that they know the issues, yes.

“[The] research results clearly present a case that pilots’ work-load, defined narrowly or broadly, is a source of distress, fatigue and serious social disruption; it is frequently physically dangerous. It is also clear that this work creates unique problems that monetary compensation will not alleviate.”^{lx}

Patricia Shipley’s concluding words eloquently sum it up:

“If we value our pilots, then we should promote healthier systems of work. If pilots value their profession, they will try to promote their own physical and mental fitness.”^{lxi}

9. Recommendations

Pilot Service Delivery organisations should consider the following:

1. Adopt a fatigue management plan. I would recommend that the attached FMP be adopted as a minimum standard and included in the AAPMA Pilotage Standards.
2. Proposed rosters should be submitted to the Centre for Sleep Research for assessment of their fatigue implications.
3. Alcohol Consumption should cease not less than eight hours prior to the commencement of a pilotage act and the pilot should have a 0.000 BAC reading. This should also be included as navigational safety standard.
4. Tighten up the booking process. Changes to ETAs or ETDs without adequate advance warning should attract real penalties, as should delays and cancellations at short notice.
5. The use of relaxing rooms where pilots can lie down and rest between ships should be provided at all pilot stations.
6. Pilots travelling to and from outports should not be coerced into undertaking solo road journeys in excess of one hour's travelling between the hours of 2200 and 0600 prior to or after performing a pilotage act. In fact, it should be actively discouraged.

Not addressed in this paper is the stress on a Pilotage Exempt master. While fatigue management has been addressed for sea-going staff, there should be some requirement for an exempt master to take a pilot if his/her workload has been such that he/she could be sufficiently fatigued to impair judgement. This area should also be given attention.

10. Proposed Marine Pilot's FMP

HOURS OF DUTY LIMITATIONS - MARINE PILOTS

SUBSECTIONS

1 - Application and responsibility

3 - General Conditions

2 - Definitions

4 - Exemptions

1. Application and responsibility

- 1.1. - This Fatigue Management Plan applies to all Marine Pilots who hold Marine Pilotage Licences.
- 1.2. - Notwithstanding anything contained in this Fatigue Management Plan, a Marine Pilot shall not perform a Marine Pilotage Act, and an employer shall not require a Marine Pilot to perform a Marine Pilotage act, if either the Marine Pilot is suffering from, or, considering the circumstances, of the pilotage act about to be undertaken, is likely to suffer from fatigue or illness which may affect judgement or performance to the extent that safety may be impaired.
- 1.3. - A marine pilot's fatigue scores using the risk-control modelling method should not exceed a fatigue score of 80 under normal operations, but in any case should never exceed a score of 100.

2. Definitions

In this part, unless the contrary intention appears:

'Marine Pilotage Act' means the movement of a ship, which is required under the act to take a pilot, within a compulsory pilotage area.

'Marine Pilot' means any Master Mariner who is licensed under the act to perform pilotage duties within a compulsory pilotage area.

'Marine Pilotage Duties' means any duties related to the navigating of ships within a compulsory pilotage area, or any other duties pertaining to the Marine Pilot's employment.

'Rest Period' means any uninterrupted period of not less than four consecutive hours where the Marine Pilot is not engaged in Marine Pilotage duties.

'Roster Period' means any period of consecutive days during which a Marine Pilot may be required to perform Marine Pilotage Duties.

'Risk-Control Modeling Method' means the mathematical model for determining workload induced fatigue levels as developed by the Centre for Sleep Research in South Australia.

'Standby time' means any period a pilot is on roster but is not actually involved in Marine Pilotage Duties.

HOURS OF DUTY LIMITATIONS - MARINE PILOTS

3.General Conditions

- 3.1.- A period of Marine Pilotage duties shall be preceded by a rest period, at home or the pilot's place of residence, of at least:
- (a) nine consecutive hours embracing the hours between 2200 and 0600 local time; or
 - (b) twelve consecutive hours.
- 3.2. - A period of Marine Pilotage Duties shall not exceed 12 hours in any 24 consecutive hours.
- 3.3.- A Marine Pilot shall not be assigned to a ship where it is anticipated that the movement will be of a duration such that the pilot will be required to perform marine pilotage duties for a period of duty of more than 12 hours.
- 3.4. - Where a Pilotage act has commenced in accordance with 3.3 above and the movement is delayed for reasons beyond the pilot's control the period of pilotage duty may be extended beyond 12 hours.

3.5. - Where extensions have been made in accordance with 3.4 above, the pilot shall receive a rest period of twelve hours plus four hours for each hour or part thereof that the pilot's period of duty exceeds 12 hours.

3.6. - Where extensions have been made in accordance with 3.4 above, the period of Marine Pilotage Duties shall not exceed 16 hours.

3.7. - Where a pilot is required to perform a Marine Pilotage Act or acts, a minimum of 4 hours Marine Pilotage duties is recorded irrespective of the actual hours worked.

3.8.- A Marine pilot shall not be required to perform Marine Pilotage duties in excess of 7 consecutive days without an uninterrupted rest period of not less than 24 hours.

3.9. - A Marine pilot shall not be required to perform Marine Pilotage duties in excess of 120 hours in any 3 week period.

3.10. - Where a pilot is on Standby, a minimum of 4 hours Marine Pilotage duties is recorded irrespective of the actual hours worked.

3.11.- A Marine Pilot Roster Period shall be preceded by a Rest Period of not less than 2 days for each 7 days worked in the preceding roster period.

3.12.- A Marine Pilot shall not be rostered on duty for more than 15 consecutive days.

3.13.- A Marine Pilot shall not perform pilotage acts on more than 200 days per annum.

3.14. - All Marine Pilots to whom this Fatigue Management Plan applies shall keep a log of the hours worked and shall inform their employers of their rest requirements.

4. - Exemptions

4.1. - The limitations on hours may be exceeded in cases of emergency and in all circumstances where the safety of life is concerned.

ⁱ STCW.6/Circ.1 Annex, Page 133. Chapter VIII -**Standards Regarding Watchkeeping**. Section A-VIII/1. Fitness for duty.

ⁱⁱ Queensland Transport - Fatigue Management For Heavy Vehicles, February 1994

ⁱⁱⁱ MEDIA RELEASE, November 6, 1995. **WORLD-FIRST QUEENSLAND PROJECT TAKES TIREDNESS OUT OF TRUCKING**. Page 2.

^{iv} Civil Aviation Orders Part 48. Section 48. April 1991. s1.4

^v Australian Marine Pilotage Standards Part 3 - Conduct, s17.8, February 1997

^{vi} Civil Aviation Orders Part 48. Section 48. April 1991.

^{vii} Civil Aviation Orders Part 48. Section 48. April 1991. s1.4

^{viii} Queensland Transport - Fatigue Management For Heavy Vehicles, February 1994

^{ix} **Queensland Government Transport Operations (Marine Safety) Act 1994**. s43.(1)

^x Boyle, Captain P. **Bridge Watchkeeping. The Nautical Institute Council**. Nautical Briefing, Supplement to Seaways; April 1993

^{xv} Shipley, Patricia. **A Human Factors Study of Marine Pilotage**. Birbeck College, 1978.

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- ^{xxv} Shipley (1978), p78.
- ^{xxvi} Shipley (1978), p12.
- ^{xxvii} Shipley (1978), p93.
- ^{xxviii} Berger (1984), p36.
- ^{xxix} Berger (1984), p26.
- ^{xxx} Berger (1984), p20.
- ^{xxxi} Berger (1984), p28.
- ^{xxxii} Shipley (1978), p83.
- ^{xxxiii} Shipley (1978), p45.
- ^{xxxiv} Berger (1984), p43.
- ^{xxxv} **Internet Website** <http://bisleep.medsch.ucla.edu/map/world.map.html> (1997)
- ^{xxxvi} QUT - Queensland University of Technology
- ^{xxxvii} AMSA - Australian Maritime Safety Authority
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^{lix} **Australian Government - Marine Incident Investigation Unit** @ Website:
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^{lxi} Shipley (1978), p27.