1 Introduction

1.1 Fatigue is an expected and ubiquitous aspect of life. For the average individual, fatigue presents a minor inconvenience, resolved with a nap or by stopping whatever activity that brought it on. Typically, there are no significant consequences. However, if that person is involved in safety-related activities such as air traffic control, piloting an aircraft, performing surgery, or running a nuclear reactor, the consequences of fatigue can be disastrous. It is increasingly being recognised as a safety issue of the highest priority.

1.2 Fatigue is not just an industrial issue to be negotiated between employers and employees. It is also an occupational health and safety issue, a commercial issue, a public safety issue and, at times, an environmental issue. Individuals and organisations that fail to manage human fatigue sensibly, risk having or creating accidents with a broad range of damaging and enduring consequences.

2 Discussion

2.1 IFATCA Policy is that:

"MAs should draw the attention of their members to the causes of Fatigue in ATC so that they can identify those to which they are most exposed."
MAs should advise their members to seek professional psychological advice when they believe that they are subject to excessive stress-inducing agents.”

“Management has the prime role for providing fatigue management and prevention of fatigue-related catastrophes. Any situation where increased fatigue, decreased sleep, or performance loss can be demonstrated, is a situation where the margin for error is reduced, albeit by some unknown amount, and should be avoided in ATC.

The provision of a satisfactory working environment appropriate rostering, rest periods, facilities, use of overtime, relief controllers and education in human factors shall be agreed with the air traffic controllers involved. Attention must be given to individual differences, age and gender.

In exercising the responsibilities of designing of duty rosters (POLSTATs elsewhere refers), management shall be responsible for providing physical arrangements (relief controllers and adapted rest area) and sufficient break periods for controllers to try to maintain their daily eating habits regardless of which shift they are working. Such physical arrangements and sufficient break periods shall be provided to allow for strategic naps during night shifts.

Management shall approve the implementation of strategic naps as an effective way of improving alertness and anchoring the circadian rhythms of controllers during night shift.

A strategic nap is defined as a short period of sleep taken at specific times during a night shift. Recommended duration of a strategic nap varies from maximum 20 minutes for a nap early in the night to maximum 50 minutes late in the night (after 4am).

Management shall in close coordination with the air traffic controllers involved, carefully consider staffing levels during night shifts. For those controllers who have very heavy traffic loads during the night shifts, additional relief should be considered as an appropriate countermeasure to sleepiness and fatigue in order to increase the safety margins, and to reduce subsequent daytime sleepiness.

Use of overtime shall generally be kept to a minimum, and a system for allocation of overtime which takes the limitations in human performance as a factor shall be established. The combination of overtime shortly before or just after night-shifts shall be avoided.

Control-rooms shall be tobacco-smoke free areas due to the negative effects on dexterity caused by smoking.

MAs should advise their members and management about the causes of fatigue and countermeasures available. MAs should encourage
their management to include theory about the physiological principles related to sleep and circadian rhythms, both in controllers retraining and basic education. Such training should include knowledge of ways to take deliberate actions (countermeasures) to better meet controllers’ operational requirements.”

Page 4133 **WC.3.2. WORK AND REST SCHEME**

“Our Definition:

Operational Duty: The period which a controller is actually exercising the privileges of the controller’s licence at an operational position.

Rosters should be constructed following a simple pattern, with shifts of the same or very similar lengths and adequate breaks between shifts and shift cycles.

The average time of operational duty and breaks should not exceed 32 hours per week.

Each shift should not exceed 7 hours 30 minutes including breaks.

A minimum rest period of 11 consecutive hours per day should be provided.

The continuous operational duty for a controller should be 2 hours maximum and should be reduced to 90 minutes for controllers working with visual terminals and/or radar displays; after which a minimum 30 minutes break, away from the working environment, should be given to controllers.

At least one break of a minimum of 1 hour duration, on both day and afternoon shift, shall be given to controllers for the purpose of eating at regular times and to prevent gastrointestinal dysfunctions.

Extra rest hours shall be provided when requested by a pregnant controller.

By night the total operational duty time should not exceed 5 hours.

Controllers shall not be held liable in the case of an accident or incident if the controller has previously registered a formal complaint of exaggerated working hours or lack of fatigue management and these have been determined to be a major contributing factor to the incident or accident.”

Page 4134 **WC.3.3. VACATION SCHEME**

“The annual leave for a controller should be not less than 30 working days (this is the equivalent of 6 weeks), excluding public holidays, of which 3 weeks must be consecutive.”
“The duty roster should be based on at least 2 consecutive days off in every 7 days.

Duty rosters should be agreed with the air traffic controllers involved.

SPO shall be avoided. (See IFATCA TPManual SPO POLSTATs.)

An optimal roster should be promulgated, based on the maximum allowed number of working hours per week and per shift, a minimum number of break periods of an agreed minimum length, both during a shift and between shifts and on an optimal night/day switch number per week or per month as appropriate. This roster requires definition of personnel strength based on the number of sectors and traffic density. It must allow for attribution of a minimum number of days paid leave, sick leave, extraordinary leave and unpaid leave. It must be such that a minimum number of weekends per month and of public holidays per year can be taken as they occur and not later. Conditions for overtime and night work (e.g. rest facilities) must be defined and the regulations governing the various kinds of leave be clearly stated.

Duty rosters including night shifts should be of a rapidly rotating shift system in a morning, evening, night cycle. Consecutive night shifts are not recommended.

Shift systems should not include night shifts that commence on the same day that a morning shift ends.

Change-over times between night shift and the following morning shift should not take place before 6 am local time, to ensure that sleep duration for the morning shift is adequate before commencement of their duty time.

Shift systems should include preferably single night duties only but where consecutive nights are required they should be restricted to the minimum.

In respect of the nature of night shift duties Member Associations pursue additional time off for night shifts worked as compensation.

After a night shift, an off-duty period of a minimum of 30 hours is recommended.

The number of consecutive early starts (shifts starting in the period between 0600 and 0659) should be limited to a maximum of two in a period of 144 hours (6 days).”

2.2 Definition of Fatigue:
2.2.1 Defining fatigue in humans is extremely difficult due to the large variability of causes. Causes of fatigue can range from boredom to circadian rhythm disruption to heavy physical exertion. In lay terms, fatigue can simply be defined as **weariness**. There is no commonly agreed definition of human fatigue. In sports science, fatigue is seen in purely physical terms. In the context of safety in transportation, wider definitions are used which incorporate both physical and mental factors. Fatigue has been variously defined as:

- the consequence of inadequate restorative sleep,
- the progressive loss of alertness ending in sleep,
- an all encompassing term used to describe a variety of different experiences such as physical discomfort from over working a group of muscles, difficulty concentrating, difficulty appreciating potentially important signals and problems staying awake, and
- a reduction in or loss of physical and/or mental capability as a result of exertion, which may impair all physical abilities, including strength, speed, reaction time, coordination, decision making, or balance.

2.2.2 The key points taken from the above definitions are that fatigue is the result of inadequate rest over a period of time and that fatigue leads to physical and mental impairment. It is commonly understood that there are two different levels or types of fatigue:

- **Acute** fatigue is short term and is experienced as a direct consequence of some activity such as strenuous exercise or intense mental concentration.
- **Chronic** fatigue (not to be confused with the medical condition of the same name) is a cumulative state of tiredness and decreased alertness and it is more severe and long term than acute fatigue.

2.2.3 A common perception equates fatigue with feeling sleepy or tired. In many cases the research uses the terms fatigue and sleepiness interchangeably. However, many researchers differentiate fatigue from "sleepiness" or "tiredness". Tiredness may refer to the ability to initiate sleep while fatigue refers to the ability to maintain job sufficient alertness. By these definitions, it is possible to be fatigued but not tired. For example, the time of day may make it difficult to fall asleep even though a person is fatigued. Further, sleepiness is a subjective state while fatigue involves a loss of objectively measurable performance capability over time.

2.2.4 However, from an operational standpoint a more accurate definition might be: "**Fatigue is a condition characterized by increased discomfort with lessened capacity for work, reduced efficiency of accomplishment,**

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1 Federal Aviation Administration, “Fatigue in Aviation”
2 The Science of sport, Fatigue in real life
3 Managing fatigue, “A guide for the workplace”
4 Transport Accident Investigation Commission
5 Australian Government, The work practices of Marine Pilots: a review
6 Adequate Crewing and Seafarers’ Fatigue: The International Perspective
loss of power or capacity to respond to stimulation, and is not necessarily accompanied by a feeling of weariness and tiredness.”

Two key concepts can be derived from this definition.

- Fatigue can develop from a variety of sources. The important factor is not what causes the fatigue but rather the negative impact fatigue has on a person’s ability to perform tasks. A long day of mental stimulation such as processing data in air traffic control can be as fatiguing as manual labour. They may feel different—a sore body instead of a headache and bleary eyes—but the end effect is the same, an inability to function normally.

- Fatigue leads to a decrease in the ability to carry out tasks. Several studies have demonstrated significant impairment in a person’s ability to carry out tasks that require manual dexterity, concentration, and higher-order intellectual processing like air traffic control especially a busy sector with complex scenarios. Fatigue may happen acutely, which is to say in a relatively short time (hours) after some significant physical or mental activity. or, it may occur gradually over several days or weeks. Typically, this situation occurs with someone who does not get sufficient sleep over a prolonged period of time (as with sleep apnea, jet lag, or shift work) or someone who is involved in ongoing physical or mental activity with insufficient rest.

2.3 Stressors:

2.3.1 At its core, fatigue is caused by a lack of restorative sleep. The evidence suggests that three broad factors can contribute to a lack of restorative sleep: the time of day work takes place, the length of time spent at work and in work related duties (such as driving to and from work), and the amount and quality of rest obtained prior to and after a work period.

2.3.2 Research, both in Australia and elsewhere, has identified the time of day at which work takes place as a key risk factor in fatigue. As described in one research paper, “the circadian clock is a powerful modulator of human performance and alertness, and in safety critical operations, it can be disrupted by night work, time zone changes, and day night shifts”. There is a substantial body of evidence indicating that accidents and/or incidents are more likely to occur at night, particularly during the period when the circadian cycle is at its lowest point and a person would normally be sleeping.

2.3.3 Night work of any sort is well known to be at higher risk of error and result in poor performance in general. In addition, night work always requires more effort to perform than day work. For these reasons, night work should be avoided where possible. Since the result of errors and poorer performance are more likely to have serious consequences in the transport industry compared to other industries, the increased risk at night cannot be ignored.

2.3.4 Similarly, a study undertaken in 1998 by the RAAF Institute of Aviation Medicine recommended that shift lengths be adjusted so that day shifts are

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7 Federal Aviation Administration, "Fatigue in Aviation"
longer than night shifts. It is argued that shifts of equal length can cause “periods of acute fatigue and significant performance impairment”. This is due to fatigue accumulation being slower during the day and faster during the night. Further, recovery after a night shift is inefficient because the time of day does not allow for effective sleep.

2.3.5 It is widely accepted in research literature that long hours of work are a key cause of fatigue.

2.3.6 The third key cause of fatigue is the amount and quality of rest before work. Studies by the US Army Medical Corp indicate that anything less than 8 to 9 hours of sleep per night leads to degraded work performance over time. Moreover, the longer a person suffers from restricted sleep, the longer it takes them to recover even when given optimal conditions for sleep.

2.3.7 The time of day at which people seek to sleep is also an important factor in fatigue. Research shows that daytime sleep is not as effective as night sleep and is shorter in duration, even if more time for sleep is available. The best and most recuperative sleep is that which starts at around 9 pm. The worst sleep is sleep initiated in the afternoon.

2.3.8 There is also a body of evidence indicating that working at night is related to a reduction in sleep during time off duty, accumulated sleep debt and a corresponding decline in performance. This is a disturbing finding, as many workers in the transport industry regularly work at night.

2.3.9 Shift work rosters do, of course, provide for time off-duty to allow for rest and sleep. However, it can be extremely difficult to obtain sufficient rest during daylight hours. Professor Dawson notes that:

...as the amount of night work increases, so does the amount of sleep that must be attempted at biologically inappropriate times. Sleeping “out of sync” with the body’s biological clock, results in reduced duration and quality of sleep. This in turn reduces the restorative value of the sleep obtained.

2.3.10 Other factors can also influence the effectiveness of rest sought at these times, such as:

- environmental factors (such as higher levels of ambient noise and higher temperatures during the day); and
- the need to fulfil family and personal commitments.

2.3.11 Workers who are “on-call” during off-duty times can find that their opportunities for rest are disrupted significantly.

2.3.12 Many argue that not only are the three causes of fatigue (long hours of work, night work and the lack of restorative sleep) ever present in the transport industry, they are exacerbated by other factors common in the industry, such as:

- insufficient staff numbers;
- poor rostering practices;
- poor work scheduling;
- methods and rates of pay that induce employees to work longer hours;
- commercial pressures on companies that are passed on to employees;
• regulatory requirements, which compel or allow fatigue inducing practices;
• work related stress;
• environmental factors in the workplace.

2.3.13 Any fatigued person will exhibit the same problems:
• sleepiness, difficulty concentrating, apathy, feeling of isolation, annoyance, increased reaction time to stimulus, slowing of higher-level mental functioning, decreased vigilance, memory problems, task fixation, and increased errors while performing tasks.

2.3.14 None of these are good things to happen to an ATCO, much less if there is no one else to help out. In a variety of studies, fatigued individuals consistently underreported how tired they really were, as measured by physiologic parameters. A tired individual truly does not realize the extent of actual impairment. No degree of experience, motivation, medication, coffee, or will power can overcome fatigue.

2.4 Air traffic controllers and fatigue

2.4.1 Poorly managed fatigue in the provision of air traffic control services can represent a significant threat to public safety, it is inappropriate that hours of work for air traffic controllers be a matter for industrial negotiation. Hours of work for air traffic controllers should be regulated in the same manner as hours of duty for flight crew are regulated.

2.4.2 Service providers however, seem disinclined to vary the current arrangements, preferring to “take a broad, less prescriptive approach to managing fatigue”. They cite, in support of their position, the situation in the United Kingdom whereby the UK air traffic control authority has to continually issue dispensations to their strict regulations due to the lack of flexibility in the system.

2.4.3 That said, legislative bodies do have a clear responsibility for protecting the safety of third parties.

2.4.4 The risk of allowing hours of work to be settled solely in the industrial negotiations arena is that safety and hours of rest can be bargained away. Some employers may believe, falsely, that longer hours and more night shifts always represents better productivity and some employees can be tempted by the prospect of more money to do more work.

2.4.5 The development of this new regulatory environment is a crucially important task, with profound consequences for aviation safety.

2.4.6 PLC also thinks it appropriate that ANSPs take action to ensure that, in the interim, they manage their fatigue risk more effectively.

2.4.7 Regulators should test the ANSPs’ shift rosters for their current staff against one of the fatigue management models that are currently available. Unfortunately it is extremely difficult to obtain a reputable model as most models are developed in conjunction with the ANSP or employer and seem to favour the ANSP or employer and not the employee.

2.4.8 Prescriptive legislation will continue to have a place in the industry for some time yet. The advantages of a legislative approach are that the rules can be
clearly described, they apply uniformly across the industry or across particular parts of the industry and they provide a basis for consistent enforcement action. In an area where concerns about personal and public safety are growing, legislated rules provide a high degree of certainty and confidence.

2.5  
Comparison of fatigue to alcohol

2.5.1  
The comparison of fatigue and alcohol provides a way of measuring the impairment due to fatigue based on what is already known about alcohol. It provides a basis for deciding what level of fatigue may be dangerous and an accessible frame of reference for engendering a broad understanding of the effects of fatigue. Most people are aware of the effects of alcohol on their performance and now have a means of translating that knowledge and experience to their level of fatigue.

2.5.2  
As noted by Williamson and Feyer “the[se] results indicate that the consequences of fatigue are at least as important as the consequences of alcohol use in transportation, since they produce similar effects likely to compromise safety after relatively moderate hours without sleep”.

2.6  
The scope of the problem

2.6.1  
Broad ranging research into the key contributors to workplace impairment suggests that fatigue is four times more likely as a cause of impairment than drugs or alcohol. While there is agreement amongst experts that fatigue is a significant problem in the transport industry, and is growing along with the scale of the transport task itself, there is some variation in the data available on the subject.

2.6.2  
These variations can be explained by:

- differences in the way that fatigue is defined in each jurisdiction and in each sector of the industry;
- differences in data collection methodologies; and
- the practical difficulties associated with determining whether a person was suffering from fatigue immediately before an accident.

2.6.3  
Nevertheless, the data that is available allows a broad-brush picture to be established for each sector in the transport industry.

2.7  
Circadian Rhythms

2.7.1  
Chronic fatigue is directly related to the physiological need for sleep. Being required to function on a roughly 24 hour basis, either through shift work or extended hours of work, comes into conflict with the body’s internal “clock” (often referred to by the physiological term circadian pacemaker). One of the key functions of this internal “clock” is to determine when people feel the need for sleep and when they feel awake over a 24 hour period (circadian rhythms).

2.7.2  
The body’s circadian rhythms increase and decrease body temperature over a roughly 24 hour period, reaching a low point at approximately 3 am to 5 am with a less severe low point at around 3 pm and 5 pm. These low points induce a strong physiological need for sleep at around these times.
Evidence suggests that working through these periods produces a higher relative risk of an accident.

- Importantly, every person operates to a similar wake/sleep pattern. Researchers working with the NASA Fatigue Countermeasures Program observe that;
- The body's internal clock can be reset over time if external events change for an extended period, such as when people change time zones for an extended period. However, research shows that it cannot be permanently adjusted to a reversed cycle of work and sleep if external events remain the same, such as occurs in shift work.

2.8 **Sleep Deficit**

2.8.1 The optimum amount of sleep required by an individual varies, with 8 hours considered the average amount of sleep required by an adult. If an individual continually obtains less than their optimal number of hours of sleep, they build up a sleep deficit (or sleep debt).

2.8.2 A sleep debt is “the difference between a person's minimum sleep requirement needed to maintain appropriate levels of alertness and performance and the actual amount of sleep obtained”. For example, if an individual who requires 8 hours of sleep only obtains 6 hours, they are deprived of 2 hours of sleep. If this occurs over four consecutive nights the sleep loss per night would accumulate into an 8 hour sleep debt that will affect the individual's level of alertness and performance.

2.8.3 People who are suffering from a sleep debt are at risk of 'nodding off' whilst working. These brief sleep episodes are termed micro-sleeps and are usually uncontrolled and spontaneous. Research indicates that people are not always aware they have fallen asleep and that 'between 2 to 4 minutes of sleep must elapse before more than 50 per cent of people will acknowledge they have fallen asleep'. Researchers with the NASA Fatigue Countermeasures Program conclude that 'regardless of training, professionalism, or having the 'right stuff', extreme sleepiness can precipitate uncontrolled and spontaneous sleep'.

2.9 **Perceiving Fatigue**

2.9.1 The physical need for sleep does not always accord with how tired a person feels. There are two ways of understanding how a person perceives their own level of fatigue:

- **physiological**, which is the physical need for sleep, and
- **subjective**, which is how sleepy a person feels. This is not an accurate measure of an individual's physiological need for sleep. It can be affected by factors such as physical activity or a stimulating environment.

2.9.2 There are certain cultural obstacles to getting people to recognise and take appropriate action in regard to fatigue. Most commonly, people are willing to work whilst suffering from fatigue because it is seen as “professional”. The widely held belief, particularly in the transport industry, that fatigue 'comes with the job' makes it difficult for people to recognise fatigue as a problem and to take appropriate action.
2.10 The impact of fatigue

2.10.1 During Operation Desert Storm the United States Air Force observed that cumulative fatigue in C-5 air transport flight crews resulted in the fumbling of radio frequency changes, slowed reaction times, impaired judgment, diminished checklist discipline, decreased aircrew coordination and increased irritability, unfortunately there are not indebt studies on ATCOs like there is on pilots. In some situations, fatigue induced mistakes may be inconsequential, creating minor delays in completing a task or rectified by failsafe systems. In other situations, the risks of damage to equipment, of personal injury and to public safety can be far greater. The costs of badly managed fatigue can be catastrophic: for companies, for individuals and for the community.

2.10.2 While the causes of fatigue in the transport industry are plain (time of day, hours of work and inadequate rest), fatigue presents itself as a multifaceted problem requiring sophisticated management. It is not just a matter of limiting hours of work (although this is often part of an appropriate response to fatigue), but is a matter of ensuring that rostering arrangements are sensitive to optimal time of work and time of rest considerations. It is a matter of shared responsibility and proper regulation: employers establishing safe working environments and practices; employees presenting themselves in a fit state for duty.

2.10.3 Many of the approaches that have been taken to fatigue management to date recognise and respond to one or other of these matters. Very few tackle all of them successfully.

2.10.4 PLC is of the opinion that the challenge facing Regulators now is to fill in the gaps (in the areas of research and education); and select good practice from bad (promoting the former and dispensing with the latter).

2.11 Antidote to Fatigue

2.11.1 Obtaining adequate sleep is the best way to prevent or resolve fatigue. Sleep provides the body with a period of rest and recuperation. Insufficient sleep will result in significant physical and psychological problems. On average, a healthy adult does best with eight hours of uninterrupted sleep, but significant personal variations occur. For example, increasing sleep difficulties occur as we age, with significant shortening of nighttime sleep.

2.11.2 A variety of medical conditions can influence the quality and duration of sleep. To name a few: sleep apnoea, restless leg syndrome, certain medications, depression, stress, insomnia, and chronic pain.

2.11.3 Some of the more common social or behavioural issues are: late-night activities, excessive alcohol or caffeine use, travel, interpersonal strife, uncomfortable or unfamiliar surroundings, and shift work.

2.12 Prevention

2.12.1 No one is immune from fatigue. Yet, in our society, establishing widespread preventive measures to combat fatigue is often a very difficult goal to achieve. Individuals, as well as organizations, often ignore the problem until an accident occurs.
2.12.2 Even then, implementing lasting change is not guaranteed. Lifestyle changes are not easy for individuals, particularly if that person isn’t in complete control of the condition. For example, air traffic controllers and pilots must contend with shift work and circadian rhythm disruption. Often, they also choose to commute long distances to work, so that by the time a work cycle starts they have already travelled for some time.

2.13 Lifestyle Recommendations for a good nights sleep

2.13.1 Don’t...

- Consume alcohol or caffeine 3-4 hours before going to bed.
- Eat a heavy meal just before bedtime.
- Exercise 2-3 hours before bedtime. While working out promotes a healthy lifestyle, it shouldn’t be done too close to bedtime.
- Use sleeping pills (prescription or otherwise).

2.13.2 Do...

- Be mindful of the side effects of certain medications, even over the-counter medications – drowsiness or impaired alertness is a concern.
- Consult a physician to diagnose and treat any medical conditions causing sleep problems.
- Create a comfortable sleep environment at home. Adjust heating and cooling as needed. Get a comfortable mattress.
- When travelling, select hotels that provides a comfortable environment.
- Get into the habit of sleeping eight hours per night. When needed, and if possible, nap during the day, but limit the nap to less than 30 minutes. Longer naps produce sleep inertia, which is counterproductive.
- Try to turn in at the same time each day. This establishes a routine and helps you fall asleep quicker.
- If you can’t fall asleep within 30 minutes of going to bed, get up and try an activity that helps induce sleep (watch non-violent TV, read, listen to relaxing music, etc).
- Get plenty of rest and minimize stress before a shift. If problems preclude a good night’s sleep, rethink the shift and postpone it accordingly if it can be accommodated.

2.14 Fatigue and the law

2.14.1 A key aspect of this is the “increasing” desire of different legislatures to shift liability for breach of those regulations from individuals to their employers. Although legal approaches to the issue of fatigue are still evolving it is clear that there is a move away from a sole focus on the individual to a more inclusive approach that considers the legal responsibility of other players such as managers, executives and company owners. Good regulations should be enforced at all times by the regulator to ensure compliance.

3 Conclusions

3.1 Defining fatigue in humans is extremely difficult and there are various influences that act as stressors in humans causing fatigue. PLC defines fatigue in Air Traffic Control as:
“Fatigue is a condition characterized by increased discomfort with lessened capacity for work, reduced efficiency of accomplishment, loss of power or capacity to respond to stimulation, and is not necessarily accompanied by a feeling of weariness and tiredness.”

3.2 In recent years the aviation community became more aware of fatigue and its relation to incidents / accidents. As a consequence, there is greater pressure to regulate hours of service as a means to reduce the likelihood and consequence of fatigue related incidents or accidents.

3.3 There is a significant amount of published literature on the subjective, neurobehavioral and electrophysiological effects of sleep loss over a single or multiple nights. It can be extrapolated from this data to conclude that it is unlikely that prior to commencing work an individual obtaining less than the required sleep is likely to be unimpaired at a level consistent with a safe system of work. Caution should be taken as in Air Traffic Control the occupational tasks may well be more susceptible to fatigue-related error or the consequences of fatigue-related error are so severe it requires the ATCO to be very vigilant.

3.4 IFATCA has policy regarding Fatigue in Air Traffic Control, Work and Rest Scheme, Vacation Scheme and Duty Roster. Present policy does not address fatigue management systems with respect to the role of the regulator / legislator.

4 Draft Recommendations

4.1 It is recommended to insert on Page 4227 of the TP Manual

Fatigue Management Systems

4.1. The Regulator / Legislator should:

- develop comprehensive hours of duty regulations for air traffic controllers, incorporating fatigue management principles;
- require all air traffic service providers to maintain auditable fatigue management systems.

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