Extracts from IMO MSC/Circ 1014

INTERNATIONAL MARITIME ORGANIZATION
4 ALBERT EMBANKMENT
LONDON SE1 7SR

Telephone: 020 7735 7611
Fax: 020 7587 3210
Telex: 23588 IMOLDN G

IMO

E

Ref. T2/4.2

MSC/Circ.1014
12 June 2001

GUIDANCE ON FATIGUE MITIGATION AND MANAGEMENT

1 The Maritime Safety Committee (MSC), at its seventy-first session (19 to 28 May 1999), considered the issue of human fatigue and the direction where IMO efforts should be focused. In this regard, it was agreed that practical guidance should be developed to provide appropriate information on fatigue to all parties concerned. This guidance should inform each party that has a direct impact on vessel safety (naval architects, owners/operators, masters, officers, ratings, training institutions, etc.) of the nature of fatigue, its causes, preventive measures and countermeasures.

2 Accordingly, the MSC, at its seventy-fourth session (30 May to 8 June 2001), approved the annexed guidelines, composed of self-contained Modules, each addressing a different party. The Modules have been assembled using existing information, in a useful format, for transmission to the different parties who have a direct impact on vessel safety.

3 Member Governments are invited to:

.1 bring the attached guidelines to the attention of their maritime Administrations and relevant industry organizations and to all other parties who have direct impact on ship safety;

.2 use this guidance as a basis for developing various types of tools for dissemination of the information given in the guidelines (such as: pamphlets, video training modules, seminars and workshops, etc.); and

.3 take the guidelines into consideration when determining minimum safe manning.

4 Shipowners, ship operators and shipping companies are strongly urged to take the issue of fatigue into account when developing, implementing and improving safety management systems under the ISM Code.

***

Guidelines on Fatigue
Module 4

FATIGUE AND THE MASTER

Foreword

The Guidelines on Fatigue contain practical information that can assist interested parties (Naval architects/Ship designers, owners/operators, Masters, Officers, other crew members and training institutions) to better understand and manage fatigue.

The guidelines provide information on the potential dangers of fatigue and ultimately the effect on the health and safety of the personnel working on ships. The guidelines contain information on the symptoms and causes of fatigue, and address solutions to combat fatigue in order to improve associated health problems and prevent fatigue related accidents from occurring.

The guidelines have been divided into nine modules, as follows:

1. Module 1	Fatigue
2. Module 2	Fatigue and the Rating
3. Module 3	Fatigue and the Ship's Officer
4. Module 4	Fatigue and the Master
5. Module 5	Fatigue and the Training Institution and Management Personnel in charge of Training
6. Module 6	Shipboard Fatigue and the Owner/Operator/Manager
7. Module 7	Shipboard Fatigue and the Naval Architect/Ship Designer
8. Module 8	Fatigue and the Maritime Pilot
9. Module 9	Fatigue and Tugboat Personnel
10. Appendix	Fatigue related documentation

It is recommended that all parties become familiar with Module 1 prior to using Modules 2 - 9. Module 1 contains pertinent background information on the subject of fatigue.

Module 4 contains practical information intended for the ***Master*** working on board ships. It is recommended that the Master also becomes familiar with Modules 2 and 3 (Fatigue and the Rating and Fatigue and the Ship's Officer respectively).

Guidelines on Fatigue
Module 4

FATIGUE AND THE MASTER

1. HOW CAN YOU RECOGNIZE FATIGUE IN YOURSELF AND OTHERS (SIGNS/SYMPTOMS)?

Fatigue can affect your mind, emotions and body (e.g. your capacity for tasks involving physical exertion and strength, as well as your ability to solve complex problems or make decisions, etc). Your level of alertness is dependent on fatigue, and therefore, human performance can be impaired.

Table 1 describes some of the possible effects of fatigue by listing performance impairments and the symptoms associated with them. These signs and symptoms of fatigue may be used to identify an individual's level of alertness. It must be noted, however, that it is difficult for an individual to recognize the symptoms of fatigue within him/herself, because fatigue impairs judgement.

TABLE 1
EFFECTS OF FATIGUE

PERFORMANCE IMPAIRMENT		SIGNS/SYMPTOMS
1	Inability to concentrate	• *Unable to organize a series of activities* • *Preoccupied with a single task* • *Focuses on a trivial problem, neglecting more important ones* • *Reverts to old but ineffective habits* • *Less vigilant than usual*
2	Diminished decision-making ability	• Misjudges distance, speed, time, etc. • Fails to appreciate the gravity of the situation • Overlooks items that should be included • Chooses risky options • Difficulty with simple arithmetic, geometry, etc.
3	Poor memory	• Fails to remember the sequence of task or task elements • Difficulty remembering events or procedures • Forgets to complete a task or part of a task
4	Slow response	• Responds slowly (if at all) to normal, abnormal or emergency situations
5	Loss of bodily control	• May appear to be drunk • Inability to stay awake • Affected speech e.g. it may be slurred, slowed or garbled • Feeling heaviness in the arms and legs • Decreased ability to exert force while lifting, pushing or pulling • Increased frequency of dropping objects like tools or parts

6	Mood change	• Quieter, less talkative than usual • Unusually irritable • Increased intolerance and anti-social behavior • Depression
7	Attitude change	• Fails to anticipate danger • Fails to observe and obey warning signs • Seems unaware of own poor performance • Too willing to take risks • Ignores normal checks and procedures • Displays a "don't care" attitude • Weakness in drive or dislike for work

In addition to the behavioral changes listed in the table (symptoms), there are also a number of other changes associated with fatigue that will manifest as physical discomfort, such as:

- Headaches
- Giddiness
- Heart palpitations / irregular heart beats
- Rapid breathing
- Loss of appetite
- Insomnia
- Sudden sweating fits
- Leg pains or cramps
- Digestion problems

2. WHAT CAN CAUSE FATIGUE?

Fatigue may be caused and/or made worse by one or a combination of things:

- Lack of sleep
  Only sleep can maintain or restore your performance level. When you do not get enough sleep, fatigue will set in and your alertness will be impaired. (Refer to Section 3)

- Poor quality of sleep
  Fatigue may be caused by poor quality of sleep. This occurs when you are unable to sleep without interruptions or you are unable to fall asleep when your body tells you to. (Refer to Section 3)

- Insufficient rest time between work periods
  Apart from sleep, rest (taking a break) between work periods can contribute to restoring your performance levels. Insufficient rest periods or postponing assigned rest times (to finish the job early) can cause fatigue. (Refer to Section 3)

- Poor quality of rest
  Disturbances while resting such as being woken up unexpectedly while on call (during port operations) or unpredictable work hours (when arriving in port) can cause fatigue.

- Stress
  Stress can be caused by personal problems (family), problems with other shipmates, long work hours, work in general, etc. A build up of stress will cause or increase fatigue.

- Boring and repetitive work
  Boredom can cause fatigue. You may become bored to the point of fatigue when your work is too easy, repetitive and monotonous and/or bodily movement is restricted.

- Noise or vibration
  Noise or vibration can affect your ability to sleep/rest, and it can affect your level of physical stress, thus causing fatigue.

- Ship movement
  The ship's movement affects your ability to maintain physical balance. Maintaining balance requires extra energy, which can then cause fatigue. A ship's pitching and rolling motions mean you might have to use 15-20% extra effort to maintain your balance.

- Food (timing, frequency, content and quality)
  Refined sugars (sweets, doughnuts, chocolates, etc.) can cause your blood sugar to rise rapidly to a high level. The downside of such short-term energy is that a rapid drop in blood sugar can follow it. Low blood sugar levels can cause weakness, instability and difficulty in concentrating and in the extreme case, unconsciousness. Eating large meals prior to a sleep period may disrupt your sleep.

- Medical conditions and illnesses
  Medical conditions (i.e. heart problems) and illnesses such as the common cold can cause fatigue. The effect not only depends on the nature of the illness or medical condition, but also the type of work being carried out. For example, common colds slow response time and affect hand-eye coordination.

- Ingesting chemicals
  Alcohol, caffeine and some over the counter medications disrupt sleep. Caffeine consumption can also causes other side effects such as hypertension, headaches, mood swings and anxiety.

- Jet-lag
  Jet-lag occurs following long flights through several time zones. It is a condition that causes fatigue in addition to sleep-deprivation and irritability. It is easier to adjust to time zones while crossing from east to west as opposed to west to east. The greatest difficulty in adjustment results from crossing 12 time zones, the least from crossing one time zone. Our bodies adjust at the rate of approximately one-hour per day.

- Excessive work load
  Working consistently "heavy" workloads can cause fatigue. Workload is considered heavy when a person works excessive hours or performs physically demanding or mentally stressful tasks. Excessive work hours and fatigue can result in negative effects:
  - Increased accident and fatality rates
  - Increased dependence upon drugs, tobacco or alcohol
  - Poor quality and disrupted sleep patterns

- Higher frequency of cardiovascular, respiratory or digestive disorders
- Increased risk of infection
- Loss of appetite

3. HOW CAN PEOPLE PREVENT THE ONSET OF FATIGUE?

A. Sleep Issues

The most effective strategy to fight fatigue is to ensure that you get the very best quality and quantity of sleep. Sleep loss and sleepiness can degrade every aspect of human performance such as decision-making, response time, judgement, hand-eye coordination, and countless other skills.

In order to be effective in satisfying your body's need, sleep must meet three criteria:

- Duration
  Everyone's sleep needs are unique; however, it is generally recommended that a person obtain on average 7 to 8 hours of sleep per 24-hour day. A person needs the amount of sleep that produces the feeling of being refreshed and alert. Insufficient sleep over several consecutive days will impair alertness; only sleep can maintain or restore performance levels.

- Continuity
  Sleep should be uninterrupted. Six one-hour naps do not have the same benefit as one six-hour period of sleep.

- Quality
  People need deep sleep. All sleep is not of the same quality and does not provide the same fully recuperative benefits.

Here is some general guidance on developing good sleep habits:

- Develop and follow a pre-sleep routine to promote sleep at bedtime (e.g. a warm shower, reading calming material, or just making a ritual of pre-bed preparation can provide a good routine).
- Make the sleep environment conducive to sleep (a dark, quiet and cool environment, and a comfortable bed encourages sleep).
- Ensure that you will have no interruptions during your extended period of sleep.
- Satisfy any other physiological needs before trying to sleep (e.g. if hungry or thirsty before bed, eat or drink lightly to avoid being kept awake by digestive activity and always visit the toilet before trying to sleep).
- Avoid alcohol and caffeine prior to sleep (keep in mind that coffee, tea, colas, chocolate, and some medications, including cold remedies and aspirin contain alcohol and/or caffeine). Avoid caffeine at least six hours before bedtime.
- Consider relaxation techniques such as meditation and yoga, which can also be of great help if learnt properly.

B. Rest Issues

Another important factor that can affect fatigue and recovery is rest. Rest, apart from sleep, can be provided in the form of breaks or changes in activities. Rest pauses or breaks are indispensable as a physical requirement if performance is to be maintained. Factors

influencing the need for rest are the length and intensity of the activities prior to a break or a change in activity, the length of the break, or the nature or change of the new activity.

C. <u>Guidelines on maintaining performance</u>

Here are some general guidelines that can help you maintain performance:

- Get sufficient sleep, especially before a period when you expect that time for adequate sleep will not be available.
- Ensure continuous periods of sleep.
- Take strategic naps (the most effective length of time for a nap is about 20 minutes).
- Take breaks when scheduled breaks are assigned.
- Develop and maintain good sleep habits, e.g. develop a pre-sleep routine.
- Monitor and effectively manage hours of work and rest by maintaining individual records of hours rested or worked.
- Maintain fitness for duty including medical fitness.
- Eat regular, well-balanced meals.
  Exercise regularly.

4. WHAT CAN MITIGATE THE EFFECTS OF FATIGUE?

The most powerful means of relieving fatigue is to get proper sleep and to rest when appropriate. However, a number of countermeasures have been identified as potentially providing some short-term relief. It must be emphasized that these countermeasures will not restore an individual's state of alertness; they only provide short-term relief, and may in fact, simply mask the symptoms temporarily. The following list captures some of the short-term countermeasures:

- Interest or opportunity
  An interesting challenge, an exciting idea, a change in work routine or anything else that is new and different may help to keep you awake. If the job is boring or monotonous, alertness fades.

- Environment (light, temperature, humidity, sound, and aroma)
  Bright lights, cool dry air, obtrusive or loud music or other annoying irregular sounds, and some invigorating aromas (such as peppermint) may temporarily increase alertness.

- Food and consumption of chemicals
  Caffeine (encountered in coffee and tea, and to a lesser extent in colas and chocolate) may combat sleepiness in some people for short periods. However, regular usage over time reduces its value as a stimulant and may make you more tired and less able to sleep

- Muscular activity
  Any type of muscular activity helps to keep you alert; running, walking, stretching or even chewing gum can stimulate your level of alertness.

- Social Interaction
  Social interaction (conversation) can help you stay awake. However, the interaction must be active to be effective.

- Job Rotation
  Changing the order of activities, where personnel are assigned tasks that include variety in the nature of tasks, can be beneficial in breaking up job monotony. Mixing tasks requiring high physical or mental work with low-demand tasks can be beneficial.

- **Strategic Napping**
  Research has identified "strategic napping" as a short-term relief technique to help maintain performance levels during long periods of wakefulness. The most effective length of time for a nap is about 20 minutes. This means that if you have the opportunity to nap you should take it. However, there are some drawbacks associated with napping. One potential drawback is that naps longer than 30 minutes will cause sleep inertia, where situational awareness is impaired (grogginess and/or disorientation for up to 20 minutes after waking. A second is that the nap may disrupt later sleeping periods (you may not be tired when time comes for an extended period of sleep).

5. WHAT CAN BE DONE TO REDUCE CREW FATIGUE ON BOARD SHIP?

There are a number of steps that can be taken to prevent fatigue. Many of the measures that reduce fatigue are unfortunately beyond a single person's ability to influence, such as voyage scheduling, ship design, and work scheduling. Steps such as the following are important in the prevention of fatigue on board ship, and are within the Master's ability to influence and/or implement:

- Ensuring compliance with maritime regulations (minimum hours of rest and/or maximum hours of work)

- Using rested personnel to cover for those traveling long hours to join the ship and whom are expected to go on watch as soon as they arrive on board (e.g. allowing proper time to overcome fatigue and become familiarized with the ship)

- Impressing upon shore management the importance and benefits of addressing fatigue management and countermeasures in the context of the company's Safety Management System (as required by the International Safety Management Code)

- Impressing upon shore management the importance of the constant interaction between them and the ship management with respect to fatigue awareness and preventive measures on board the ships

- Creating an open communication environment, by making it clear to the crew members that it is important to inform supervisors when fatigue is impairing their performance and ensuring that there will be no recriminations for such reports

- Emphasizing to shore management the importance of selecting seafarers with the right training and experience for the job

- Improving shipboard conditions to ensure that when there is an opportunity to sleep, crew members can take advantage of it without interruptions, e.g. by scheduling drills and routine maintenance functions in a manner that minimizes the disturbance of rest/sleep periods

- Establishing on-board management techniques when scheduling shipboard work and rest periods and when scheduling watchkeeping practices and assignment of duties in a more efficient manner (using, where appropriate, IMO and ILO recommended formats – "Model Format for Table of Shipboard Working Arrangements" and "Model Format for Records of Hours of Work or Hours of Rest of Seafarers")

- Assigning work by mixing up tasks to break monotony and to combine work requiring high physical or mental demand with low-demand tasks (job rotation)

- Scheduling potentially hazardous tasks for daytime hours

- Advocating to shore management that shipboard personnel should be provided with training and support so they may recognize and deal with the effects of fatigue

- Emphasizing the relationship between work and rest periods to ensure that adequate rest is received; this can be accomplished by promoting individual record keeping of hours at rest or worked. Using (where appropriate) IMO and ILO recommended formats in "IMO/ILO Guidelines for the Development of Tables of Seafarers' Shipboard Working Arrangements and Formats of Records of Seafarers' Hours of Work or Hours of Rest"

- Taking time to personally verify that watchkeeping personnel are getting adequate rest

- Ensuring that shipboard conditions, within the crew's ability to influence, are maintained in a good state (e.g. maintaining the heating, ventilation and air-conditioning on schedule, light bulbs are replaced, sources of unusual noise are taken care of at the first opportunity)

- Re-appraising traditional work patterns and areas of responsibility on board to establish the most efficient utilization of resources (such as sharing the long cargo operations between all the deck officers instead of the traditional pattern and utilizing rested personnel to cover for those who have travelled long hours to join the ship and who may be expected to go on watch as soon as they arrive)

- Promoting supportive relationships on board (good morale) and dealing with interpersonal conflict between seafarers

- Establishing shipboard practices for dealing with fatigue incidents and learning from them (e.g. as part of the safety meetings)

- Increasing awareness of the long term health care of appropriate lifestyle behavior (e.g. exercise, relaxation, nutrition, smoking and alcohol consumption)

6. WHAT RULES AND REGULATIONS ARE IN PLACE TO PREVENT AND DEAL WITH FATIGUE?

Each individual Flag Administration is responsible for the development, acceptance, implementation and enforcement of national and international legislation (conventions, codes, guidelines, etc.) that deal with the various fatigue aspects: work hours, rest periods, crew competency and watchkeeping practices.

The following international organizations have issued various conventions and other instruments that address fatigue:

- *International Labor Organisation (ILO)*
  Convention Concerning Seafarers' Hours of Work and the Manning of Ships – ILO Convention No.180[6]*;*
- International Maritime Organisation (IMO)
  International Convention on Standards of Training Certification and Watchkeeping for Seafarers, 1978, as amended in 1995 (STCW Convention)[7]; Seafarer's Training, Certification and Watchkeeping Code (STCW Code) Parts A[8] and B[9]; International Safety Management Code (ISM Code)[10]; and various guidelines/recommendations.

In addition to the international standards, company and flag administration policies, which may be more stringent in some cases, should be followed on board all ships.

7. HOW DOES FATIGUE RELATE TO THE ILO AND IMO INSTRUMENTS?

The following ILO instruments contain guidance on fatigue related aspects:

- Convention No. 180
  This convention introduces provisions to establish limits on seafarers' maximum working hours or minimum rest periods so as to maintain safe ship operations and minimize fatigue. The text from the Convention is provided in the Appendix.

- Other Conventions
  Other ILO Conventions related to fatigue include the following convention numbers: 92, 133, 140, 141 and 147. Each introduces minimum habitability requirements (e.g. noise control and air conditioning) on board ships.

[6] Not yet in force.
[7] Mandatory instrument.
[8] Mandatory instrument.
[9] Recommendatory guidance.
[10] Mandatory instrument.

The following IMO instruments contain guidance on fatigue related aspects:

- ISM Code
  This Code introduces safety management requirements on shipowners to ensure that conditions, activities, and tasks (both ashore and afloat) that affect safety and environmental protection are planned, organized, executed and verified in accordance with company requirements. The fatigue related requirements include:
  1. manning of ships with qualified and medically fit personnel;
  2. familiarization and training for shipboard personnel; and
  3. issuance of necessary support to ensure that the shipmaster's duties can be adequately performed.

- STCW Convention and STCW Code
  The STCW Convention requires that Administrations, for the purpose of preventing fatigue, establish and enforce rest period requirements for watchkeeping personnel. In addition, the Convention sets minimum periods and frequencies of rest. Part A of the Code requires posting of the watch schedules. Part B of the Code recommends that record keeping is useful as a means of promoting compliance with the rest requirements.

- Resolution A.772(18) [11] – Fatigue Factors in Manning and Safety
  This Resolution provides a general description of fatigue and identifies the factors of ship operations which may contribute to fatigue.

- Other Instruments
  The Appendix contains a list of IMO instruments identified as having some applicability to crew fatigue.

[11] Resolutions are not binding on governments, however their content is in some cases implemented by government through incorporation in domestic legislation.

REFERENCES

[1] **International Maritime Organization (IMO) & International Labour Office (ILO) (1999)-** *IMO/ILO Guidelines for the Development of Tables of Seafarers' Shipboard Working Arrangements and Formats of Records of Seafarers' Hours of Work or Hours of Rest.* IMO – London, United Kingdom

International Transport Workers' Federation (1997) - *Seafarer Fatigue: Wake up to the dangers.* IMO, MSC 69/INF.10 - United Kingdom.

Kroemer, K.H.E., & Grandjean, E. (Re-printed 1999) – *Fitting the Task to the Human.* Taylor & Francis Ltd. – London, United Kingdom.

McCallum, M.C., & Raby, M., Rothblum A. (1996) - *Procedures for Investigating and Reporting Human Factors and Fatigue Contributions to Marine Casualties*. Report No. CG-D-09-97. Batelle Seattle Research Center and U.S. Coast Guard Research and Development Center – Connecticut, United States.

Moore-Ede M., Mitchell R. E., Heitmann A., Trutsche U., Aguirre A., & Hajarnavis H. (1996) - *Canalert 1995: Alertness Assurance in the Canadian Railways* - Circadian Technologies, Inc. – Massachusetts, United States.

Parker, A.W., Hubinger, L.M., Green, S., Sargent, L., & Boyd, R. (1997) - *A survey of the health, stress and fatigue of Australian Seafarers* - Australian Maritime Safety Authority - Australia.

Pollard J.K., Sussman E.D., & Stearns M. (1990) - *Shipboard Crew fatigue, Safety and Reduced Manning.* Report No. DOT-MA-RD-840-90014. John A. Volpe National Transportation Systems Center – Massachusetts, United States.

Sandquist T., Raby M., Maloney A.L., Carvalhais T. (1996) - *Fatigue and Alertness in Merchant Marine Personnel: A field study of work and sleep patterns.* Report No. CG-D-06-97. Batelle Seattle Research Center and U.S. Coast Guard Research and Development Center – Connecticut, United States.

Transportation Safety Board of Canada (1997) - *A Guide for Investigating for Fatigue* – Canada.

United Kingdom National Union of Marine Aviation and Shipping Transport Officers (1997) - *Give us a Break: NUMAST Report on Fatigue*. IMO, MSC 68/INF. 9 - United Kingdom.

Videotel (1998). *Fatigue and Stress at Sea* [video] - London, United States.