HUMAN FACTORS

BRIEFING NOTE No. 5

Fatigue

A feeling of weariness caused by prolonged or excessive exertion (not just physical exertion, but mental exertion for example from intense concentration).

Why fatigue?

Fatigue can play a significant role in the causation of incidents and accidents, since a fatigued worker is more likely to err or show poor decision making. It is important to ensure that fatigue (and its prevention) is managed proactively by the organisation.

Does your company have problems with fatigue?

If the answer to any of the following questions is 'Yes', then you should take action!	Yes	No
Is it common to find that people in your company:		
1. Doze off suddenly during a shift?		
2. Feel generally drowsy a lot of the time?		
3. Regularly work a lot of overtime?		
4. When changing from night shifts to day shifts they feel 'rough' for the first few days?		
5. Are noticeably absent-minded or forgetful at work or find it hard to concentrate?		
6. Sometimes feel that they just can't move; or don't want to?		
7. Suffer from a lot of heartburn, indigestion or generally upset stomach?		
8. Find it difficult to get a good undisturbed sleep between shifts?		
9. Drink more coffee or smoke more and eat badly on the nightshift?		
10. Regularly find they are so busy that they can't take a proper break?		

Sometimes, the above happen to a level that is considered normal, for example feeling a bit out of sorts on changing shifts; they may also be due to other things, for example overeating out of boredom. But any effects noted should not be severe or persistent. Answering 'yes' to any of the above is not necessarily acceptable. If anyone is showing severe or long-term symptoms of fatigue, you should take action.

What should my company do about it?

There is evidence that arrangements for working shifts offshore, though still not ideal, are generally better than onshore. For example, timing of meal breaks and the availability of quiet/dark sleeping quarters generally help the offshore shift worker to acclimatise better than onshore.

In all sectors of the petroleum and allied industries, management should be aware of some key facts about fatigue:

- Length of sleep – everyone needs about eight hours sleep per day.
- Bodyclock ('circadian rhythms') – it's not good to be awake at night: it's not good to try to sleep in the daytime. Forward rotating shifts – mornings to afternoons to nights – are better than backward rotating shifts.
- Errors – are more likely between midnight and 6 am and between the second and fourth hours of a shift (2 pm to 4 pm are also high points for error).
- Adaptation – it takes a few days to adapt to a new shift.
- Effects of fatigue – reduced alertness, memory failure, irritability and increased reaction time (effects are very similar to those of alcohol).
- Denial – people can find it difficult to realise or admit that they are fatigued.
- Health – as well as safety – can be affected by fatigue (e.g. stomach problems or, in the extreme, heart problems).
- Individual differences – the above affect different people in different ways.

A fatigue (and risk) index

The Health and Safety Executive (HSE) has developed a simple to use tool for deriving a fatigue index (FI). The FI is a calculator presented in the form of a spreadsheet. The user enters information into the spreadsheet concerning: the nature of the task, including workload, time of day, shift start time, shift duration, number of consecutive shifts, rest breaks within and between shifts, direction and speed of rotation of duties. From this information, the calculator produces an index relating to the risk of an incident or accident occurring compared with a defined 'average' shift (risk index). It also produces an index relating to whether the shiftworker will experience excessive levels of sleepiness working this shift pattern (FI). It can be used to demonstrate whether particular shift arrangements are likely to cause fatigue and can also be used in incident investigations to determine whether fatigue was a likely factor.

Note that the calculator is not suitable for dayshift-only working or for typical offshore work patterns.

A report on the development of the index (Reference 1), also a user guide and the spreadsheet can be found at: http://www.hse.gov.uk/research/rrhtm/rr446.htm

CASE STUDY 1

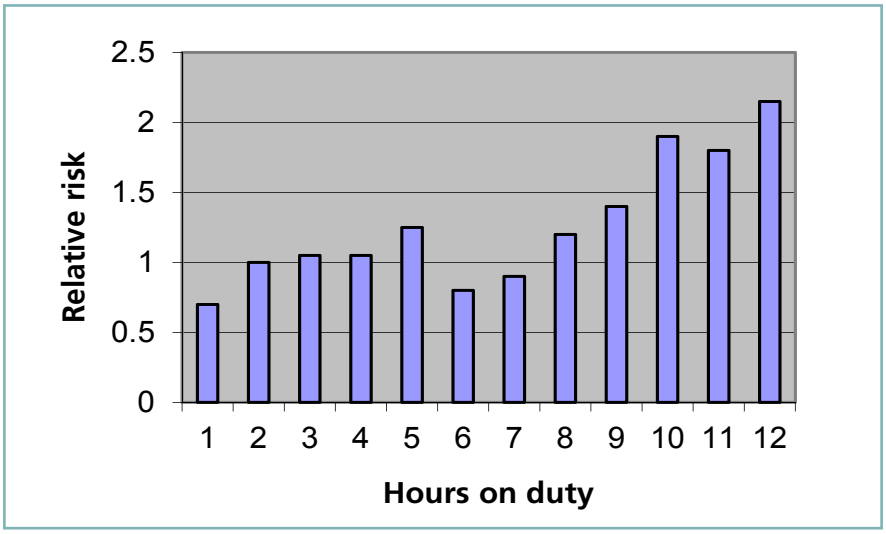
The Mogford Report cites fatigue as one of the root causes of the Texas City accident: "some employees had worked up to 30 days of consecutive 12-hour shifts. The reward system…within the site encouraged this extended working period without consideration of fatigue. There were no clear limitations on the maximum allowable work periods without time off. It has not been possible for the investigation team to directly attribute actions or inactions of the operators and supervisors to fatigue. However, this extended working period clearly has the potential to contribute to a lack of attentiveness, and slowness to identify and respond to process upsets."

Source: *The report of the BP US refineries independent safety review panel* ('Baker' report).

Management responsibility

In the UK the Management of Health and Safety at Work Regulations 1999 require that management must assess and take steps to control all risks to the health and safety of their employees. This includes assessing working time arrangements. Risk assessment should consider the following:

- Night working and changing from one shift to another (e.g. nights to days).
- Length of shift including any overtime.
- Length and quality of rest breaks during the shift.
- Rest breaks between shifts and the amount and quality of sleep taken.
- Type of work – try to schedule safety critical tasks, tedious work or work that needs close concentration to avoid known high error periods; generally design tasks to be stimulating: not repetitive, not boring.
- Bio-rhythms (working with or against your body clock).
- Environmental – mainly temperature and lighting – effects on drowsiness.
- Individual preferences and suitability of certain people for shift work.
- Training/awareness raising among shiftworkers and their families, supervisors and managers on the signs and problems of fatigue and also on sleep patterns, nutrition, and effects on social life.
- Contingency plans if a crew member is absent (don't overload everyone else).
- Monitoring of employees for signs of fatigue, particularly on safety critical work.
- Examining accidents and incidents for evidence of fatigue.



The graph shows that the average risk of an injury or accident increases over the course of a shift. After 10, 11 and 12 hours of duty, the risk is almost twice that at two, three and four hours.

Source: Office of Rail Regulation.

CASE STUDY 2

"Driver sleepiness is estimated to account for around one fifth of accidents on major roads, and is responsible for around 300 deaths per year."

Source: Department for Transport (DfT) THINK! Road safety website

"…the 2007 industry data showed that vehicle incidents were once again the single largest cause of fatalities in the upstream industry."

Source: www.ogp.org.uk

Driving to, from and at work could therefore be the largest risk we face. Research has also established that driving tired and having had a modest amount of alcohol – well within legal limits – considerably increases the chances that a driver will crash.

Source: Road Safety Research Report No. 62, DfT, July 2006.

Energy Institute (EI) guide

The issue of fatigue is not clear-cut and research continues on the subject. *Improving alertness through effective fatigue management* (Reference 2) describes the key factors affecting fatigue and summarises the key research carried out on the subject. The document includes checklists, questionnaires and other simple tools to help identify fatigue risks and to identify solutions.

Measuring performance

Below is a sample of performance indicators that could potentially be used to monitor how effectively fatigue is being managed, divided into leading indicators (showing that a problem may occur in future) and lagging indicators (showing that there is currently a problem). See Briefing note 17 *Performance indicators* for more information on using performance indicators.

Leading indicators	Lagging indicators
Average number of hours worked (or percentage overtime worked) from timesheet analysis (a trend towards more overtime might suggest increased potential for fatigue/reduced alertness). Results of shift reviews either with or without fatigue risk indicators/ shift assessment or other tools. Number of non-compliances with documented shift pattern. Number of consecutive shifts worked by individuals. Percentage of work breaks missed (sampling/interview).	Any instance of falling asleep at work. Number of workforce reports of drowsiness or inattention. Number of near-misses arising from shiftwork/fatigue issues. Levels of sickness absence (may be indicative of fatigue issues if sickness absence is a means to avoid working a shift. Care is required in interpretation).

CASE STUDY 3

At a gold mine in Western Australia, the workforce must attend an induction course on fatigue management covering: what is fatigue, the cause and effects of fatigue, circadian rhythms, sleep factors, work factors, health factors, danger periods, sleep debt, stimulants and ways of reducing fatigue. A contractor-led programme covered further issues: drugs and alcohol, managing shift change, eating, exercising, life away from work and evaluating and developing individual fatigue plans. It also provided practical advice.

Source: http://www.anglogoldashanti.com – case studies.

References

1. HSE (2006), *The development of a fatigue/risk index for shiftworkers*, Research Report 446, HSE Books.
2. Energy Institute (2006), *Improving alertness through effective fatigue management*, http://www.energyinst.org.uk/humanfactors/fatigue.

Further reading

- HSE (2001), *An intervention using a self-help guide to improve the coping behaviour of nightshift workers and its evaluation*. HSE Contract Research Report CRR 365/2001.
- HSE (Jan 2002), *Working Time*, Offshore Safety Division Safety Notice 4/96.
- Energy Institute (2001), *Workshop on fatigue*.
- Step Change website http://stepchangeinsafety.net/OIM (2001), *Guidance for offshore rotas and rest periods*.
- HSE Human factors briefing note 10, *Fatigue*, http://www.hse.gov.uk/humanfactors/comah/10fatigue.pdf.
- Health and Safety Laboratory (2003), *Working long hours*, Report HSL/2003/02.

For background information on this resource pack, please see Briefing note 1 *Introduction*.