Managing Rail Staff Fatigue

**Management of Health and Safety at Work
Regulations 1999**

**Railways and Other Guided Transport Systems (Safety)
Regulations 2006**
January 2012

Contents

This guidance is issued by the Office of Rail Regulation. Following the guidance is not compulsory and you are free to take other action. But if you do follow the guidance you will normally be doing enough to comply with the law. Railway inspectors seek to secure compliance with the law and may refer to this guidance as illustrating good practice.

1. Introduction

Purpose of this guidance

1.1 This guidance is aimed at companies and individuals who have responsibility for managing fatigue in railway staff, including those who have control of safety critical work under regulation 25 of the Railways and Other Guided Transport Systems (Safety) Regulations 2006 (ROGS). Although ROGS requirements apply to safety critical work as defined in these regulations, many of the principles and controls involved in controlling fatigue will be common to all staff irrespective of whether their work is safety critical under ROGS or not. Many companies will choose to manage fatigue risks in the two groups of staff in similar ways, though the details of fatigue controls will vary depending on the likely risks from fatigue.

1.2 This guidance gives **advice on good practice** in managing fatigue associated with work in the rail industry, and builds on the more general guidance applicable to all industries, including rail, in HSE's guidance booklet HSG256 "*Managing shift work – health and safety guidance*".

What do we mean by fatigue?

1.3 There is no single agreed definition of fatigue, but for the purposes of this guidance fatigue will be considered as "a state of perceived weariness that can result from prolonged working, heavy workload, insufficient rest and inadequate sleep". It involves a general feeling of tiredness, resulting in a reduced ability to perform work effectively. A fatigued person will be less alert, less able to process information, will take longer to react and make decisions, and will have less interest in working compared to a person who is not fatigued. Fatigue increases the likelihood of errors and adversely affects performance (HSE booklet HSG256, 2006), especially in tasks requiring:

- vigilance and monitoring;
- decision making;
- awareness;
- fast reaction time;
- tracking ability;
- memory.

1.4 Fatigued staff may not adequately perceive risk, and may tolerate risks they would usually find unacceptable, accepting lower standards of performance and safety. Staff communication, monitoring and co-ordination activities are adversely affected by fatigue. People can often be completely unaware of the extent to which their performance is being reduced by fatigue, and may be unaware of lapses in attention or even briefly "nodding off". Fatigue can be hard to detect in staff – unlike other causes of temporary mental impairment such as drugs and alcohol, there is no "blood test" for fatigue. These features make fatigue a particular concern in any safety critical work.

1.5 Various factors contribute to fatigue, generally by reducing sleep duration, extending hours awake or disrupting the timing of sleeping and waking periods. Causes of fatigue include :

- work related factors e.g. timing of working and resting periods, length and number of consecutive work duties, intensity of work demands;

- individual factors e.g. lifestyle, age, diet, medical conditions, drug and alcohol use, which can all affect the duration and quality of sleep;

- environmental factors e.g. family circumstances and domestic responsibilities, adequacy of the sleeping environment.

1.6 Although employers clearly have control over work related factors, later sections of this guidance provide advice on how employers can help ensure that fatigue management arrangements also address individual and environmental factors, so far as is reasonably practicable. It is important to emphasise though that employees themselves have their own part to play in obtaining sufficient sleep, and in making their employer aware of any fatigue concerns.

Why is managing fatigue important?

1.7 Failure to manage rail staff fatigue properly can have disastrous consequences. Staff fatigue caused by excessive overtime was identified as a contributory factor in the 1988 Clapham Junction collision which killed 35 people. Fatigue was considered a possible causal or contributory factor in at least 74 railway accident and incident reports between 2001 and 2009 (RAIB, East Somerset Junction report 2009).

1.8 Being awake for around 17 hours has been found to produce **impairment on a range of tasks** equivalent to that associated with a blood alcohol concentration above the drink driving limit for most of Europe. Being awake for 24 hours produces impairment worse than that associated with a blood alcohol concentration above the legal limit for driving on the UK's roads (DfT 2010a p26, Dawson & Reid 1997).

1.9 There is mounting evidence that working long weekly hours over long periods increases the **risk of accidents and incidents** (Dembe et al 2005).

1.10 Additionally, the incidence of **health problems** such as sleep, gastrointestinal and cardiovascular disorders has been estimated to be greater in shift workers than day workers (RSSB T699 p37; Costa 2003; Knuttson 2003; Harrington 2001). The International Agency for Research on Cancer (IARC) concluded that shift work which involves circadian disruption is "probably" carcinogenic to humans (IARC 2010). The difficulties that shift workers face of maintaining social relationships and activities can also influence individuals' health.

1.11 In addition to increasing the risk of accidents, incidents and ill-health, fatigued staff increase an **employer's costs**. It has been estimated that sleep-related accidents could cost UK companies some £115-240 million per year (Folkard, 2000). Fatigue makes expensive mistakes more likely, reduces productivity and morale, and increases absenteeism (DfT 2010a p27, Dawson et al, 2000). Thus there are sound financial, as well as legal and moral, reasons to manage fatigue properly.

2. Legal duties

2.1 Sections 2(1) and 3(1) of the **Health and Safety at Work etc Act 1974** (HSWA) place general duties on employers to reduce risks so far as is reasonably practicable, including risks from staff fatigue. Section 7 requires employees to co-operate with their employer by for instance ensuring they are adequately rested to do their work safely, and by reporting any concerns about fatigue promptly to their employer.

2.2 The **Management of Health and Safety at Work Regulations 1999** (MHSWR) require employers to assess risks arising from their operations, including risks from staff fatigue, and to put in place effective arrangements for the planning, organisation, control, monitoring and review of these controls - the "POPMAR" approach (abbreviated from Policy, Organise, Plan & implement, Measure, Audit, Review). In depth guidance on the POPMAR approach is available in HSE's booklet HSG65 "*Successful health and safety management*", and Section 5 of this guidance summarises some key POPMAR features to consider in relation to railway staff fatigue controls.

2.3 When considering fatigue management, reference is often made to the **Working Time Regulations 1998** as amended (WTR), which amongst other things place maximum limits on the amount of time an employer can ask an employee to work. Employers and other duty holders need to consider and comply with the requirements of WTR, but complying with WTR is not in itself sufficient to adequately control risks from staff fatigue - some work patterns could comply with WTR but still be potentially fatiguing. For more information see ORR's Railway Guidance Document RGD-2004-16 "*Handling of rail enquiries and complaints under the Working Time Regulations 1998 (as amended)*", available from ORR's website at www.rail-reg.gov.uk/server/show/ConWebDoc.8630 and the other Working Time regulations references in the "Further Information" section.

2.4 In addition to the above more general duties, regulation 25 of the Railways and Other Guided Transport Systems (Safety) Regulations 2006 (ROGS) places specific fatigue management duties on controllers of safety critical work in the railway industry. These specific duties were the subject of previous (2006) ORR guidance "Managing fatigue in safety critical work". Section 6 of this document now revises and updates that guidance.

2.5 Duty holders should however remember that many of the controls required by ROGS for the control of fatigue amongst staff carrying out "safety critical" work will also be relevant to staff carrying out work which is not "safety critical" under ROGS, and therefore falls outside the formal scope of ROGS. Although the precise details of fatigue controls may differ between the "safety critical" and "non-safety critical" groups, similar fatigue principles will often apply. Many employers may therefore find advantages in setting up and operating an overarching fatigue risk management system covering both safety critical and non-safety critical work, and using similar management systems to control fatigue risks in both groups even if the details of those controls differ slightly. Overall, the arrangements for managing fatigue should be proportionate to the degree of risk.

2.6 The next section outlines how this guidance should be used.

3. How to use this guidance

3.1 All rail employers should have management arrangements to control risks from staff fatigue, whether or not their staff carry out safety critical work as defined in ROGS. How complex these arrangements need to be will depend largely on the type of work carried out, especially whether shift work, significant overtime or safety critical work is carried out. So, although duty holders dealing with fatigue will find useful advice on good practice throughout this guidance, the most relevant sections for different types of operation are outlined in Table 1 below.

Type of work	Likely significance of risks from fatigue	Relevant sections of this guidance
No shift work, no significant overtime, no ROGS safety critical work	Low	Section 4 "Basic fatigue controls"
Some shift work and/or significant overtime but no ROGS safety critical work	Medium to high	Section 5 "Fatigue Risk Management Systems"
ROGS safety critical work	High	Section 5 "Fatigue Risk Management Systems" AND Section 6 "Managing fatigue in ROGS safety critical work"

Table 1. The three-tiered approach for using this guidance

3.2 **Section 4** provides guidance on basic fatigue controls which would be expected of all responsible employers, even if their staff do not work shifts or significant overtime and do not carry out safety critical work under ROGS.

3.3 **Section 5**, covering "Fatigue Risk Management Systems", will be relevant to all rail employers whose staff do shift work or work significant overtime, whether or not their staff do "safety critical" work under ROGS. Section 5 outlines the features of a company-wide fatigue risk management system, following the "POPMAR" framework outlined in the Health and Safety Executive publication HSG65 "*Successful Health and Safety Management*". These employers may also find much of the guidance in Section 6 (see below) useful, even though their staff may not do safety critical work under ROGS, since many of the fatigue

controls for "safety critical" work are often equally valid for staff doing "non safety critical" work. Arrangements for managing fatigue should be proportionate to the degree of risk.

3.4 **Section 6** replaces, updates and fleshes out ORR's original (2006) guidance on Regulation 25 of ROGS "*Managing fatigue in safety critical work*". It retains the original "nine stage" approach of the 2006 guidance, since many companies have devised their existing fatigue management arrangements in line with these stages. Companies with staff carrying out safety critical duties under ROGS should therefore

- review their existing fatigue controls against the updated ROGS guidance in Section 6, and

- consider whether their existing arrangements adequately address the wider issues detailed in Section 5, which gives further guidance on how the nine-stage ROGS approach should form part of a wider, company-wide "POPMAR" fatigue management framework within the organisation's safety management systems, as illustrated below.
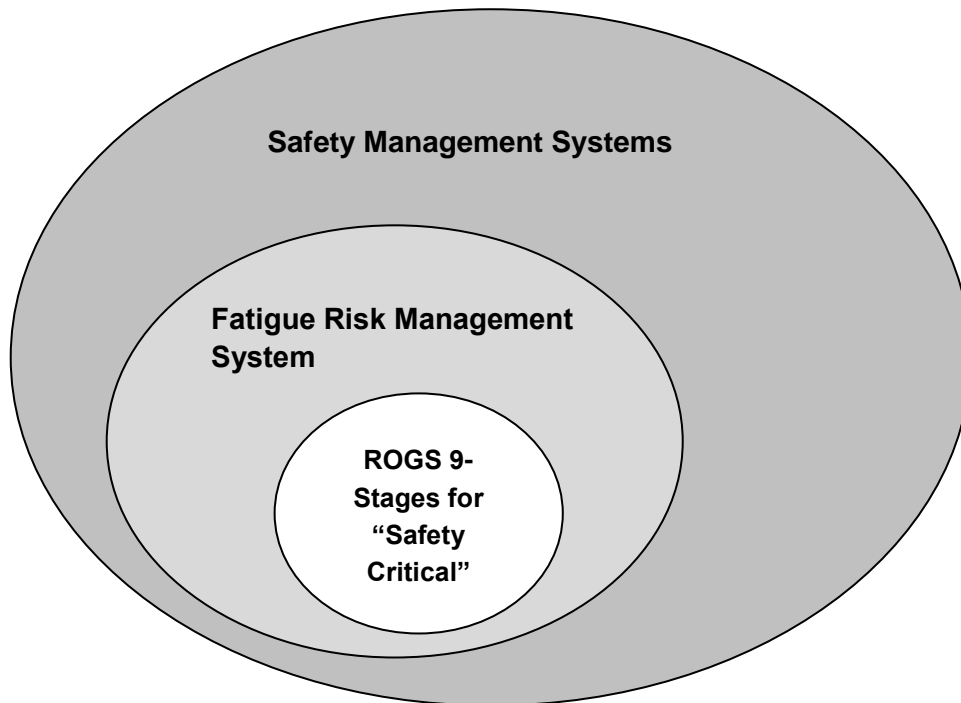
Fig 1. Fatigue controls as part of wider safety management systems

4. Basic fatigue controls

4.1 All responsible employers should have basic arrangements in place to reduce, so far as is reasonably practicable, risks from staff fatigue. This is the case even if there is no shift work, no significant overtime, and no ROGS safety critical work. These basic fatigue controls would usually be expected to include

- A brief statement in the company's health and safety policy about controlling risks to staff and others from staff fatigue

- Basic arrangements for ensuring that staff do not work when fatigued, including the following:

  - Guidelines for managers and staff on expected maximum daily and weekly hours, and arrangements for checking that these are being followed;

  - Guidelines on what staff should do if they feel too tired to work safely;

  - Guidelines on what supervisors or managers should do if they believe a member of staff is too tired to work safely;

  - Guidelines on fatigue aspects of work-related driving (road risk). For many organisations this may be the most serious potential fatigue risk for their staff. See Appendix B on Travel time for more advice, and the guidance booklet "*Driving at Work*" published by the Health and Safety Executive (www.hse.gov.uk/pubns/indg/382.pdf);

  - Guidelines for supervisors and managers on making simple enquiries of employee fatigue and general well-being, as part of their day-to-day management role – talking with staff;

  - The inclusion of fatigue in the company's general safety and well-being training (e.g. during staff induction and periodically thereafter);

  - Ensuring that incident and accident investigation procedures consider whether fatigue may have contributed.

4.2 The above basic steps should be reasonably practicable for all employers, and should help ensure that any risks from fatigue are identified and acted upon before they cause problems.

4.3 If staff in an organisation carry out shift work or significant overtime, fatigue risks are likely to be higher if uncontrolled, and a more comprehensive fatigue risk management system as described in Section 5 will be relevant.

5. Fatigue Risk Management Systems

What is a Fatigue Risk Management System?

5.1 Organisations whose staff are likely to work long hours from time to time, who work significant overtime or who do shift work are likely to have greater potential fatigue risks. They are likely to need more formal arrangements for controlling fatigue than the basic controls described in section 4, especially if staff use potentially dangerous machinery at work or do other work which makes alertness important for safety, such as working near moving vehicles or construction plant, working at heights, or doing electrical work. These more formalised controls can be described as a **fatigue risk management system (FRMS)**.

5.2 An FRMS **identifies and draws together** all the preventive and protective measures which help an organisation control risks from fatigue. It should be based on a comprehensive understanding of fatigue, managing fatigue in a flexible way which is appropriate to the risk and nature of the operation. An FRMS should as far as possible:

- Be based on sound fatigue control principles rather than custom and practice;

- Take account of fatigue information collected about the organisation's own operations and feedback from staff, tailoring fatigue controls accordingly;

- Be integrated with the company Safety Management Systems (SMS);

- Be a continuous and adaptive process, continuously monitoring and managing fatigue risk, whatever its causes.

5.3 A Department for Transport study (DfT RR120. 2010, p29) reported several **advantages of adopting a FRMS approach**, including improved safety, improved staff morale, reduced absenteeism, competitive advantage, and future-proofing against any changes in legislation.

Features of a Fatigue Risk Management System

5.4 An FRMS uses **several layers of defence** to prevent fatigue and fatigue-induced errors from developing into incidents or accidents. An FRMS can be thought of as four successive, repeating steps which together comprise a continuous fatigue risk management process, as summarised in Figure 2 overleaf.
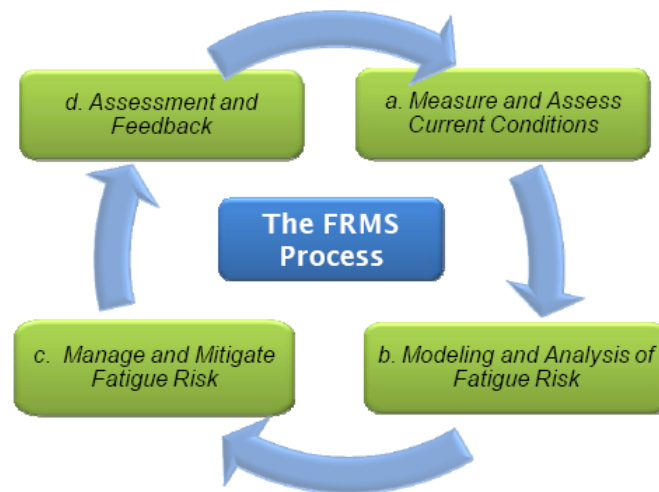
Figure 2. The FRMS Process (after United States Federal Aviation Administration)

5.5 This repeating FRMS cycle leads to continuous improvement and reductions in fatigue related risk. The cycle is summarised below.

(a) **Measuring and assessing current conditions.** The starting point is measuring and assessing the level of fatigue risk associated with current work patterns and operations, by collecting information on staff fatigue reports, staff fatigue surveys, fatigue related errors and incidents, and information on the work patterns and other factors that led to these reports. Understanding the current conditions within the organisation is critical for developing an effective fatigue management system.

(b) **Modelling and analysing.** Next, root causes of fatigue are sought by modelling the work patterns and analysing the likely associated fatigue risk. Fatigue risks are assessed and traced back to the conditions that contribute to the risk. Fatigue risk assessment tools can help find the specific factors that could lead to fatigue risk. Analysis considers not only how likely fatigue is, but also the possible consequences. For instance, work during the dip in alertness between midnight and 0600 is likely to increase fatigue compared to daytime work, but the significance of this fatigue depends on what activities will be carried out during this period.

(c) **Managing and mitigating fatigue risk.** Based on the above findings, control measures are devised and put in place to reduce likely staff fatigue. Managers take a collaborative approach, involving staff and consulting other relevant parties such as trade unions in devising and setting up controls to eliminate or reduce the factors which contribute to fatigue. Controls may include for instance: shorter shifts; fewer successive shifts without a rest day; steps to reduce short-notice variations in planned start times; and enhanced fatigue education and training. Staff and their representatives including trade unions co-operate with employers in ensuring that risks from fatigue are properly controlled.

(d) **Assessment and feedback.** To complete the cycle, evidence is sought about whether the changes to fatigue controls have successfully reduced risks from fatigue, and the findings are fed back into the system. Evidence could include: comparisons of fatigue rating scale scores and/or staff fatigue survey findings before versus after changes in controls; changes in fatigue assessment tool scores; number of reported fatigue problems; evidence of increased sleep. The purpose is to check whether changes have made any difference in fatigue - not all measures may be as effective in reducing fatigue as anticipated, and further adjustments may be required.

5.6 Companies with experience of operating an FRMS emphasise that encouraging employees to believe and engage in the FRMS is vital, stressing open two-way communication on fatigue issues, visible

commitment and safety leadership by managers at all levels, and managers and employees accepting that fatigue management is a joint responsibility. For an FRMS to be fully effective, there should be mutual trust between staff and management, and a **positive culture** towards safety. Staff have to take their own responsibilities to obtain sufficient sleep seriously, but also need to believe that they will be treated fairly if, for instance, a temporary problem at home such as a new baby or family illness means on a particular occasion, with good reason, they feel too tired to work safely. See Appendix C for some basic information on the features of a positive safety culture.

Integrating the FRMS with wider risk control systems

5.7 For any FRMS to be effective it needs to be integrated with the organisation's wider **Safety Management Systems** (SMS). The building blocks of the FRMS will be an extension of existing processes for managing safety. For example, existing incident-reporting forms may only need slight expansion to collect information for fatigue analysis. Data should flow freely between the general SMS and the FRMS, which should use similar processes (DfT Report 120, 2010). So, although the term Fatigue Risk Management System could imply a stand-alone or discrete system, in practice most elements of the FRMS should be integrated with the company's other risk control procedures.

5.8 Responsible rail companies will already have various controls in place to reduce fatigue risks, including for instance: staff selection procedures which consider any medical conditions which could contribute to fatigue; limits on working hours and patterns; and requirements for what staff and managers should do if someone feels or appears to be too tired to work safely. In practical terms, organisations with an established SMS may simply need to review their existing SMS to identify those existing risk control measures which contribute to fatigue management, and to assess whether there are any reasonably practicable ways of further reducing risks from fatigue. A document can then be compiled drawing together and **providing "signposts"** to existing fatigue control elements, and allowing any gaps to be identified by comparison with the recommended features of an FRMS outlined in this Section and the FRMS checklist at Section 12. It is recognised that not all items will be appropriate for all organisations – controls should be proportionate to the risks.

A proportionate approach to managing risks from fatigue

5.9 Duty holders should devise and implement an FRMS which is **proportionate to the likely risks** from fatigue. This guidance outlines some key features of a comprehensive FRMS, but the extent to which each of the outlined features may be necessary for a particular organisation will depend on the nature, size and complexity of the operation, and the degree of risk which may arise from fatigue.

5.10 Organisations should design an FRMS to fit their own operation, and avoid simply copying another organisation's FRMS or a generic system – there is no "one size fits all". An organisation's **FRMS should be tailored** to its own operations and context, with substantial involvement and input from staff. To determine the likely scope of controls needed and the rigour of controls required, an assessment should be made of the degree of exposure to risk from fatigue in the operation. Then:

- If likely risks from fatigue are assessed as relatively low (e.g.only daytime work; no safety critical tasks performed) simple arrangements such as those outlined in section 4 "Basic fatigue controls" may suffice, and it may only be necessary for a single person to oversee the fatigue management arrangements

- At the other end of the scale, if staff work shifts, there is significant overtime and especially if they do safety critical work, likely risks from fatigue could be relatively high, warranting more rigorous controls

and a much more comprehensive fatigue risk management system (DfT 110, 2010 p11&49). Some suggested key components are outlined in the remainder of this Section.

Fatigue Risk Management Systems - the POPMAR approach

5.11 There is no "one-size-fits-all" for fatigue risk management systems, and in reality the various fatigue controls will usually be embedded in the organisation's over-arching risk management systems rather than existing as a separate system. Health and Safety Executive publication HSG65 "*Successful Health and Safety Management*" outlines the "**POPMAR" approach** to risk management systems, involving a continuously repeating cycle of Policy, Organising, Planning & implementing, Measuring, Auditing and Reviewing risk controls, as illustrated in Figure 3.
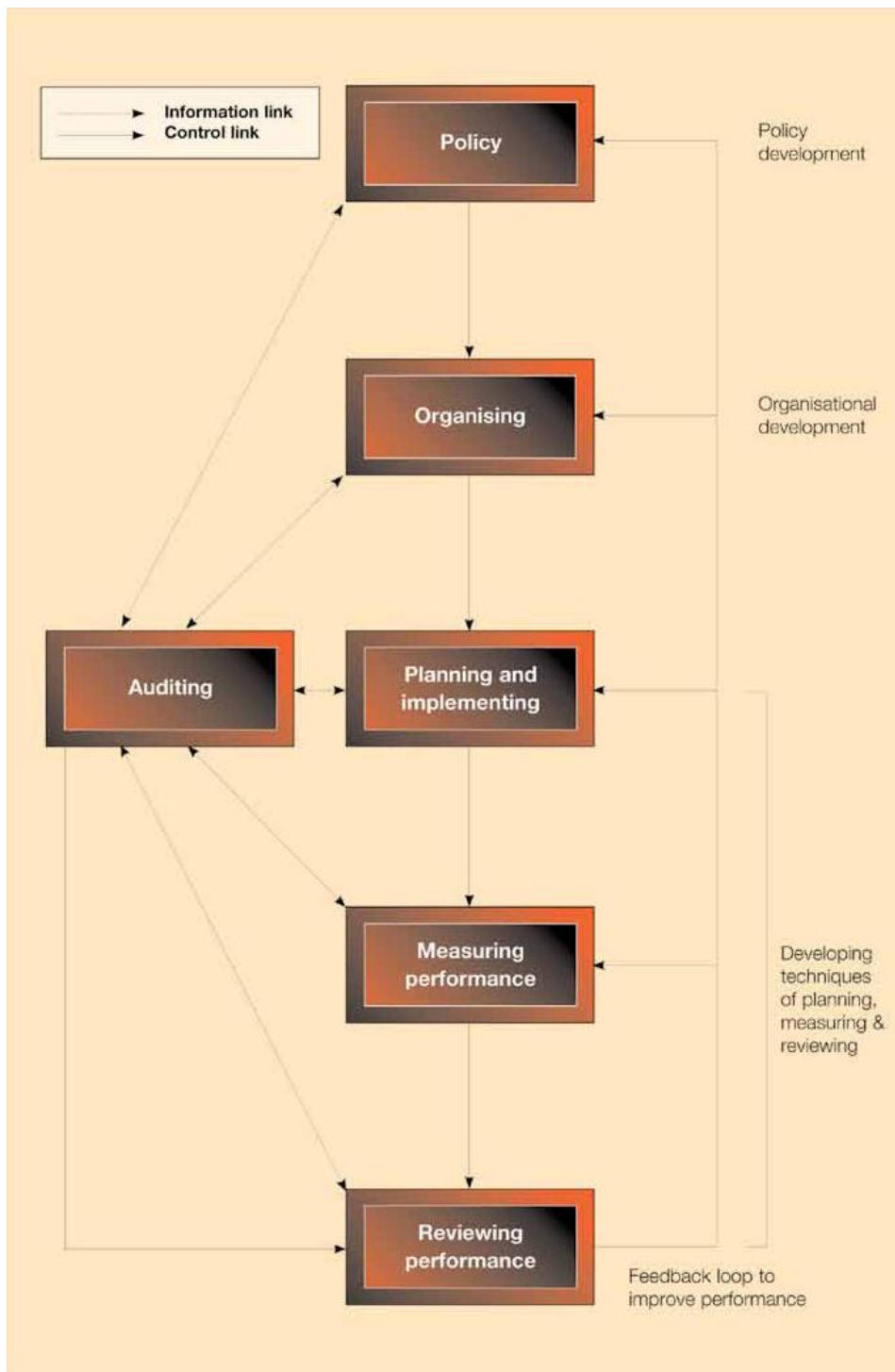
Fig 3. POPMAR Model for managing fatigue (from HSG65)

5.12 Although other approaches can be used, the same underlying general principles outlined in the POPMAR model can be found in most effective management systems, including Fatigue Risk Management Systems. This section now gives guidance on applying the POPMAR approach to fatigue management, and in conjunction with the FRMS checklist at Section 12, should help organisations assess where they may need to introduce additional fatigue management arrangements, proportionate to their size, complexity and the degree of fatigue risk. In especially complex situations, and where risks from uncontrolled fatigue could be especially high, it may be prudent to seek the advice of an independent external consultancy with specialist expertise in assessing and managing fatigue.

Policy

5.13 HSE publication HSG65 gives general guidance on policy aspects of risk management systems.

5.14 The various elements of the FRMS should stem from a statement of the organisation's overall policy on fatigue – a **Fatigue Risk Management Policy**. Although a separate policy on fatigue management can help emphasise the importance of fatigue in controlling risks, the fatigue policy could be part of the overall safety management policy.

5.15 Whatever form the fatigue management policy takes, it is recommended that when it is being developed, the following issues are considered.

5.16 The policy should recognise that there are **human performance risks** from fatigue which may cause accidents, that fatigue cannot be overcome by an individual making more effort, and that excessive fatigue and shift work can adversely affect safety and health.

5.17 The policy should recognise that in order to control fatigue risks, an **effective FRMS is needed.**

5.18 The policy should recognise that, for its full benefits to be realised, **senior management commitment and leadership** is needed to support all stages of introducing and implementing the FRMS, and to support the creation of a "just" culture in relation to fatigue, where staff and managers feel encouraged to honestly discuss and progress fatigue issues.

5.19 The policy should recognise that the organisation must be willing to **commit the resources** to develop and sustain the FRMS on an ongoing basis. The resource commitment needed will obviously depend on the nature, size and complexity of the operation and the degree of fatigue risk. Once people have been identified to progress FRMS activities, they will need time to develop policies, training and education programmes, data gathering processes, analysis methods and management procedures to implement, monitor, audit, and guide the FRMS process. Various fatigue risk assessment tools, fatigue reporting systems and databases may be needed, and the organisation must be willing to commit resources to procure and support these. Much of this staff time and resource commitment will be "up-front" while the system is being devised and set up, and will reduce as the FRMS matures. However, it is important for senior managers to recognise that an FRMS is not a one-off activity – it is a continuous improvement system that requires an ongoing commitment of resource to support effective, ongoing fatigue controls.

5.20 The policy should recognise that the effective management of fatigue is a **collaborative process.** Senior management should be committed to involving staff and appropriate staff representative groups (e.g. trade unions) in devising, implementing and monitoring effective fatigue risk control measures. There must be "buy-in" from staff, and the FRMS policy should recognise that the organisation may need to invest time up-front to help "sell" the need for, and benefits of, the co-operative FRMS approach to staff and their representatives.

5.21 Fatigue is an issue which most people have at some stage experienced, and can therefore identify with. Organisations have found benefits in bringing together managers and employee representatives to co-operatively improve fatigue controls, for instance by setting up a joint management and staff **Fatigue Safety Action Group**, or similar. Such a group can help ensure that fatigue controls are sensibly prioritised and co-ordinated across functions and locations, and can help demonstrate the company's commitment to involving staff in improving fatigue controls. Such collaborative working also helps build bridges between groups who may traditionally have taken opposing stances on issues, potentially

improving wider industrial relations. Some organisations may of course prefer to use an existing joint management / staff group with a wider safety improvement remit, to help co-ordinate fatigue risk management.

5.22 Fatigue risks cannot be properly controlled by management alone - the only remedy for insufficient sleep is sleep, so **employees and trade unions** (or other staff representative groups) have their own important responsibilities in controlling risks from fatigue. A clear policy outlining fatigue management expectations on individuals, and the role of trade unions and other staff representative groups, helps emphasise that fatigue can only be successfully managed if all parties co-operate responsibly. For instance:

5.23 **Individual employees** will have various duties in relation to fatigue. The employer should, so far as is reasonably practicable, set out relevant expectations on employees, but duties on employees under section 7 HSWA in relation to fatigue would generally include, for instance:

- making appropriate use of off-duty periods provided in the working pattern to obtain sufficient sleep to carry out their work safely, including taking future duty times into account when planning their off-duty lives;

- taking reasonable steps to ensure that their sleeping environment, nutrition, use of caffeine, alcohol, drugs and medications, and their travel arrangements do not adversely affect their ability to carry out their duties safely;

- participating in fatigue-related education and training activities arranged by their employer;

- informing their manager as soon as possible if they believe that they or a colleague are, or are likely to become, too tired to carry out their duties safely

- declaring any second job which could reasonably be expected to adversely affect their level of fatigue and their consequent ability to carry out their duties safely;

- informing their manager if they become aware that they may have a condition such as a sleep disorder which could make them more liable to potentially dangerous levels of fatigue at work;

- reporting any other concerns they may have regarding risks from fatigue in the operation;

- co-operating with other reasonable requirements or requests of their employer which are aimed at controlling risks from staff fatigue.

5.24 **Trade unions** and other staff representative groups will also have an important role to play in, for instance:

- co-operating with an employer's reasonable efforts to ensure that risks from staff fatigue are adequately controlled;

- making reasonable efforts to ensure that fatigue risk management good practice is taken into account by their representatives during negotiations on working patterns and other issues having a bearing on the control of fatigue risks.

5.25 Some organisations in other industries use "**sleep contracts**", requiring significantly more formality in the arrangements between employers and staff regarding sleep obligations. A recent RSSB report found this more formal approach may have some benefits but also some significant potential pitfalls (RSSB Report T699 App G p13). For the time being, duty holders considering a formal "sleep contract" arrangement should approach the concept with care and caution - efforts at improving the perception of a

"just" company culture, which welcomes and actively encourages reporting of any fatigue concerns, are likely to be of wider benefit than sleep contracts.

5.26 The policy should recognise that any fatigue management system works best in a **"just" organisational culture** where managers and employees can openly share information about fatigue. The company policy should therefore consider the organisation's high level aims in relation to a "just" culture, in particular emphasising the need for openness, honesty and trust between managers and staff on fatigue issues. The organisation's expectations on individuals' and managers' behaviour in relation to fatigue should be clear. In particular, staff and managers should be clear about what to do if they become concerned about their ability to work safely due to fatigue - individuals concerned about fatigue should not feel coerced into working regardless. See Appendix C on Safety Culture for more information.

5.27 The policy should recognise the relationship between available **staff resources, workload, fatigue and stress.** In simple terms, other things being equal, reducing staffing levels will tend to increase individuals' workloads, increasing the likelihood of fatigue and in some cases work related stress. Properly taking into account these likely links will be particularly important during significant organisational changes (e.g. restructuring, downsizing) or periods of additional demands (e.g. higher workloads, heavy training needs, high levels of sickness absence).

5.28 It is recommended that the fatigue management policy should outline the organisation's **high-level (general) expectations** on the following:

- the company's **overall commitment** to managing fatigue, including the status of any relevant company standards and limits, and their relationship to any relevant negotiated agreements with trade unions or other staff representative groups, for instance terms and conditions of employment;

- how the organisation will **collect and use data** on fatigue and its effects, including the fatigue reporting system for reporting errors, adverse events and concerns which could have a fatigue element;

- staff **education and training** on fatigue;

- **reviewing the adequacy** of fatigue controls periodically, and if there is reason to doubt their effectiveness.

Organising

5.29 HSE publication HSG65 gives general guidance on organisational aspects of risk management systems.

5.30 The FRMS should describe the overall organisational arrangements for exercising management and supervisory control over fatigue risks, including the allocation of **responsibilities, roles and functions** regarding fatigue management. If staff do safety critical work under ROGS, this should include details of the organisational arrangements, roles and responsibilities for each of the nine "Stages" in fatigue management outlined in Section 6 of this guidance (identifying affected workers; settings standards and designing work patterns; limiting exceedances; consulting workers; recording arrangements; providing information to staff; monitoring; taking action when staff are fatigued; reviewing arrangements).

5.31 Appointing a "**fatigue champion**" can help make sure fatigue controls are properly thought through and implemented in a co-ordinated way. They should be a person in a position of authority with operational

knowledge, who is enthusiastic and dedicated to developing and maintaining an effective FRMS (DfT paper 120 p51).

5.32 The FRMS should outline how **fatigue risk assessments** are to be carried out, who should carry them out, and under what circumstances, for instance before changes in working patterns, after incidents or reports of concerns about fatigue. Expectations on the use of any fatigue assessment tools should be included. Arrangements should seek to identify significant factors contributing to fatigue, tracing back fatigue to its root causes, by gathering information from diverse sources. See Appendix A regarding assessing fatigue risks, including the benefits and limitations of fatigue assessment tools – such tools are just one component of a fully informed fatigue risk assessment.

5.33 With the constant strive for improved efficiency, a significant contributory factor to fatigue can often be **resource allocation** and the availability of competent staff. If fewer competent staff are available, workload demands on individuals may rise, increasing the likelihood of fatigue. Organisational changes which could impact on staffing resources should be safety validated, and the validation process should consider risks from staff fatigue. Staff should feel able to cope with the demands of their jobs, and systems should be in place locally to pick up and respond to any individual concerns. The organisation should provide staff with adequate and achievable demands in relation to the agreed hours of work. People's skills and abilities should be matched to their job demands. Jobs should be designed to be within the capabilities of staff. Employees' concerns about demands on them should be addressed. Minimum staffing levels for safety critical posts should where possible be specified, and arrangements should include contingency arrangements for foreseeable abnormal conditions such as sickness absence, network disruption and emergencies. Employers should not rely on voluntary overtime arrangements to cover normal working periods – all duty turns should be covered in a planned way. For further information, see RIAC Information Sheet "*People Resource Planning*" (see ORR's website at www.rail-reg.gov.uk/server/show/nav.2020). Useful guidance is also available on HSE's website, in the "Demands" section of the *Stress Management Standards* (www.hse.gov.uk/stress/standards/demands.htm).

5.34 Employers and employee representative bodies should consider whether **pay structures** could inadvertently be encouraging fatigue. Some pay structures, such as hourly rates, can promote fatigue more than others by giving employees an incentive to work long hours. More robust fatigue controls may be needed if the pay structure is likely to encourage more fatiguing work patterns. Decisions on fatigue management should be based on reliable information about the patterns which staff actually work. Duty holders should only use information collected from pay systems if they are sure it accurately reflects true working patterns. The same applies for monitoring adherence to agreed work patterns.

5.35 The FRMS should outline how the company will ensure adequate **co-operation** between management, staff and their representatives (e.g. trade unions) and any other relevant parties in relation to fatigue. The need for a collaborative approach to fatigue, and the possible benefits of establishing a joint management / staff Fatigue Safety Action Group or similar are discussed in the previous "Policy" section. Trade union consultation and co-operation will be particularly important if there are conflicts between good fatigue management practices and existing staff terms and conditions of service, which may have evolved historically without full consideration of possible fatigue effects.

5.36 The safe and efficient operation of the railway depends not only on good co-operation within organisations, but also on the co-ordination and co-operation of other parties - for instance the many employers and their workforces who work together to provide and maintain rail infrastructure under the overall oversight of the infrastructure controller. So, in addition to co-operation within each organisation, companies should consider what arrangements they may need to **co-operate with other organisations** on controlling fatigue risks (regulation 11 of the Management of Health and Safety at Work Regulations

1999, and regulations 22 and 26 of ROGS Regulations 2006). To fulfil these duties, infrastructure managers and those otherwise in control of premises may legitimately require duty holders accessing their infrastructure / premises to adhere to requirements on fatigue controls in order to control system safety risks. In a commercially competitive market, less responsible companies may try to secure work by cutting costs without properly considering fatigue risks. For instance, they may try to use fewer staff working longer hours or travelling long distances before and after work, thereby increasing fatigue risks.

5.37 **Arrangements for awarding contracts** and subsequent compliance monitoring arrangements should ensure, so far as reasonably practicable, that there is no financial incentive for contractors to operate with high or unmanaged levels of fatigue. Organisations responsible for awarding contracts where contractor staff fatigue could increase risk should therefore make their expectations on contractors' fatigue management arrangements adequately clear to contractors during the bidding process, and these expectations should so far as is reasonably practicable be embedded in contractual requirements. Clarity in such expectations helps create a "level playing field" for contractors by reducing opportunities for under-cutting, and helps ensure safety while allowing more realistic resource planning and costing. Contractors should in turn co-operate and comply with these expectations.

5.38 The FRMS should ensure there are adequate **fatigue communication arrangements** in the organisation, which ensure that company expectations on fatigue management are communicated clearly to all, are understood by all, and that there are open, easy-to-use channels of communication for reporting any concerns. See Appendix D on Fatigue reporting. An open, reporting culture is a key aim – see Appendix C on Safety Culture. Once again, setting up a joint management / staff Fatigue Safety Action Group or similar, tasked with ensuring adequate fatigue communication arrangements, should help.

5.39 Where people have responsibilities for managing fatigue, there should be adequate **competence management arrangements** in place to ensure that they acquire and retain the appropriate fatigue knowledge and skills. This will be particularly important for supervisors and managers of staff carrying out safety critical work, and staff who devise and amend rosters. General guidance on competence management is given in ORR's Railway Safety Publication 1 "*Developing and Maintaining Staff Competence*".

5.40 Comprehensive **fatigue education and awareness arrangements** are an essential foundation for managing and mitigating fatigue risks. Such arrangements would usually include content on the following:

- basic information on the causes of fatigue, the importance of sleep, and the effects of circadian (daily) rhythms on alertness and performance;

- awareness of the organisation's FRMS program itself, including fatigue related policies and procedures, and the responsibilities of management and employees;

- personal assessment of fatigue risk and identifying the early signs of fatigue in others;

- the procedures which staff should follow when they identify or suspect fatigue risk in themselves or others;

- personal strategies for preventing and managing fatigue risk, covering both work and home / personal life issues. This should include the sleeping environment, proper nutrition, the effects of caffeine and other stimulants, alcohol, drugs and medications on fatigue, the role of physical fitness in coping with shift work, and the importance of maintaining social contact with family and friends;

- procedures for reporting adverse incidents which could be fatigue related, and fatigue concerns;

- other topics related to fatigue management specific to the organisation, such as managing risks from travel time, work-related driving controls (e.g. policy on driving to, at and from work), use of rest facilities, any napping arrangements, expectations for the provision and use of lodgings.

5.41 **Refresher briefing** in fatigue controls should be provided at appropriate intervals, depending on the degree of fatigue risk in a particular role. Fatigue management should in any case form part of managers' and supervisors' day to day conversations with staff, especially staff in safety critical roles.

5.42 Since fatigue increases the likelihood of errors, processes which **detect the early stages of fatigue**, or which **detect or mitigate the effects of fatigue-induced errors** should be introduced where reasonably practicable. For many years various "hardware" aids have been used in the rail industry to help detect or mitigate fatigue related errors, including for instance the Driver's Vigilance Device (DVD), Automatic Warning System (AWS) and Train Protection and Warning System (TPWS). Manufacturers, leasing companies and operators should consider the potential benefits available from developing and introducing improved hardware aids for detecting the early stages of fatigue, and for detecting and mitigating fatigue-induced errors. Improving technology makes such aids increasingly feasible. Increasing the capability of On Train Monitoring & Recording (OTMR) equipment is one likely area. Some of the opportunities and challenges of using technology to help detect and monitor fatigue are outlined by Balkin (see Further Information section), but such technologies are in the early stages of development, and it will always be important not to place excessive reliance on them which could lead to wider organisational fatigue controls being neglected. Such technologies will supplement, rather than replace, wider organisational fatigue controls.

5.43 Error detection and correction processes are not confined to hardware fixes – improvements to "people" processes should also be considered. One example is **training staff in Non-Technical Skills** (NTS), which can help key staff to avoid, detect and recover from errors, whether caused by fatigue or not, and mitigate their consequences. For more information, including the development of short NTS training courses for key staff, see RSSB's Non-Technical Skills webpage at www.rssb.co.uk/EXPERTISE/HF/Pages/NON-TECHNICALSKILLS.aspx . Although this work is at an early stage (as at autumn 2011) in the rail industry, it shares much in common with the approach used with some success in similar industries, especially aviation.

5.44 The FRMS should outline in particular the organisational arrangements for controlling **overtime, shift exchange, travel time and on-call** duties, as these areas are often poorly controlled.

5.45 The "Policy" section above outlined some possible benefits of creating a **joint management / staff fatigue group** to oversee fatigue control systems. In smaller organisations a single joint fatigue risk action group may provide a suitable forum for progressing fatigue management. Larger organisations may wish to assign strategic functions to a high-level Fatigue Risk Management Steering Group, and assign more routine, day-to-day implementation and practical fatigue advice to a working level Fatigue Safety Action Group. It may well be appropriate for an existing joint management / staff group with a wider safety remit to take on board the fatigue functions suggested here – once again, there is no "one-size-fits-all". Whatever their name or constitution, such joint groups can obviously play a key role in overseeing the practical development of fatigue controls and ensuring they are workable and effective. Some possible areas of activity for such joint fatigue groups would include

5.46 Direction on high level, strategic fatigue issues such as:

- Overseeing collection of management information relevant to fatigue;

- Advising on fatigue aspects of staff terms and conditions, pay structures;

- Developing fatigue standards, procedures and other documentation;

- Advising on fatigue aspects of any organisational changes;

- Fatigue aspects of resource allocation (staffing levels etc);

- Procedures for managing overtime and on-call work;

- Establishing triggers for action on fatigue;

- Proposing, overseeing and monitoring fatigue reduction strategies and plans;

- Making reasonable efforts to incorporate good fatigue management practices from comparable organisations.

5.47 More routine, day-to-day input on:

- Helping managers and roster clerks devise fatigue-friendly working patterns and rosters;

- Helping managers with fatigue risk assessment including the use of any fatigue assessment tools;

- Monitoring fatigue information to identify trends, including comparisons of planned versus actual working patterns;

- Collecting data on any problematic shifts / rosters / diagrams etc;

- Fatigue problem solving;

- Investigating exceedances of company fatigue limits, deviations from expected fatigue controls and incidents where fatigue may have contributed;

- Staff fatigue surveys and trends;

- Sickness absence trends and fatigue;

- Devising and delivering fatigue education and training programmes;

- Keeping senior management informed on progress with fatigue controls;

- Keeping staff and trade unions informed on progress with fatigue controls.

Planning & Implementing

5.48 HSE publication HSG65 gives general guidance on planning and implementation aspects of risk management systems.

5.49 In terms of **fatigue management planning**, the FRMS should consider three key questions: Where are we now? Where do we want to be? How do we get there?

5.50 These questions may need to be asked at all levels or parts of an organisation, depending on its size and complexity. Planning for fatigue controls should be coordinated to ensure consistent implementation of fatigue policy, avoid duplication of effort and avoid critical omissions – an identified fatigue champion and/or fatigue risk steering group can play a key role here.

5.51 **"Where we are now"** may be answered by gathering accurate information about the current level of fatigue risk in the organisation. Comparing this with suitable benchmarks (including for instance the recommendations in Section 6, Stage 2 of this guidance on Setting standards and designing work patterns), allows the organisation to decide **"where we want to be"**. The simplest objective will always be to achieve legal compliance, but some organisations may choose to strive for higher standards and this will shape the way they build their fatigue management system - aiming for excellence reduces the chance of occasionally dipping below bare legal compliance if one or more controls fail.

5.52 Deciding '**how do we get there**?' involves practical decisions about how to move fatigue controls forward. For example, organisations might decide to devise new components of the fatigue management system (e.g. a new fatigue reporting system) or to improve existing ones (e.g. reducing maximum permitted hours per week).

5.53 **Fatigue management plans** should then be drawn up, with objectives for developing, maintaining and improving fatigue controls, such as for instance:

- requiring each site/depot to have an annual fatigue management plan and a fatigue investigation system, meeting core company standards

- establishing a reliable fatigue risk assessment process

- setting up a forum to involve employees in devising improved fatigue controls

- completing all fatigue risk assessments by the end of the year

5.54 The FRMS should also detail the company's processes for **designing work patterns and rosters**. Working patterns and rosters should be devised by people who are familiar with the causes of fatigue and with good practices in managing fatigue.

5.55 Working patterns should be designed to **incorporate good fatigue management principles** and minimise features of working patterns known to contribute to fatigue, using guidance in for instance HSE booklet HSG256 "Managing Shift Work" and the features of work patterns outlined in Section 6, Stage 2 of this guidance "Setting standards and designing working patterns".

5.56 Once draft working patterns have been devised incorporating good fatigue management principles, likely fatigue risks from the proposed pattern should be assessed, to check whether the planned pattern is likely to adequately control fatigue and to identify whether there are any opportunities for further reducing fatigue risks. The assessment may include the use of a **fatigue assessment tool**. See Appendix A for further guidance on using fatigue risk assessment tools.

5.57 A note of caution: even if working patterns are designed incorporating the good practice principles outlined above, a fatigue risk assessment tool also suggests fatigue levels are unlikely to be a concern, and staff representatives agree to the proposed pattern, employers should also, soon after its introduction, **ask staff** about how tiring they are finding the working pattern in reality. General principles and fatigue modelling tools are not perfect – it is important to carry out a "reality check" by seeking staff feedback on whether the pattern is adequately controlling fatigue in practice. This general three-part sequence can be summarised as follows, consulting with staff at appropriate stages:-

   (a) design the work pattern, maximising good fatigue management practices

(b) assess likely fatigue risks from the resulting work pattern, using a fatigue assessment tool

(c) ask staff whether the working pattern is controlling fatigue, any particular features which may need further improvement.

5.58 The remainder of this section outlines some key points for **implementing practical fatigue controls** as part of the FRMS.

5.59 Organisations employing staff for safety critical work should have a competence management system which incorporates suitable **medical assessments** during staff selection procedures, and for ensuring ongoing staff fitness for duty. General advice can be found in ORR's Railway Safety Publication 1 "Developing and Maintaining Staff Competence". Various medical conditions and sleep disorders may increase the risk of an individual feeling sleepy. Research in both the road and rail transport sectors has found that the prevalence of a sleep condition called sleep apnoea (intermittently stopping breathing during sleep, which disturbs sleep and causes fatigue) is higher than in the general population. RSSB have produced useful guidance on sleep apnoea in Railway Group Standard GO/RC3561 at Appendix I entitled "*Obstructive sleep apnoea and excessive daytime sleepiness*".   Various screening questionnaires have been developed which can help a competent occupational health practitioner in the initial identification of individuals who could be suffering from undiagnosed sleep apnoea (see for instance the Berlin Questionnaire and the STOP-BANG Questionnaire, accessible via the websites of the British Snoring and Sleep Apnoea Association and the American Sleep Apnea Association). Screening for such conditions periodically and for instance after any suspected fatigue related incidents can help reduce risks from staff developing such problems as their career progresses – effective treatments are often available.

5.60 Recording the **start and end times** of individuals' working periods (e.g. booking on and off) is common in some rail occupations but, at present, not in many supervisory and management roles, where there may be an explicit or implicit expectation that staff work the hours required to "get the job done", sometimes without adequate consideration of possible fatigue risks. Accurately recording and then monitoring the time spent working (and time spent travelling associated with work) helps the company to honestly assess the demands on their employees and the fatigue these demands are likely to generate. Such an honest evaluation may reveal significant fatigue risks which are being tolerated by individuals because of the prevailing safety culture, but which could cause incidents with serious consequences for staff, others on the rail network or, if staff drive to / at / from work tired, to themselves and other road users. Fatigue risk assessment tools can help assess likely risks from commute and travel times. See Appendix B on Travel Time for further information.

5.61 There may be an increasingly important **role for technology** in easily recording and monitoring working time. Electronic swiping of Sentinel or other personal smart-cards to book on and off could help companies assess and control staff fatigue risks in many rail occupations, especially if combined with a requirement to record travel time and the location where staff are sleeping (postcode or town). There are other obvious potential benefits of such smart-card technology, for instance in helping ensure that staff have appropriate, in-date competences.

5.62 Employers should require employees to declare any **second jobs** which could affect fatigue risks, and should assess the potential impact on their own operation which the likely increase in fatigue from a second job would bring, due to the reduced opportunity for sleep and other unavoidable activities.   A smart-card system of the type suggested above could help reduce "second job" risks from staff working for more than one rail employer.

5.63 Many rail occupations involve some form of **on-call duty**, especially supervisory and management roles. Unless carefully managed, on-call work can easily make a nonsense of otherwise reasonable planned working patterns, especially during periods of disruption, staff shortages, emergencies and so on. Sometimes the company culture leads to on-call work going unrecorded, potentially leading to under-estimation of staffing requirements and elevated fatigue risks. Once again, honesty in recording time spent on-call, especially at times when the individual would otherwise be asleep, helps to properly assess and control fatigue risk. At present, for many roles the on-call arrangements involve a system where all supervisory and managerial staff are effectively on-call "just in case" most of the time outside their core working hours. For instance, many daytime staff may remain, officially or unofficially, "on-call" most evenings and weekends. In many cases it would be beneficial to change to a more managed on-call rota system where each individual takes their turn (e.g. one in four, one in seven) in taking all on-call queries for relevant colleagues. This can improve network risk control by ensuring that only well-rested individuals handle such important calls, and can reduce staff fatigue and improve well-being by reducing disturbed sleep and improving peace-of-mind (staff can leave their work behind them until their next duty period, rather than half-expecting a call at any moment whilst they are off duty). If personal knowledge is absolutely essential to resolving an urgent on-call issue (such circumstances may in reality be rare), such an on-call rota system may be less realistic.

5.64 Companies should have **fitness for duty** checking arrangements to ensure that staff reporting for safety critical work are not suffering, or likely to suffer during their shift, from fatigue. Such arrangements seek to identify any issues which may reduce the individual's ability to work safely including not only fatigue but any drug and alcohol use, illness or its after-effects, potential distraction or other psychological effects from any recent incident, work related or domestic problems. The system should seek to establish whether the individual has had sufficient sleep in the hours before starting work, such that they should be able to carry out their work safely for the whole of their shift. The system should identify not just whether the individual is fit at the start of the shift, but is likely to remain fit until the end of their shift – being awake too long before work greatly increases the risk of fatigue later in the work period. If remote booking-on procedures are used, random face-to-face checks should be carried out sufficiently frequently to provide an effective deterrent against the system being abused.

5.65 All staff should have a basic awareness of **how to recognise fatigue** in themselves or others, but this is especially important for staff responsible for carrying out fitness for duty checks and for those responsible for ensuring staff remain fit for duty throughout their shifts. Some of these, taken from Network Rail's very helpful e-learning guide (CD-ROM) on Fatigue Management, are outlined in Table 2

Likely level of fatigue	Signs / symptoms
Early warning signs of fatigue which should prompt people to look out for more conclusive evidence of fatigue	• Fidgeting • Rubbing the eyes
Signs of moderate fatigue suggesting performance is being affected. Take these seriously - it is not necessary to fall asleep to make a critical error	• Frequent yawning • Staring blankly • Frequent blinking
Signs of severe fatigue. Liable to brief uncontrollable "micro-sleeps", risk of errors very high.	• Nodding head • Difficulty keeping eyes open & focussed • Long blinks

Table 2. Some signs and symptoms of fatigue

5.66 In addition, various fatigue question-sets and rating scales are available which may help staff checking fitness for duty (see RSSB's fatigue guidance) but these depend on staff being honest, and can be easy to defeat if people wish to pretend they are not tired. The best defence against staff working when they are fatigued is therefore the existence of an **open, "just" culture**. In a just culture staff take their responsibilities to obtain sufficient sleep seriously, but feel confident that, if on occasion they feel too tired to work safely (e.g. due to a new baby at home keeping them awake), they will not be punished for honestly declaring this so that alternative arrangements can be made. Planning for sufficient spare staffing cover, so far as is reasonably practicable, can also help avoid staff feeling compelled to work even if fatigued, but this again relies on staff not abusing the arrangements. See Appendix C on safety culture.

5.67 In order to prevent staff swapping shifts without a proper assessment of the potential fatigue consequences, companies should have a policy and agreed arrangements for **shift exchange**, commensurate with the degree of risk. These should wherever reasonably practicable involve an assessment of fatigue risk by a nominated manager before any exchange is agreed. The assessment should for instance consider whether the proposed exchange is consistent with relevant company limits and good fatigue management practices in terms of minimum rest periods between shifts, changes between night and day shifts etc (see Section 6 Stage 2 on Designing working patterns). If the assessment includes use of a fatigue assessment tool, the tool's limitations should be appreciated. Some recent scheduling software packages which incorporate fatigue tools can produce an almost "real time" estimate of likely fatigue levels, provided the system has been fed up-to-date information on hours actually worked, but these should not be used in isolation - see Appendix A on fatigue risk assessments and tools.

5.68 Similar considerations apply to authorising **overtime.** Organisations will sometimes have a legitimate need to use overtime. However, some individuals may be keen to maximise their earnings by working as much overtime as possible, with potentially dangerous consequences in terms of fatigue. Companies are therefore recommended to have an agreed policy and arrangements for authorising overtime,

commensurate with likely fatigue risks. Arrangements should ensure, so far as is reasonably practicable, that likely risks from fatigue are assessed before authorising overtime. See also Section 6 Stage 3 on limiting exceedances. As outlined in the previous paragraph, if a fatigue assessment tool or scheduling software is used as part of the overtime authorisation decision, its limitations should be appreciated.

Measuring performance

5.69 HSE publication HSG65 gives general guidance on performance measurement aspects of risk management systems.

5.70 To be effective, an FRMS should incorporate procedures for **measuring and monitoring the levels of fatigue** which actual (rather than planned) working patterns are likely to be creating. Although changes from planned working patterns should be kept to a minimum, it is recognised that changing circumstances, for instance temporary staff absence, over-running engineering work or disruption due to an incident mean that the patterns staff work may sometimes differ from those originally planned. It is important that these actual working patterns are monitored so that likely effects on fatigue can be assessed. There are several ways of doing this including:

- Comparing features of actual work patterns with good practice;

- Using fatigue assessment tools;

- fatigue reporting systems;

- staff fatigue surveys;

- ensuring that the possibility of fatigue is considered during investigations of incidents;

- monitoring trends in shift exchange;

- monitoring trends in overtime;

- monitoring sickness absence;

- other methods e.g. sleep logbooks, actigraphs (an activity monitor worn like a wristwatch).

5.71 Some points about each are considered in turn below. In reality, a suite of these methods will be used, depending on size and complexity of the operation and the likely risks from fatigue.

5.72 It can be difficult to detect fatigue in operational settings because, unlike for example alcohol impairment, there is no "blood test" for fatigue. However, the conditions that contribute to fatigue are well known and can be measured. For instance, **deviations from good fatigue management practices** (e.g. those outlined in Section 6 Stage 2 of this guidance) are likely to increase the likelihood of fatigue, so assessing actual working patterns against these good practices and highlighting significant deviations will help identify features of the patterns likely to cause increased fatigue. Samples of actual working patterns can be compared against good practices manually but this can be time consuming - more advanced work scheduling software packages can be programmed in a tailored way to flag up deviations from specified conditions (e.g. "Attention – less than 12 hours between duties"), both during the planning of working patterns and also retrospectively.   Using such methods can help identify rosters / depots /departments / roles / individuals etc with higher potential fatigue risks, allowing the company to prioritise its fatigue reduction efforts more efficiently.

5.73 Similarly, **fatigue assessment tools** can be used retrospectively on actual working patterns to help identify relative fatigue risks. Some more recent staff scheduling software packages incorporate a fatigue assessment tool which can automatically provide an indication of the estimated fatigue which a member of staff is likely to have experienced from their actual working pattern. Alternatively, but requiring more time and effort, companies may use staff timesheet information (provided it is reliable) to identify those staff working the most hours (e.g the top 5% of staff by hours worked), and transfer this timesheet information into a fatigue assessment tool. See Appendix A on fatigue risk assessments.

5.74 If it is not reasonably practicable to monitor all actual working patterns retrospectively, companies should use their judgement and other likely sources of fatigue information in deciding **how to sample working patterns** for further fatigue assessment. Efforts may be best directed at any work patterns or features which staff state they find tiring and, for instance, groups of staff or individuals recording the most hours worked. Simply asking staff which turns / links etc cause problems is a good starting point – staff often know from experience which patterns they find most tiring, and can often suggest why. Collecting simple information such as this may quickly and cheaply reveal the factors contributing most to fatigue, and help suggest where schedule changes or extra controls may be needed to reduce fatigue risk.

5.75 A non-punitive **fatigue reporting system** encourages staff to report instances when they feel excessively tired, and if necessary request relief from duties. These reports contain valuable data, especially when coupled with information about the conditions that contributed to fatigue, such as the work schedule and features for the period leading up to the report. However, subjective reports of fatigue can underestimate the true extent of performance impairment, especially when an individual is already suffering from acute or chronic fatigue due to sleep loss or disruption of daily sleep patterns. A non-punitive reporting system is essential to encourage staff to report fatigue. See Appendix D on fatigue reporting systems for more guidance, and Appendix C on a positive safety culture to encourage open reporting.

5.76 **Staff fatigue surveys** are a useful supplement to routine monitoring of fatigue using other methods. It may be appropriate to survey staff fatigue by questionnaire or similar if there have been reports or other information suggesting a particular aspect of the work pattern is making staff tired. Additionally, in higher risk operations it is good practice to conduct a survey of staff fatigue across the operation periodically to help assess the effectiveness of existing controls, even in the absence of reported fatigue - the absence of fatigue reports does not mean that fatigue is absent. RSSB report T699 outlines a method used for a very comprehensive fatigue survey, but elements of this approach may be adapted and used in a simpler survey to glean valuable information on staff's perceptions of fatigue and its causes. Again, simply asking staff which turns / links etc cause problems is a good starting point – staff often know from experience which patterns they find most tiring, and can often suggest why. It may be relatively simple to identify any "problem" shifts or work patterns / features by for instance asking all staff to take a few seconds to anonymously complete a simple fatigue rating score (e.g. the 7-point Samn-Perrelli scale) before / during / at the end of a shift, with simple identification of the depot / route / link etc, for immediate deposit in a box in the cab/depot. In this way, a large amount of useful information can be easily and cheaply collected on perceived fatigue in the whole of the operation, though the approach obviously requires honesty by all parties. Appendix D on fatigue reporting gives more advice. Less formal ways of gathering staff fatigue information are of course also useful - simply asking staff occasionally about fatigue during everyday contacts helps monitor whether fatigue is a concern for them, and why. Overall, a proportionate approach is recommended – it makes sense to focus fatigue survey efforts on areas of the operation likely to involve greater risks from fatigue.

5.77 **Incident investigation procedures** should include arrangements for assessing whether fatigue may have been a contributory factor in accidents, incidents and near-misses. It is good practice for investigation procedures to provide prompts on fatigue aspects, to specify what information should be collected relevant to fatigue, and how this information should be assessed. Investigations should collect accurate duty start and end times and associated travel times in the days and weeks leading up to an incident. This information should extend back at least to the last time when the individual was completely rested – this may be several weeks, given the recovery time needed to make up any accumulated sleep debt. The patterns worked can then be assessed for deviations from good fatigue management guidelines (e.g. Section 6 Stage 2), and a fatigue risk assessment tool may be used to assess likely fatigue, provided the limitations of the tool are appreciated and taken into account (Appendix A). These findings should be supplemented by a "reality check", asking the individuals involved, and individuals with experience of similar work patterns, about whether they believe fatigue may have played a role in the incident, and the reasons for this belief. Other information needed includes how successful the individuals were in obtaining sleep in the opportunities available, environmental conditions that may have exaggerated or contributed to fatigue, relevant health or medical conditions etc. Appendix D suggests examples of fatigue report form information which can be incorporated into company incident investigation procedures to gather information on whether fatigue may have contributed to an incident. A just culture encourages constructive, honest input to the investigation procedure – see Appendix C on positive safety culture.

5.78 Monitoring **trends in shift exchange** can help reveal potentially problematic rosters or personal preferences. For instance, an individual may regularly seek to swap a day for a night shift due to domestic circumstances or personal preferences – it may sometimes be possible to accommodate these preferences from the outset when designing rosters, rather than coping with the knock-on effects of informal shift swapping later on.

5.79 Monitoring **trends in overtime** can help reveal individuals, departments, depots, grades etc which are potentially vulnerable to fatigue risk since, other things being equal, excessive overtime suggests inadequate staffing. Overtime may be used as a trigger for more in-depth fatigue assessment. For instance, if a member of staff works more than a particular number of hours overtime in a month, a procedure could be triggered to investigate the reasons, and an assessment of likely fatigue risks made by comparing hours worked against good practice, by using a fatigue assessment tool, and by asking staff about possible fatigue. Payroll savings can be made by evolving rosters to reduce the amount of overtime worked.

5.80 Examining **sickness absence records** may reveal trends in absence rates between particular turns, depots, work pattern features etc. Increased sickness absence usually requires sickness cover by the remaining staff, increasing demands on them and their likely level of fatigue (i.e. sickness absence causing fatigue). In addition, increased sickness absence trends are sometimes caused by staff finding these particular turns / features more tiring than others, leading to staff calling in sick on these turns. Investigating the reasons behind such variations may therefore help identify any contributory fatigue problems (i.e. fatigue causing sickness absence).

5.81 **Other data** on for example errors in procedures, near misses, data on train delays and irregular working and other safety-concern reporting systems can all help form a more complete picture of fatigue and its likely causes. If there are particular concerns about fatigue in particular parts of the operation, it may be reasonable to supplement self-reports of fatigue from fatigue surveys with other methods to monitor sleep and performance in staff. For instance, while it may not be practical to apply these techniques widely, periodic studies of actual sleep using actigraphs (motion-sensing wristbands) and sleep logbooks can be valuable in more objectively measuring the extent of fatigue across different

work patterns or groups. Such approaches are becoming more common in other countries and for instance the airline industry, helping to identify causes of fatigue which can then feed into modified work schedules or other aspects of the FRMS.

5.82 Useful **background on methods for measuring fatigue** can be found in Appendix B of the joint ICAO / IATA / IFALPA publication *Fatigue Risk Management Systems – Implementation Guide for Operators* issued for the international civil aviation community (ICAO / IATA / IFALPA, 2011). Although aimed at an aviation setting, much of the advice is equally relevant to rail operations.

Audit & Review

5.83 HSE publication HSG65 gives general guidance on audit and review aspects of risk management systems

5.84 The FRMS should be **a self-correcting process** which periodically audits and reviews the effectiveness of the organisation's existing fatigue policy and the fatigue-related organising, planning, implementing, and measuring processes. The system should also incorporate arrangements to trigger a review of the FRMS if there is reason to doubt its effectiveness, for instance a fatigue related incident; a series of reports of fatigue; improvements in fatigue management good practice; results of fatigue surveys. The findings of the fatigue audit and review process should be fed back into the FRMS to ensure that fatigue controls continuously improve.

5.85 The continuous improvement process should include a system for evaluating and reporting the **overall effectiveness of the FRMS**. Metrics or key performance indicators (KPIs) should be established which reflect the degree of fatigue in the organisation, to help track the effectiveness of the FRMS over time and for instance between roles, sites etc. The organisation should monitor these metrics regularly, looking for trends over time which may suggest the need for change or validate the effectiveness of existing controls. This could be one role for any Fatigue Safety Action Group or similar joint group.

5.86 Audit and review arrangements should preferably, and especially in high risk situations, include a system for periodic **independent review** of how effectively the FRMS is managing fatigue related risk. An occasional independent audit of the program by an external observer familiar with FRMS principles and good practices developed by other organisations can greatly improve the effectiveness and efficiency of the FRMS process.

5.87 Finally, an effective FRMS ensures that the results of audit and review processes **feed back into FRMS improvements**.

5.88 Improvements in the FRMS should be accompanied by **feedback and publicity to affected staff,** to encourage cooperative participation in managing fatigue company-wide. Company newsletters can for instance be used to help publicise the benefits and encourage staff involvement and support.

5.89 Organisations may find the suggestions in the **FRMS checklist** at Section 12 useful in considering the adequacy of their fatigue management arrangements, though it is important to recognise that not all the suggested items will be appropriate for all organisations – fatigue controls should be proportionate to the size and complexity of the organisation and the likely risks from fatigue.

5.90 Useful sources of guidance on Fatigue Risk Management Systems are listed in the **Further Information** section.

6. Fatigue in ROGS Safety Critical Work

6.1 If some of the work a person carries out is "safety critical" as defined in ROGS (see 6.4 below), then in addition to the general guidance on fatigue risk management systems outlined in Section 5 of this guidance, the fatigue management requirements of ROGS regulation 25 will apply.

6.2 This section replaces, updates and fleshes out ORR's original (2006) guidance on Regulation 25 of ROGS "*Managing fatigue in safety critical work*". It retains the original "nine stage" approach of the 2006 guidance, since many companies have devised their existing fatigue management arrangements in line with these stages. Companies with staff carrying out safety critical duties under ROGS should therefore

(a) review their existing fatigue controls against the updated ROGS guidance in this section, and

(b) consider whether their existing arrangements adequately address the wider fatigue risk management system (FRMS) issues detailed in Section 5, which gives further guidance on how the nine-stage ROGS approach should form part of a wider, company-wide "POPMAR" fatigue management framework within the organisation's safety management systems, as illustrated below.

Safety Management Systems

Fatigue Risk Management System

ROGS 9-Stages for "Safety Critical"
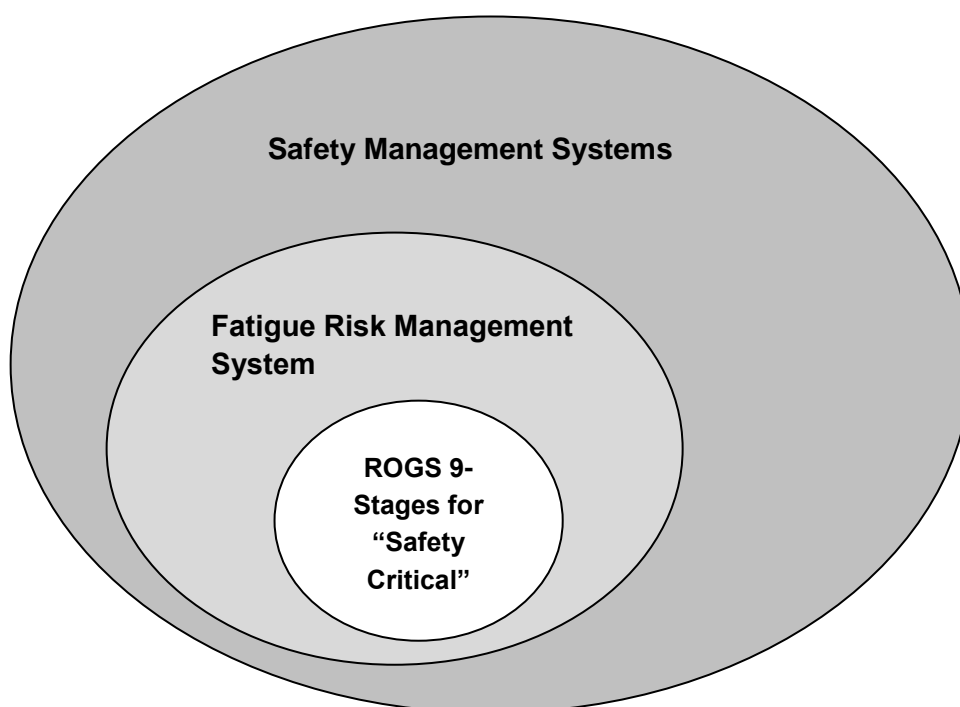
6.3 General guidance on ROGS is available in the ORR publication "*A guide to ROGS*" available on ORR's website at
www.rail-reg.gov.uk/server/show/nav.1511

6.4 Safety critical work is defined in regulation 23 of ROGS, and further guidance is given in ORR's publication "*Safety critical tasks – clarification of ROGS Regulations requirements*" available at www.rail-reg.gov.uk/upload/pdf/rsp004-rogs-crtcl_tasks.pdf .

6.5 Controllers, managers and supervisors need to ensure that workers do not undertake safety critical work if they are, or could become, so fatigued that health or safety could be significantly affected.

6.6 Regulation 24(1)(a) of ROGS requires controllers of safety critical work to ensure that people carrying out such work have been assessed as fit for that work, and Regulation 24(1)(d) requires them to have in place arrangements for monitoring the ongoing fitness of such staff. These fitness assessment and monitoring arrangements should take potential risks from fatigue into account. See Section 5.59 for further information on medical assessment, and 5.64 on fitness for duty arrangements.

6.7 This guidance relates to regulation 25 of the Railways and Other Guided Transport Systems (Safety) Regulations 2006 (ROGS). It sets out a series of stages that a controller of safety critical work should follow based on good practice in managing fatigue risks. Arrangements for complying with regulation 25 should be reviewed where there is reason to doubt the effectiveness of those arrangements.

6.8 As noted above, although ROGS regulation 25 only applies to safety critical work, employers have duties under other more general legislation to adequately control risks from fatigue amongst all employees. Some duty holders may therefore find it easier to use similar fatigue management arrangements for safety critical and non-safety critical staff. Fatigue management arrangements should be proportionate to the potential risks from fatigue.

Regulation 25: Fatigue

6.9 Regulation 25 of the Regulations states that:

1. Every controller of safety critical work shall have in place arrangements to ensure, so far as is reasonably practicable, that a safety critical worker under his management, supervision or control does not carry out safety critical work in circumstances where he is so fatigued or where he would be liable to become so fatigued that his health or safety or the health or safety of other persons on a transport system could be significantly affected.

2. *The arrangements in paragraph (1) shall be reviewed by the controller of safety critical work where he has reason to doubt the effectiveness of those arrangements.*

6.10 Safety critical work can be undertaken on a transport system at any time during the day or night, in sometimes difficult circumstances and at times with demanding work schedules. The potential for fatigue should therefore be foreseeable in such circumstances. If adequate measures are not taken to control any resulting fatigue, it can in turn lead to human error and give rise to significant risks to people on the transport system. Fatigue has been identified as a causal factor in incidents on transport systems and can lead to reduced vigilance and alertness, increased errors, impaired decision making and a general deterioration in mood and motivation.

The ROGS Nine-Stage approach

6.11 The controller of safety critical work should establish effective arrangements for managing the risks arising from fatigue in safety critical workers. This process should include the following nine stages illustrated below:

Figure 1: Summary outline of the nine stages

Stage	Summary
1 Identifying those safety critical workers affected	Identify those people carrying out safety critical work who are liable to be or could become fatigued when carrying out such work.
2 Setting standards and designing working patterns	Identify, set and adhere to appropriate standards and good practice for working hours and working patterns, observing any relevant working time limits that apply.
3 Limiting exceedances	Ensure that any standards and limits that have been identified and set are only exceeded with your prior approval and only on an infrequent basis and in exceptional circumstances.
4 Consulting with safety critical workers	Consult with safety critical workers and their safety representatives on the arrangements needed to manage fatigue and when standards and limits are to be changed.
5 Recording the arrangements	Maintain a record of your arrangements for managing the risks arising from fatigue in safety critical workers.
6 Providing information to safety critical workers	Provide all safety critical workers under your management, supervision or control with clear and relevant information on risks to health and safety owing to fatigue and your arrangements for managing fatigue.
7 Monitoring	Monitor the arrangements for managing fatigue to assess how effectively you are controlling the risks arising from fatigue.
8 Taking action when safety critical workers are fatigued	Ensure, so far as is reasonably practicable, that safety critical workers who report for duty where they are clearly unfit owing to fatigue, or who, through the course of their work shift become clearly unfit owing to fatigue, do not carry out or continue to carry out safety critical work.
9 Reviewing the arrangements	Review your arrangements for managing the risks arising from fatigue when you have reason to doubt the effectiveness of the arrangements.

Stage 1: Identifying those safety critical workers affected

6.12 Controllers of safety critical work need to identify those people carrying out safety critical work, since if these staff become fatigued there are likely to be adverse effects on the safety of people on the transport system.

6.13 In identifying such people, controllers of safety critical work should take into account any relevant significant findings of risk assessments that have been:

- carried out by transport operators in accordance with regulation 19 of the Regulations; and

- conducted in accordance with the Management of Health and Safety at Work Regulations 1999.

6.14 Safety critical work is defined in regulation 23 of ROGS, and further guidance is given in ORR's publication "*Safety critical tasks – clarification of ROGS Regulations requirements*" available at www.rail-reg.gov.uk/upload/pdf/rsp004-rogs-crtcl_tasks.pdf .

Stage 2: Setting standards and designing working patterns

6.15 Controllers of safety critical work should identify, set and adhere to **appropriate standards** for working hours and working patterns, observing any relevant working time limits that apply.

6.16 The standards and limits set should take into account recognised national industry **good practice guidance** applying to railways and other guided transport systems. Any local arrangements on rostering and working hours should be compatible with the standards and limits that have been identified and set.

6.17 It is vital that staff who devise working patterns receive **training in roster design** and the implications for fatigue. This should include not only the rostering staff but also any staff or trade union representatives significantly involved in devising or negotiating working patterns. Trade unions have a role to play in ensuring that negotiated terms and conditions and resulting working patterns do not give rise to excessive fatigue.

6.18 In the absence of relevant recognised national industry standards and limits, the standards and limits that the controller of safety critical work sets should, so far as is reasonably practicable, take into account **foreseeable causes of fatigue**, including:

- job design;

- the workload and the working environment;

- the shift system in operation;

- shift exchange;

- control of overtime;

- on-call working;

- the frequency of breaks;

- recovery time during periods of duty; and

- the nature and duration of any time spent travelling.

6.19 In recent years rail employers have often placed too much reliance on the so-called **"Hidden limits"** which were incorporated into the former railway group standard GH/RT4004 and many company standards following the 1988 Clapham accident. However, it is important to recognise that these were based on what was thought to be operationally achievable at the time, rather than on sound fatigue management science. They often became norms which companies then routinely planned for and "worked up to", even though it may often have been reasonably practicable to use less fatiguing work patterns. Knowledge of fatigue has since improved, and it is now recognised that some working patterns complying with the "Hidden limits" can give rise to significant fatigue. GH/RT4004 was withdrawn in 2007. Employers should devise their own arrangements including any appropriate numerical limits.

6.20 Limits for hours worked and working patterns for safety critical workers are generally appropriate for:

- the maximum length of any work shift or *period of duty*;

- the minimum rest interval between any *periods of duty;*

- the maximum number of hours to be worked in any seven day period;

- the minimum frequency of rest days;

- the maximum number of consecutive *day shifts;*

- the maximum number of consecutive *night shifts* and *early-morning shifts*; and

- the maximum period of time between breaks, including breaks for meals.

6.21 Such **numerical limits** on hours worked can certainly help managers decide on a practical day to day basis what may or may not be acceptable. However, taken in isolation, a set of simplistic limits on work and rest hours as outlined above cannot account for the impact on fatigue of operational factors such as differences in workload, working conditions and personal factors such as age, health, medication, domestic and social activities (DfT report 110, 2010 p15). The emphasis should always be on reducing risks from fatigue so far as reasonably practicable (involving judgements on risks and costs) rather than "working up to" any particular limit. For these reasons duty holders need to set up and operate more wide ranging fatigue risk management systems as outlined in section 5.

6.22 Some companies complement their numerical "working hours" limits with company limits on, for instance, **fatigue assessment tool scores**. This approach can give a more rounded assessment of the likely levels of fatigue from proposed working patterns, provided the assumptions and limitations of the tool are understood (see Appendix A on fatigue risk assessments). Whatever limits are used, they should not be used in isolation but should be complemented by building-in good fatigue management principles from the outset (Stage 2 on designing working patterns), and by seeking feedback from staff on how tiring they find the working patterns in practice. See Appendix A on fatigue risk assessments.

6.23 Working **patterns can be designed to**:

- minimise the build up of fatigue by restricting the number of consecutive *night or early-morning shifts*;

- allow fatigue to dissipate by ensuring adequate rest between shifts and between blocks of shifts; and

- minimise sleep disturbance.

6.24 **Planned work patterns may vary** when workers are on call or when unplanned overtime needs to be worked, e.g. as a result of worker shortages or sickness. These features also need to be assessed and managed to minimise the risks from fatigue. Proposed changes to work patterns should wherever reasonably practicable be risk assessed beforehand to check whether they adequately take account of good fatigue management practices (see 6.60 and Table 3). Short-notice changes should be avoided so far as is reasonably practicable. Software packages are now available which can help duty holders estimate likely fatigue risks from changes to planned rosters more easily, provided their limitations are appreciated – see Appendix A on fatigue assessment tools.

6.25 The controller of safety critical work should **consider the questions below** when designing work patterns:

- Overall, is the proposed working time pattern likely to increase the risk of accidents arising from fatigue?

- Does the proposed working time pattern have any particular feature that could give rise to fatigue risks?

6.26 In answering these questions, there are **five aspects of the working time pattern** that are relevant to the question of fatigue. These are discussed below.

Length of periods of duty

6.27 The duration of the shift is a key factor influencing fatigue, and long shifts have been linked with an increased risk of accidents. There is a strong case for limiting the duration of a shift to 12 hours, with further restrictions on duties, such as nights and early starts, that impinge significantly on the normal hours of sleep. For example, while it may be acceptable to work a 12-hour day shift, lower limits such as 10 hours should be considered where night shifts or early morning start times are planned (RSSB report T699 p44).

6.28 There is evidence that human performance deteriorates significantly when people have been at work for more than 12 hours. In a review of the relative risk of accidents or injuries, the risk of an incident was shown to increase with increasing **shift length** over eight hours. Relative to eight hour shifts, 10-hour shifts were associated with a 13% increased risk, and 12-hour shifts with a 27% increase (T699 p29, Folkard et al 2006). Staff regularly working 12 hours or more per day were found in a large US study (Dembe et al 2005) to have a 37% higher injury rate compared to other staff.

6.29 Controllers of safety critical work should therefore consider in particular whether any shift (including overtime) for safety critical workers could exceed 12 hours in length, and **consider the risks involved in activities** (whether at work or, for instance travelling home) that workers could be carrying out after the twelfth hour. Below 12 hours the extent to which fatigue occurs may depend on other aspects of the working time pattern, such as the adequacy of breaks taken during the shift and the length of interval since the previous duty (as well as other factors such as the nature of the work and the working environment). Even shifts of eight hours or less can be fatiguing if the work is very intense, demands continuous concentration, there are inadequate breaks, or is very monotonous.

6.30 Good practice for **maximum shift lengths** would be as follows (RSSB T059)

- Day shift – twelve hours

- Night & early shifts – ten hours

- Shifts starting before 0500 - eight hours.

6.31 It is important to recognise that controlling the time actually "at work" may not properly manage work related fatigue if travel times to and/or from the place of work to home or lodgings are significant. Some organisations therefore place limits on maximum **"door-to-door" times** between leaving and returning to the home / lodgings. This more integrated approach has the added benefit of helping to control fatigue risks arising from travel to or from the workplace, including work related road risks. See Appendix B on travel time for more information.

Intervals between duties

6.32 The **daily rest interval** for safety critical workers needs to be adequate to enable them to return to work rested after a full sleep. Studies suggest that the average amount of sleep required per 24 hours is 8.2 hours (Van Dongen et al, 2003), and that if people are continuously awake for more than about 16 hours, lapses in performance can be expected to increase. This is obviously relevant to shift workers, particularly those working early starts, late finishes or night shifts, which may unless properly managed result in staff getting well under eight hours sleep.

6.33 It is advisable to include a **minimum rest period** of 12 hours between consecutive shifts, increasing to 14 hours rest in the case of consecutive night shifts (RSSB report T699 p45).

6.34 A feature of some shift work patterns is the occasional short rest interval of perhaps only eight hours. This will not usually be an adequate rest interval, and patterns involving such short rest intervals should be revised as soon as is reasonably practicable. Until the pattern is revised to eliminate such short intervals, it is important to ensure that other daily rest intervals in the shift pattern are of adequate length and that breaks during the shift after the short interval are adequate.

6.35 Arrangements whereby workers occasionally stay overnight in specially provided **accommodation near to the workplace**, where they can obtain the maximum sleep in the time available, may reduce the likelihood of fatigue.

6.36 There is evidence that time spent travelling to and from work does not provide rest in the same way as time spent at home. It is important to monitor long **travelling times** to and from work and consider how this can reduce the opportunity for daily rest and so increase the risk of fatigue. Where a large proportion of a group of safety critical workers have long travelling times, this ought to be taken into account when considering changes to working time patterns. See Appendix B on Travel Time for more information.

Recovery time

6.37 There is clear evidence about the value of **rest days** in enabling workers to 'recharge their batteries' and to maintain their work performance. Rest days allow the "cumulative fatigue" which accumulates over successive shifts worked to dissipate. The planning of rest day arrangements for safety critical workers needs to take account of the length of shifts and daily rest intervals. The frequency of rest days and the length of the recovery time are both relevant. Workers may benefit from regular (at least fortnightly) recovery periods of at least 48 hours. These are particularly important for shift workers, especially those working nights as shortened or interrupted sleep over a period can result in them spending part of their rest day sleeping.

6.38 Studies suggest that where sleep is restricted to seven hours or less, there are cumulative effects on cognitive performance over successive days (Belenky et al, 2003; Van Dongen et al, 2003).

6.39 In general, staff may need longer to recover properly from a night or very early shift than a day shift (RSSB report T699 p15).

6.40 Good practice for the maximum number of **consecutive shifts** before a rest day would be as follows (RSSB report T059):

- Day (including mixed patterns) – seven

- Night – three

- Early – five

6.41 However, where there is a greater need for night work (e.g. freight and infrastructure maintenance), limiting the number of consecutive nights would mean more switching from nights to days and back (RSSB report T699 p34). Controllers of safety critical work should assess the relative pros and cons of such trade-offs and make a judgement on the best overall solution, documenting their reasoning. See also Table 3 under the heading Weekly work / rest ratio.

6.42 Good practice also suggests allowing two rest days before an early start which follows a night shift, and one rest day before an early shift which follows a late shift (RSSB report T059).

6.43 **Rest day working** should be kept to a minimum, to ensure that planned recovery time is effectively used.

Shift work

6.44 It is the nature of the railway business that some safety critical workers work rotating **shifts**, and that these may include night work. Workers may have difficulty in adjusting to varying sleep patterns, or to daytime sleep; this is an effect of the internal 'body clock' regulating sleep and wakefulness, which corresponds to the natural cycle of night and day. It may also be difficult to find the right conditions at home for daytime sleep. As a result, there may be a reduction in the quantity and quality of sleep, and the effects can build up over a period. On average, a person may lose two hours sleep for each night shift worked. The resulting fatigue that safety critical workers may experience is likely to be most noticeable on the night or early-morning shift, and to be more marked the more monotonous or repetitive the task. While some people prefer to work more consecutive shifts in order to take a block of days off afterwards, this needs to be balanced with the risk of higher levels of fatigue from the greater number of shifts worked.

6.45 Research suggests that a **rotating shift pattern** that changes about once a week is likely to be more difficult to adjust to than a more rapidly or more slowly changing one. Current thinking (Driscoll et al, 2007, p191) suggests that starting a shift later than the previous one (forward rotation) may be less of a problem than starting a shift earlier than the last one (backward rotation). Some shift patterns can result in a short daily rest interval of perhaps only eight hours; a pattern including such a short interval would be particularly unfavourable for safety critical workers as it provides inadequate opportunity for sleep, and wherever reasonably practicable such patterns should be revised to remove such short intervals.

6.46 For **three-shift systems,** better patterns rotate rapidly in a forward direction e.g. MMMAANNRR, MMAAANNRR or MMAANNNR (where M is a morning shift, A is an afternoon and R is a rest day), with rest

days generally best placed after the sequence of nights, to optimise recovery. To avoid early starts and late finishes and reduce sleep disruption on the morning and afternoon shifts, recommended changeover times are therefore close to 07:00, 15:00 and 23:00 (DERA advice for nuclear installation guidance, 2000).

6.47 For **two shift systems**, similar considerations about the placement of rest days apply. However, fatigue levels towards the end of the shift are likely to be higher with 12 hour shifts, especially if the work is demanding, requiring closer attention to fatigue controls. So, although 12 hour shifts reduce the number of handovers and journeys to and from work, can be popular with some staff due to increased days off, and have been reported as improving staff morale, this must be balanced against the evidence on increased incident and error rates for longer shifts. To avoid early starts on the day shift, recommended changeover time is at or soon after 07:00 (DERA advice for nuclear installation guidance, 2000).

6.48 For safety critical workers who are on call, or whose **starting time frequently varies** with very little notice given, the uncertainty makes it difficult to plan suitable sleep time and fatigue is more likely as a result. A particular example is drivers on a 'spare turn', who can have large variations (up to four hours) in their duty start time. If consecutive duty start times vary by so much, then fatigue is highly likely to be a problem. As far as possible, shift start times and on call duties should be planned to avoid variations of more than two hours. Where this is not possible then additional control measures, such as additional rest breaks within a period of duty or a shorter shift length, should be considered. A series of consecutive rostered duties with large variations in start times should be avoided.

6.49 **People differ** in their ability to adapt to and tolerate shift work. For instance, studies of ageing and the ability to cope with shift work have suggested that older workers generally cope well with the demands of early shifts but may experience more difficulties with the night shift – with ageing there is a tendency to become more of a "lark" (waking earlier and most alert in the first part of the day) than an "owl" (waking later and most alert later in the day or evening) (T699 p21, 36 and App G p9; Monk 2005). When allocating individuals to particular shift patterns, employers should make reasonable efforts to accommodate personal preferences, some of which may stem from such trends in shift work tolerance.

Time of day

6.50 The risk of fatigue-related accidents is related to the **time of the day**. The worst time is in the early morning from midnight to 6 am, with a lesser problem in the middle of the afternoon from 2 pm to 6 pm. A recent RSSB analysis of SPAD (Signal Passed at Danger) incidents indicated that the risk factor increased between two and three fold between midnight and 06:00 (RSSB report T699 p26). A recent study of data from 8-hour morning, afternoon and night shifts indicated that the risk of an accident was 28% higher on the night shift and 15% higher on the afternoon shift than on the morning shift (RSSB report T699 p40).

6.51 The main problem in the management of shift work is to cover the night-time hours when alertness is naturally low. People who work in the **late night or early morning** often feel sleepy and fatigued during their shift. This occurs because their internal 'body clock' is telling them they should be asleep. Night workers also have to sleep during the day and their day sleep can often be of a poorer quality. Early-morning shift workers have to wake up very early and can have a reduced length of sleep, leading to a progressive build up of fatigue over successive early starts. It may sometimes be practicable to plan safety critical work to avoid these times when alertness is low. Other control measures should include planned rest breaks, working in pairs, encouraging workers to stand up and move around, and changes to the working environment such as higher levels of lighting and lower ambient temperatures.

6.52 The risk of accidents and injuries has been found to increase over spans of four **consecutive night shifts** (Folkard and Akerstedt, 2004), and some studies indicate that performance errors increase and alertness decreases over four consecutive night shifts (Walsh et al, 2004). Some individuals however report that over successive night shifts they find less difficulty concentrating and find sleep between shifts progressively easier, finding the first in a series of night shifts to be particularly fatiguing (RSSB T699 p31, 34, 37). It may be that staff changing from a "daytime awake / night-time asleep" pattern may feel less fatigued on their second and third night shifts than their first night shift, as their "body clock" adjusts. However, this is probably countered by a steady accumulation in "sleep debt" with each night worked due to generally shorter, poorer quality daytime sleep. Employers should assess the relative pros and cons of such trade-offs and make a judgement on the best overall solution, documenting their reasoning. It is unlikely that individuals will adapt to night shifts completely – a recent study found that less than 3% of permanent night workers adapted completely (Folkard 2008, and RSSB report T699 p37). Individuals vary in their ability to cope with successive night shifts. Special consideration may be warranted for the first night shift, for instance by making it shorter. Some general guidelines on night shifts are given in Table 3 and paragraphs 6.39 to 6.42.

Identify factors that may affect the onset of fatigue

6.53 Controllers of safety critical work should be aware of **factors affecting the onset of fatigue**, and design tasks and the working environment to maximise alertness so far as is reasonably practicable.

6.54 A number of factors may affect the onset of fatigue, including the **nature of the work** itself. Tasks that require sustained vigilance, or where the employee may have low levels of workload, may be more susceptible to fatigue. For example, driving the same route a number of times in the same shift is a factor that will influence fatigue. The working environment (including low lighting levels, high temperature, and quiet conditions) may also increase fatigue and feelings of drowsiness, particularly for sedentary tasks. In some roles, for instance track maintenance work, the amount of heavy physical work can also affect how fatigued staff feel.

6.55 HSE carried out a series of inspections on fatigue management of train drivers and identified the following factors that might affect the onset of fatigue:

- repetitive routes;
- long night turns;
- insufficient rest before starting a *night shift* after working an *early shift*;
- high vacancy levels;
- very short turnaround time provided;
- poor timing of meal breaks in early shifts;
- variations in start time of spare turns; and
- not including training days within roster.

Provide adequate rest breaks before and within a period of duty

6.56 Controllers of safety critical work should not allow workers to undertake safety critical work if they have not had sufficient rest before starting a period of duty.

6.57 Controllers of safety critical work should make arrangements for workers to take **breaks during periods of duty**, except where the work provides natural opportunities for relaxation or reduced vigilance. The length and timing of breaks should be appropriate to the nature of the work and the length of time spent on duty. Frequent short breaks during a shift help manage fatigue and maintain attention. Research (HSE CRR 254, 1999, p9) found for instance that during periods of high workload, a fifteen minute break may overcome reductions in performance due to fatigue, a six minute break overcame many but not all performance reductions, and a two minute break was of some benefit but was considerably less effective. Scheduling breaks at the start or end of a shift reduces any beneficial effects – breaks should be scheduled at a suitable time with respect to the task activities, and ideally towards the middle of a shift (RSSB report T699 p6). Less demanding tasks are likely to require shorter breaks than more demanding tasks. Wherever reasonably practicable, safety critical workers who work at a workstation (e.g. in a driver's cab or signal box) should be given the opportunity to spend breaks away from the workstation.

6.58 The **timing of breaks** is important. General advice for tasks which require continuous sustained attention, with no natural breaks in the task and where a lapse in attention can lead to safety implications, is for a regular 10-15 minute break every two hours during the day and every hour during the night. An alternative is to rotate workers around different tasks, providing that not all tasks require similar sustained attention. It is unlikely that the majority of safety critical tasks in the transport system would be of this extreme nature. For driving tasks, good practice would be to plan a short break about every three hours. It is better to plan regular breaks throughout a shift rather than have a break very near the start of the shift followed by another right at the end of the shift.

6.59 The '**quality' of breaks** is also important. A food and drink preparation area, a quiet rest area at a suitable temperature and with suitable seating, and the facility to talk to colleagues and to take a walk are positive points. In the case of safety critical workers on night shift, the facility to take a short nap during a break can be especially beneficial. Naps of no more than 10 minutes are advisable if safety critical tasks are to be resumed within 20 minutes of waking. This is to avoid any grogginess on waking from a nap ("sleep inertia").

Summary of features of work patterns

6.60 Features of work patterns to consider are summarised in Table 3. The table provides guidance on when to review controls in place to manage the risks from fatigue. These are given as **good practice suggestions**. The guidelines are not proposed as prescriptive limits, but are intended to provide a framework to help guide duty holders in defining their own schemes for controlling fatigue risks. The guidelines should not be taken as being the only reasons for a review of controls. In general terms, the more a working pattern deviates from the guidelines, the greater the likely need to assess and control the potential risks from fatigue.

Table 3: Features of work patterns

Feature	Options	Think about:	Review adequacy of fatigue management controls when:
Timing of shift start	Day, evening, night, early or late	Night and early shifts can cause reduced sleep and fatigue.	Night and very early shifts start between 20:00 and 05:00 and if they last for more than 8 hours.
Length of shift	8, 10, 12 hours or split shift	Shorter shifts can cause less fatigue for night and early shifts. The risk of accidents rises after 12 hours on shift. Long split shifts are a problem area. Good practice for maximum shift lengths would be as follows (RSSB T059) Day shift – twelve hours. Night & early shifts – ten hours. Shifts starting before 0500 - eight hours.	A planned shift extends beyond the guidelines for day, night and early shifts given in the previous column. Overtime is worked before or immediately after any planned shift, or a split shift extends beyond 12 hours (including the long break within the shift).

Feature	Options	Think about:	Review adequacy of fatigue management controls when:
Weekly work-rest ratio	Number of workdays to rest days	Minimise the number of consecutive night shifts and early shifts worked and allow two rest days after a block of such shifts. Good practice would be to ensure at least 12 hours rest in a 24 hour period, more for night shifts (recommended 14 hours rest) or early shifts. Longer runs of consecutive nights may require more rest days.	The number of consecutive night shifts or very early shifts exceeds four in a rotating shift pattern or six when working a permanent shift pattern. Where more than three consecutive night shifts exceeding 8 hours are worked (RSSB T699 p44) The number of consecutive day shifts exceeds 12.
	Overtime workdays	After overtime, ensure sufficient time for sleep, travelling, and meal breaks before the start of the next shift.	More than 7 consecutive 8-hour shifts, or more than 4 consecutive 12-hour shifts, are to be worked (T699 SPAD analysis at p27 found risk increased after six days or more at work) Only one day's rest is planned after any number of night shifts or very early turns.
	Weekend working	Plan some free weekends.	Regular planned or unplanned overtime is being worked or overtime is unevenly distributed among staff. Planned work, together with overtime and unplanned on-call work over a seven day rolling period , builds up to 55 hours (RSSB T699 p44; similar to heavy goods vehicle and aviation requirements)
Shift rotation	Permanent shift times (no rotation)	Individuals may have a preference for working permanent shift times. This can avoid problems	The direction of shift rotation varies between shifts. For example a person works two nights, three early shifts, and

Feature	Options	Think about:	Review adequacy of fatigue management controls when:
		with shift exchange and improve work–life balance.	then two more nights – the shift start times are first advancing forwards and then being put backwards.
	Rotating speed	Rapid rotation or slow rotation is easier to adjust to than a shift pattern that rotates about once a week.	
	Direction of rotation	Rotating speed refers to the number of workdays before a shift change. Rapid rotation is two days per shift type; slow rotation is 21 days per shift. Clockwise rotation from day to evening to night shift is usually preferable to counter-clockwise change from day to night to evening.	
Predictability	Emergency or on call duty	All these can affect any other part of the work pattern and will impact on levels of workers fatigue.	Spare turns or unplanned on-call shifts have a start time that varies by more than 2 hours, or late notice is given of additional or altered duties. For example, a person is told at 10 am that they are requested to work an evening on-call shift.
	Unplanned overtime	Restrict unplanned work and allow workers adequate rest before their next planned shift. If workers have been awake for more than 17 hours then their performance is likely to be at greater risk of errors.	A rest period of less than 8 hours has occurred because of on call or emergency working.
	'Spare' turns with late notice/variable start time	Plan spare duties so that workers know start times in advance. Try to incorporate a requirement for sufficient warning to be given of	

Feature	Options	Think about:	Review adequacy of fatigue management controls when:
		extra duties or changes to the start time of a duty.	

6.61 Once draft working patterns have been devised incorporating good fatigue management principles, a **fatigue risk assessment** should be carried out. The assessment may include the use of a fatigue assessment tool, to help check whether the pattern is likely to adequately control fatigue and to identify whether there are any opportunities for further reducing fatigue risks. See Appendix A for further guidance on fatigue risk assessments, including tools.

6.62 A note of caution: even if working patterns are designed incorporating the good practice principles outlined above, a fatigue risk assessment tool also suggests fatigue levels are unlikely to be a concern, and staff representatives agree to the pattern, employers should also, soon after its introduction, **ask staff** about how tiring they are finding the working pattern in reality. General principles and fatigue assessment tools are not perfect – it is important to carry out a "reality check" by seeking staff feedback on whether the pattern is adequately controlling fatigue in practice.   This general sequence can be summarised as follows, consulting with staff at appropriate stages:-

   (a) design the work pattern, maximising good fatigue management practices

   (b) assess likely fatigue risks from the resulting work pattern, using a fatigue assessment tool

   (c) ask staff whether the working pattern is controlling fatigue, any particular features which may need further improvement.

See also Stage 7 regarding Monitoring, and Appendix A on fatigue risk assessments.

Stage 3: Limiting exceedances

6.63 Controllers of safety critical work should ensure that any standards and limits that have been identified and set are only exceeded with their **prior approval**, on an infrequent basis, and in exceptional circumstances.

6.64 '**Infrequent and exceptional circumstances'** relates to situations where extended working is necessary to avoid or reduce risks to the health and safety of people on a transport system or significant disruption to services, and it is not reasonably practicable to take alternative steps. Such circumstances would include extreme weather conditions, equipment failure, or an accident or other serious incident. By their nature these circumstances will be unplanned and unforeseeable.

6.65 Duty holders should have a clear, documented process for deciding **whether to authorise exceedances** of their limits, and staff able to authorise exceedances should receive training in the process. Before authorising an exceedance the risks should be assessed, to decide whether the fatigue risks are likely to be unacceptable. Exceedance authorisation forms are usually used to guide staff through this risk assessment process, which should require those making authorisation decisions to

- Consider whether any reasonably practicable alternative options are available (e.g. doing the work at another time with less fatigued staff)

- Identify what reasonably practicable mitigation measures may be taken to address fatigue risk

- Consider the factors which are likely to affect fatigue risks including for instance: the level of supervision; the frequency and quality of rest periods; the working pattern leading up to the requested exceedance; the opportunity for breaks; time of day; nature of the work including how demanding it is; the working environment including lighting and weather; individual factors such as experience and level of alertness; and travelling time

- Make a written record of the decision summarising the risks considered and the corresponding fatigue controls and mitigation measures (e.g. the exceedance authorisation form)

6.66 Where it can be foreseen that the limits are likely to be exceeded more than occasionally, e.g. where hours of work are already close to the limits, controllers of safety critical work should plan accordingly and make any necessary **contingency provision** to ensure that the limits are not exceeded, except on a very infrequent basis. Planned training or safety briefings for safety critical workers should not be a reason for exceeding the standards or limits. Neither should, for example, the existence of long-standing job vacancies, a block of maintenance work extending over a few days (e.g. plant shut down or blockade working) training delays or planned organisational changes that affect the numbers of safety critical workers. All of these should be foreseeable circumstances. In any case suitable action should be taken.

6.67 In exceptional circumstances where extended working is necessary, all reasonable steps should be taken to **relieve safety critical workers** who have worked in excess of any limits as soon as possible and to ensure that they have sufficient time to be fully rested before their next period of duty.

Stage 4: Consulting with safety critical workers

6.68 Controllers of safety critical work should **consult** with safety critical workers and their safety representatives on the arrangements needed to manage fatigue and when standards and limits are to be changed.

6.69 Following consultation, controllers of safety critical work should take account of the **views and experiences** of the safety critical workers affected, as expressed either directly or through their safety representatives.

Stage 5: Recording the arrangements

6.70 Controllers of safety critical work should maintain a **record of their arrangements** for managing the risks arising from fatigue in safety critical workers.

6.71 Those arrangements should be incorporated into the safety management system for those controllers of safety critical work who are subject to Part 2 of the ROGS Regulations.

6.72 For those controllers of safety critical work who are not subject to Part 2 of the ROGS Regulations, the arrangements should be incorporated into their health and safety arrangements required by the Management of Health and Safety at Work Regulations 1999.

Stage 6: Providing information to safety critical workers

6.73 Controllers of safety critical work should provide all safety critical workers under their management, supervision or control with **clear and relevant information** on risks to health or safety due to fatigue, and on their arrangements for managing fatigue.

6.74 Workers have a duty under Section 7 of the Health and Safety at Work etc Act 1974 to take reasonable care of their own health and safety and that of others who may be affected by their activities at work. This duty implies that they should take steps to understand the risk factors in their work (such as causes of fatigue), **comply with safety rules and procedures** and ensure that they do not put anyone at risk as they carry out their duties.

6.75 Safety critical workers should be made aware of their role and the requirements on them in meeting the arrangements for managing fatigue. They should be aware of the impact of their activities on the safety of the transport system and the influence that their alertness and fatigue can have on that safety when performing safety critical tasks.

6.76 Safety critical workers should be made aware of the standards and limits that apply to the work they are to undertake and the nature of those exceptional circumstances in which the limits can be exceeded with prior approval.

6.77 Safety critical workers should be made aware of the procedures to be followed if they consider that there are circumstances, such as significant life events or medical conditions, that may cause them to either be or become so fatigued that health and safety could be significantly affected.

Stage 7: Monitoring

6.78 Controllers of safety critical work should monitor the arrangements for managing fatigue to **assess how effectively** they are controlling the risks arising from fatigue.

6.79 The **actual hours worked** should be monitored. This should include any periods of overtime (whether planned or unplanned) and any periods of non-safety critical work that could have a bearing on the safety critical worker's fatigue and ability to undertake the safety critical work. The work patterns undertaken by safety critical workers should be monitored against the standards and limits that the controller of safety critical work has identified and set.

6.80 For samples of **higher risk staff** (e.g. staff recording the most hours worked, and staff working patterns which are otherwise likely to be more fatiguing, for instance involving a greater proportion of nights), assessing likely fatigue risks from actual hours worked using a fatigue assessment tool can help suggest particular features of working patterns warranting closer attention. As stressed in Appendix A, information from such tools should not be considered in isolation, but should be complemented by comparisons with good fatigue management practices as outlined in this guidance, and by seeking feedback from staff on how fatiguing they find the working pattern in reality.

6.81 If working hours information for monitoring fatigue is derived from payment systems, employers should ensure that the information accurately reflects hours actually worked. There have been instances where overtime payment systems and unrecorded on-call duty has distorted the true picture of hours actually worked.

6.82 Where the organisation's standards and limits have been exceeded, the **reasons for the *exceedance*** should be identified and suitable measures should be taken to reduce the risks arising from fatigue and to prevent the exceedance reoccurring.

6.83 Excessive **overtime** levels that could have a bearing on the safety critical worker's fatigue and ability to undertake safety critical work should be monitored and controlled.

6.84 The nature and duration of **time spent travelling** should be monitored and, so far as is reasonably practicable, controlled when it could have a bearing on the person's fatigue and ability to undertake safety critical work. See Appendix B on travelling time.

6.85 See Section 5 of this guidance under "Measuring Performance" for further advice on good practice.

Stage 8: Taking action when safety critical workers are fatigued

6.86 Controllers of safety critical work should ensure, so far as is reasonably practicable, that safety critical workers who report for duty where they are clearly **unfit due to fatigue**, or who, through the course of their work shift become clearly unfit owing to fatigue, do not carry out or continue to carry out safety critical work.

6.87 The reason(s) why the safety critical worker is or has become fatigued should be established, so far as is reasonably practicable.

6.88 In the event of a safety critical worker being so unfit, appropriate control measures (such as providing sufficient rest) should be applied before the safety critical worker commences or recommences safety critical work.

Stage 9: Reviewing the arrangements

6.89 Controllers of safety critical work should **review their arrangements** for managing the risks arising from fatigue when they have reason to doubt the effectiveness of the arrangements.

6.90 A review should be undertaken where:

- there has been a significant change in circumstances, such as job design, workload, or organisational changes;

- there are plans to *change the existing working patterns* and *existing limits;*

- there is a change in relevant recognised good practice standards, and limits for managing fatigue in the railways and other guided transport systems;

- fatigue has been identified as a causal factor in an incident investigation which gives reason to doubt the effectiveness of the arrangements;

- monitoring has shown that standards and limits are being exceeded on a regular basis;

- long-term sickness, a significant number of unfilled job vacancies or industrial action results in frequent *exceedances*;

- there is a significant incidence of safety critical workers being stopped from carrying out safety critical work due to being unfit because of fatigue; or

- there is any other reason to doubt the effectiveness of the arrangements.

So far as is reasonably practicable, controllers of safety critical work should act upon recommendations from reviews related to fatigue.

7. Appendix A. Fatigue risk assessments

7.1 Organisations' arrangements for managing fatigue should detail how their **processes for designing work patterns and rosters** will ensure that risks from fatigue are assessed. Working patterns and rosters should be devised by people who are familiar with the causes of fatigue, and with good practices in managing fatigue.

7.2 Working patterns should be designed to incorporate **good fatigue management principles** and to minimise features of working patterns known to contribute to fatigue. They should take account of guidance in for instance

- HSE booklet HSG256 "Managing Shift Work"

- this ORR guidance document, and

- any role-specific fatigue guidance (e.g. RSSB report T059 for passenger train drivers; RSSB report T699 for freight train drivers and contract track workers)

7.3 Generally, the more the working pattern deviates from the good practice guidelines in the above guidance, the greater the likely risk of fatigue.

7.4 Once draft working patterns have been devised incorporating, so far as reasonably practicable, good fatigue management principles, it is recommended that an assessment is carried out on the proposed pattern using a **fatigue assessment tool**, to check whether the planned pattern is likely to adequately control fatigue and to identify whether there are any opportunities for further reducing fatigue risks. It is important however to be aware of the limitations of such tools – see below regarding the role of fatigue assessment tools.

7.5 **Staff should be consulted** on the proposed working patterns, and their views on fatigue risk aspects considered.

7.6 However, experience has shown that even if working patterns are designed incorporating good practice principles, a fatigue risk assessment tool also suggests fatigue levels are unlikely to be a concern, and staff representatives agree to the proposed pattern, employers should also, soon after its introduction, **ask staff about how tiring** they find the working pattern in reality. General principles and fatigue modelling tools are not perfect – it is important to carry out a "reality check" by seeking staff feedback on whether the pattern is adequately controlling fatigue in practice.

7.7 This general three-part sequence can be summarised as follows, consulting with staff at appropriate stages:

- design the work pattern, maximising good fatigue management practices;

- assess likely fatigue risks from the resulting work pattern, using a fatigue assessment tool;

- ask staff whether the working pattern is in reality controlling fatigue, and any particular features which may need further improvement.

1. Consistent with good practices?
e.g. HSE Managing Shift Work (HSG256)
ORR fatigue guidance
RSSB fatigue guidance
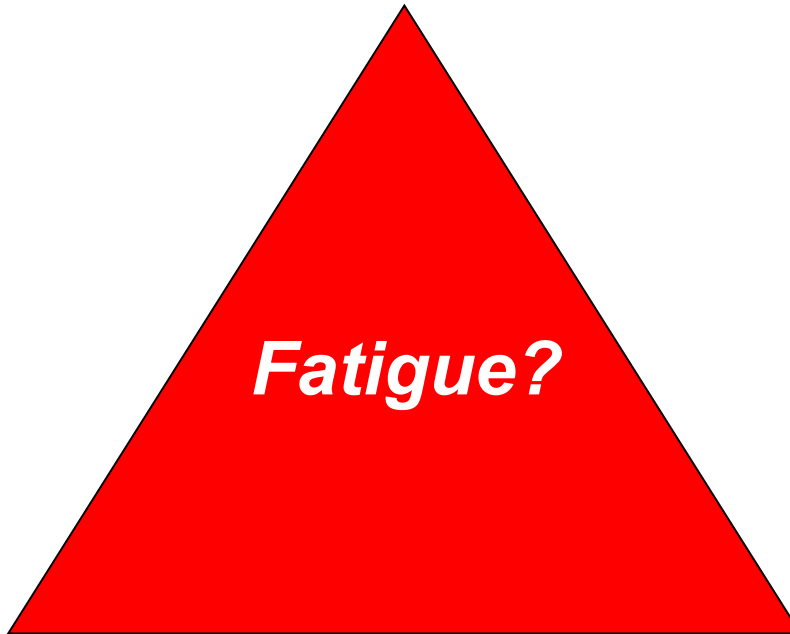
Fatigue?

2. Fatigue tool?
Does a fatigue assessment tool suggest any problems?

3. How tiring do staff actually find the pattern?
e.g. fatigue reports?
fatigue rating scales?
fatigue survey?

The role of fatigue assessment tools

7.8 Companies considering using a fatigue risk assessment tool to help assess likely fatigue risks should ensure they are aware of the **assumptions and limitations** of the tool. ORR does not compel, endorse or advocate the use of any one tool over another – all have their benefits and limitations, and it is for each organisation to decide which tool(s) best suit their requirements. Some benefits and limitations are outlined below.

7.9 Some possible benefits of fatigue risk assessment tools include:

- They can help assess the likely level of fatigue from a **current working pattern**, to help decide whether further fatigue reduction measures may be reasonably practicable;

- They can help compare the likely level of fatigue which would arise if **changes to a working pattern** are being considered, for instance during timetable changes or the introduction of a new train service or infrastructure maintenance regime;

- They can help identify **particular shifts or sequences** within a working pattern where fatigue is likely to be higher, which helps to efficiently target efforts at reducing fatigue risks. For instance, assessment may suggest that the bulk of duties are unlikely to cause a fatigue problem, but that one particular sequence is likely to cause a peak in fatigue, allowing targeting of that sequence for further investigation and risk reduction;

- They can help identify particular **features of work patterns**, shifts or sequences which are especially likely to contribute to fatigue. This allows alternative fatigue reduction measures to be considered, and the likely effects on fatigue estimated before making any change - duty holders can use some tools to "optioneer", estimating the likely relative merits of for instance shortening shifts or providing extra or longer breaks;

- They can be used as part of **incident investigation** to help indicate whether fatigue may have been a contributory factor;

- Some fatigue risk assessment tools can be incorporated into **resource planning and monitoring software**, with the aim of helping organisations to devise fatigue-friendly rosters more easily and quickly from the outset. Some packages can be tailored to automatically monitor deviations from any defined company limits or guidelines (e.g. "less than 12 hours between duties" etc), both in "planned" and "actual" working patterns, making it easier to identify likely fatigue hotspots in order to investigate causes. Such packages are often used to identify staff with the appropriate, in-date competencies. They can also help managers make more informed decisions when considering overtime, extra duties, or shift exchange, by identifying staff whose working pattern over previous days/weeks means they may, on average, be less likely to be fatigued. However, it is vital that the outputs of such tools are not used in isolation for such decisions, as they only provide a general indication of likely fatigue and cannot take into account the many individual factors which can make an individual more or less fatigued than a bio-mathematical model may suggest. Some of these limitations are outlined below.

7.10 It is imperative to understand that bio-mathematical fatigue models and the fatigue assessment tools which use them have **significant limitations,** so there are several important notes of caution to bear in mind when considering using fatigue assessment tools and their outputs:

- Although bio-mathematical fatigue models and tools based on them can provide a useful indication of the level of fatigue which staff are likely to encounter, it is important that staff using them and interpreting their output are aware of the particular tool's **assumptions and limitations**;

- The models used in fatigue assessment tools do not "know" the level of fatigue staff will encounter when working a particular pattern, they merely make a **mathematical prediction**;

- When using a fatigue assessment tool it is important to understand and **think carefully about what the output actually means** rather than to blindly assume it produces an authoritative "satisfactory / unsatisfactory" decision. Taking as an example the Health and Safety Executive Fatigue and Risk Index tool (see HSE report RR446 for more detail) :

  - The Fatigue Index represents the estimated probability, expressed as a percentage, that a person working the pattern concerned will feel very fatigued at some point during the shift. A fatigue index of 10 therefore means that on average, 1 in 10 people working that pattern are likely to feel very tired. Although this is clearly more desirable than a fatigue index of 50 (meaning half the people are likely to feel very tired), it does not mean that a fatigue index of 10 is risk-free. But it does indicate which of the two working patterns is likely to be less tiring

- Similarly, the Risk Index gives an estimate of the relative risk of an incident compared to a reference pattern of 12-hour shifts on a typical two-day, two-night, four-off schedule. A risk index of 1.4 therefore means that there is an estimated 40% increase in risk compared to the reference pattern - better than a risk index of 2.0 (double the risk), but not risk-free. The tool helps **compare** the likely relative merits of working patterns rather than giving any "acceptable / unacceptable" decision

- Fatigue assessment tools **cannot model all the factors which affect fatigue**. People naturally vary in how much sleep they need, how easily they are able to adapt their sleeping patterns, whether they are more alert earlier or later in the day, and their personal circumstances. Every work situation brings its own unique combination of individual circumstances which can affect fatigue including age, health, personality, family, domestic and social circumstances, personal preferences and detailed work demands. Models used in fatigue assessment tools cannot account for all these variables and therefore cannot perfectly predict fatigue. The best they can do is give a prediction of likely fatigue;

- In particular, many models assume that staff will be able to get **sufficient, quality sleep during off-duty periods**. They do not take into account that staff may not have been able (or in some cases willing) to get the "assumed" amount of quality sleep before presenting themselves for work. Hence the importance of devising fatigue-friendly working patterns which encourage sufficient good quality sleep, and of personal accountability, education in sleep hygiene, and a "just" culture which encourages openness about fatigue problems;

- For all the above reasons, organisations should not blindly trust the outputs of such tools but should consider their output **alongside other information** on staff fatigue, including consistency with good fatigue management practices, and staff views on how tiring they actually find particular work patterns. Blindly trusting the outputs of fatigue models in isolation can result in decisions which either promote fatigue or place un-necessary limitations on work;

- Organisations should **treat any recommended "thresholds" with caution.** They may be useful as a rough comparator, for giving a general indication of how fatiguing a pattern is likely to be, but should not be used as a hard and fast threshold with "satisfactory" below and "unsatisfactory" above. Considering again HSE's FRI, in 2008 the Health & Safety Laboratory (HSL) produced a report "*Evaluation of the UK Rail Sector Initial Fatigue & Risk Index Thresholds: Identifying Good Practice*" which referred to "indicative threshold" values for the FRI fatigue and risk index outputs. These values reflect what was found to be achievable by the great majority of the rail companies surveyed at the time, rather than a definitive, universal interpretation of good fatigue control. Organisations should not assume that just because FRI analysis of their working patterns produces FRI values below the 2008 indicative thresholds that they need do no more - it will often be reasonably practicable to improve fatigue controls further.

7.11 Recent reviews of fatigue models and tools and their uses (ITSR, 2010; CASA 2010; Dawson et al, 2011) emphasise their limitations, and that they are only appropriate as **one element in a wider fatigue risk management system**. ORR does not compel the use of such tools, and does not endorse or advocate the use of any one tool over another. All have their benefits and limitations, and each organisation should decide for itself which tool best suits their requirements.

7.12 Overall then, although fatigue assessment tools are a **useful aid to making decisions** about fatigue, it is important to take into account any assumptions and limitations of the specific tool, and to think carefully about the meaning of their output. Such tools are not a substitute for a comprehensive FRMS, rather they are just one useful component.

8. Appendix B. Travel time

8.1 Time spent **travelling to and from work** does not provide rest in the same way as time spent at home. This is especially true of staff who drive themselves to, from or at work since, to state the obvious, driving provides no opportunity for sleep. Travelling as a passenger in a car, van, taxi or by public transport prevents a tired employee endangering other road users, but does not allow the same opportunities for sleep and rest as a bed at home or in lodgings, with consequences for subsequent fatigue.

8.2 An estimated 25 to 33% of **fatal and serious UK road traffic accidents** involve drivers who are on the road for work related reasons (Health & Safety Executive Work-related Road Safety Task Group, 2001). 17% of UK road traffic collisions causing injury or death on major roads are sleep related (Dept for Transport 2010a p19).

8.3 The **courts have taken a serious view** of employers not adequately controlling fatigue in staff driving home after work. For instance, in 2002 a worker for a potato firm driving home after a third consecutive long night shift crashed and died when his van drifted into the path of an oncoming lorry. The firm had failed to monitor and control the hours employees worked, and the deceased was thought to be suffering from chronic fatigue causing him to fall asleep at the wheel. The firm was prosecuted under the Health and Safety at Work etc Act 1974, and convicted of failing to ensure the health and safety of their employee and the public.

8.4 **How long people have been awake** is a key consideration - long journeys to work mean staff may well become unfit to work safely later in the shift, and unfit to drive home safely. Employers are recommended to consider the likely effects of travel times when recruiting staff, especially into safety critical roles. Shift workers are more likely to be tired on the drive to and from work than non-shift workers. In particular, sleepiness has been reported to be higher on the drive home after a night shift than from all other shifts. Factors found to contribute to the risk of falling asleep are previous sleep periods of less than six hours, and travel time over 35 minutes (RSSB T699 p36), though the significance of travel time will obviously vary depending on the shift length.

8.5 Travel time can be a significant issue when considered in conjunction with time spent at work "on site". A recent survey found that eight per cent of freight train drivers reported a journey to their booking on point of more than an hour, and that seven percent of contract trackworkers travelled more than two hours to work (RSSB T699 p13 & p24). The same study found that levels of fatigue reported at the start of a shift were correlated with the amount of time spent travelling to work, with increased fatigue from longer travel times.

8.6 Travel time can contribute significantly to fatigue, and can in turn affect

- the safety of the **rail transport system**, if the person's work is "safety critical" under ROGS

- staff **personal safety** at work e.g. a trackworker working near moving trains or construction plant, working with dangerous machinery, or working at height, and when driving to / from or at work, or

- the safety of **other road users**

8.7 Fatigue management systems should therefore include arrangements for **assessing and controlling risks from travel time**. Assuming 8 hours for sleep, an hour for waking, washing, breakfast etc and a minimum of an hour on returning to home/ lodgings for a meal, shower, contacting family and winding down to get some quality sleep, this leaves an absolute maximum of 14 hours between leaving home/lodgings and returning. This time has to cover not only work on site but the associated travel there and back. This "worst case scenario" of 14 hours door-to-door time is used by some companies as the maximum which may be considered on an exceptional basis with extra fatigue controls in place, but even for a single shift, especially a night shift, it is likely to lead to excessive fatigue. Although better than completely uncontrolled door-to-door travel time arrangements, such a schedule is nevertheless likely to be very fatiguing if carried out repeatedly, and is very likely to make staff unfit, for instance, to drive after their shift. Extra fatigue control measures are very likely to be needed, which may include for instance

- avoiding the need for safety critical work towards the end of the shift

- extra supervision towards the end of the shift

- extra breaks to help relieve fatigue

- provision of lodgings near the work site to avoid long travel times, and adequate arrangements to ensure their use

- provision of safe transport to and from the place of rest, for instance taxi or provision of a nominated, adequately rested driver

8.8 Employers should consider their wider duties to assess and control **work-related road risks** in their operation, taking into account guidance published by the Health & Safety Executive and other agencies - see "Driving at work", (available from the health and Safety Executive website at *www.hse.gov.uk/pubns/indg382.pdf*) . This guidance points out that health and safety law does not apply to commuting, unless the employee is travelling from their home to a location which is not their usual place of work. However, time spent travelling, including commuting, can contribute to fatigue and so should be considered in assessments of fatigue. Some fatigue assessment tools allow commute times to be taken into account in overall assessments of fatigue risk.

8.9 Fatigue risks from travelling can only be properly assessed if adequate information is collected. For staff who work at fixed sites and sleep at home this should be straightforward. For staff whose work site varies, and/or who stay in lodgings when working away from home (for instance infrastructure maintenance staff working in possessions) likely fatigue risks can still be assessed if the following information is collected – this can be incorporated into the **booking-on procedure** at the site access point.

- Location (e.g. postcode / town of lodgings) where they slept before the shift

- Time they left the above address

- Method of travel to site and name of driver

- Shift start time

- Shift end time

- Location (e.g. postcode / town of lodgings) where they will sleep after this shift

- Method of travel back from site and name of driver

- Time of arrival at sleeping location

8.10 Selection processes for **staff in control of booking on** and site access arrangements should ensure they have the necessary assertiveness and communication skills to effectively challenge work/access by staff who they believe are, or could become, unduly fatigued due to travel time or other issues. They should be provided with clear instructions on the action to take if they believe travel time rules have been or are likely to be exceeded.

8.11 Employers and others with responsibilities to manage staff fatigue should make reasonable efforts to ensure that the travelling and sleeping arrangements are realistic and will not give rise to excessive fatigue. For instance, provided that staff are required to record their sleeping locations (postcode / town), free internet journey-planning sites can easily be used to assess **whether journeys are feasible** in the claimed time.

8.12 Depending on the possible consequences of fatigue, duty holders should where reasonably practicable expect their **contractors to provide information** on staff travel and lodging arrangements before awarding contracts. Failing to honestly consider this beforehand can lead to contractors being awarded work without building in sufficient allowance for staff travel time and associated costs, and lodging costs, indirectly encouraging contractors and their staff to be less than honest about their real travel and lodging arrangements. Responsible clients and principal contractors will have supply chain management arrangements which source competent labour locally in the first instance, to minimise costs and associated risks from staff having to travel to and from the work.

8.13 Some general considerations in managing **work related road risk** are outlined in Fig 4 below, from HSE Research Report RR018 "*Management of work related road safety*", available on HSE's website at www.hse.gov.uk/research/rrpdf/**rr018**.pdf . The report also links to case studies illustrating how the principles may be applied in practice. Useful information can also be found on the website of the Occupational Road Safety Alliance at www.orsa.org.uk/index.htm

Fig 4.

Model of Occupational Road Safety Risk Management

Success factors:	Initial Risk Assessment	Barriers:
• Senior management commitment.	1) Discussions with drivers, managers, professionals, fleet managers	• Time requirement.
• Employee involvement in risk assessment, procedure development, and auditing.	types of vehicles	• Appropriate guidance.
• Raising awareness among managers and employees. Changing employees' attitudes.	types of journeys purpose of journeys nature of drivers	• Lack of awareness due to inaccurate data. • Attitudes to road safety risk and driver behaviour.
• Accurate data collection to measure improvement.	2) Review of accident / incident history	

Policy Development

- List of procedures and reporting
- Clarification of responsibilities
- User friendly and transportable
- Developed in consultation with employees

Control Measures

- Need identified through risk assessment.
- Involve employees in development of interventions.
- Tailor to needs of individuals (where possible).

Recruitment and selection	Medical screening	Accident and incident recording	Accident Incident analysis and investigation	Near miss reporting and analysis
Journey scheduling	Alternative means of transport	Bonus and incentive schemes	Risk awareness and education	Awareness campaigns
Training	Guidance notes and documents	Maintenance	Ergonomic checks and car specifications	Driver assessments

Audit and evaluation

- Evaluation of procedure
- Procedure review

Overall Review

- Near misses
- Incident statistic
- Risk assessment review
- Policy Review

9. Appendix C. Features of a positive safety culture

9.1 A positive safety culture can be summarised as a reporting, just, flexible, learning culture. Creating such a culture in an organisation is not a quick, one-off activity, but requires the sustained, consistent implementation of risk management principles in a comprehensive health and safety management system. Some features of such a culture are summarised below, but for more detailed information see for instance James Reason's 1997 book "*Managing the Risks of Organisational Accidents*".

A reporting culture

9.2 In a reporting culture, people are on the lookout for, and routinely report, errors, near misses, unsafe conditions & any other safety concerns. Mutual trust is essential. Reporting systems for incidents, near-misses and concerns are easy to use, and give rapid, useful and accessible feedback to potential reporters.

A just culture

9.3 A "just" culture treats people such that the majority believe justice will usually be dispensed – the system is seen as fair. A "just" culture is part-way between a "blame" culture (where fear prevents open risk communication) and a "no-blame" culture (where sloppy practices and negligence tend to creep in). It is important to gain agreement and trust from staff on fair disciplinary systems.   Safe behaviours are rewarded. Truly egregious (flagrant / reprehensible) unsafe acts are punished, to boost the perception of justice, as "cowboys" are seen to get their come-uppance.

9.4 When considering the culpability of an individual for an unsafe behaviour, it can be helpful to consider the "Substitution test" - would a well motivated, equally competent and comparably qualified individual in the same circumstances, without the benefit of hindsight, have behaved differently? If not, blaming the individual may divert attention from underlying organisational weaknesses.

A flexible culture

9.5 In a flexible culture, decisions are made by the people best equipped to make them, irrespective of their position or grade. The identity of decision makers is decided on the basis of functional skill. Although control is usually centralised by means of adherence to well-tried Standard Operating Procedures, a flexible culture recognises that blind rigidity in following "rules" carries risk, because it is impossible to devise rules covering every situation. Unexpected or fast-developing circumstances are best controlled by staff closer to, and more familiar with, a changing situation.

9.6 A flexible culture recognises that first-line supervisors' competence is critical, since they are placed in control at critical times when the value of their experience and judgement is vital. This requires a common

understanding of decision premises and assumptions, so that decentralised control is consistent with overall central expectations, and so that there are no major "surprises" in staff behaviour which could exacerbate the situation.

9.7 Diverse work groups are encouraged, to bring more perspectives and a greater total span of experience, insight and flexibility than a homogenous group.

9.8 All rules are kept under constant review, and modified where experience shows improvement is needed, following a modification process which involves rule users throughout, to ensure that rules are practicable and will actually control risk.

A learning culture

9.9 In a learning culture the organisation facilitates staff learning and continuously transforms itself, with individual and organisational learning seen as critical to the organisation's survival & development. Good competence management systems (see Railway Safety Publication 1 *"Managing Staff Competence"*) are a prerequisite. There is a recognition that the organisation doesn't operate in a static environment - new processes, pressures and incidents arise, and reports generated by a reporting culture are only useful if the organisation learns from them.

9.10 A learning culture propagates information about improvements in risk control upwards, downwards and across management structures. Processes exist to encourage staff participation, and staff involvement leads to increased competence and confidence amongst individuals in their ability to change outcomes. This in turn increases their motivation to participate further. Involving staff is recognised as key.

(summarised from James Reason, 1997 "Managing the Risks of Organisational Accidents")

10. Appendix D. Fatigue reporting

10.1 A lack of fatigue reports is not evidence that fatigue is not a problem – it could be evidence that effective fatigue reporting processes are not in place (Jackson, 2008*).* Rail organisations need to encourage the **pro-active reporting of fatigue and its precursors** including for example long travel times before a shift; noisy lodgings; over-running work; late notice changes etc. Unless the organisation already has an established, effective, well-used safety-concern reporting system which captures pre-cursors to fatigue, it may be necessary to introduce a dedicated fatigue reporting system. A dedicated fatigue reporting system may also raise the profile of fatigue risks amongst staff and emphasise that management are serious about tackling genuine fatigue concerns.

10.2 A staff **Fatigue Report Form (FRF) system** provides a formal method for collecting data on fatigue and its likely causes, and allows staff to suggest possible solutions. It allows staff to report fatigue-related incidents, errors, behaviours and other concerns. An FRF system can collect information on factors which may have contributed to fatigue, for instance workload, travel arrangements, domestic circumstances and so on. Fatigue report forms should therefore include space for staff to suggest corrective actions.

10.3 A fatigue reporting system should be supported by a system for **managing and responding to reports**. Staff may not bother reporting unless they receive feedback on reports they submit, confirming that reports are taken seriously and considered - reasons for any actions taken or not taken as a result of their report should be fed back to reporters.

10.4 The FRF system can help to build a picture of fatigue in the operation, and should help identify any problem shifts / locations / roles / routes and so on, and can help show any trends over time. This helps ensure that efforts to reduce fatigue are targeted where they are most needed.

10.5 To encourage reporting, forms should be easily accessible (e.g. copies kept on hand in all train cabs, depots etc), should be **easy and quick** to complete, usually no more than one page long. They should incorporate both "tick box" questions to allow categorisation and analysis, and free text space to allow descriptions of concerns and possible solutions.

10.6 Careful consideration should be given to **confidentiality**, with the option of de-identifying reporters.

10.7 Some of the **types of information** organisations may wish to include on fatigue report forms are illustrated in Figure 5 overleaf – these are some suggestions only, and duty holders should tailor the information collected so it is appropriate to their needs and the degree of risk.

Figure 5. Possible information to consider for fatigue report forms

This fatigue report is in relation to (tick one)
:
      Unable to attend work due to fatigue
      Stood down due to fatigue
      An incident
      A general fatigue concern

Name and role? (company to consider confidentiality issues)

Contact details

Date of incident or concern

Time

Location

Physical signs
      No physical signs noted
      Rubbing eyes
      Yawning
      Frequent blinking
      Staring blankly
      Long blinks
      Difficulty keeping eyes open
      Head nodding

Description of incident or concern

Cognitive (mental) signs
      No cognitive signs noted
      Impaired attention
      Impaired memory
      Negative mood
      Reduced communication
      Impaired problem solving
      Increased risk taking
      Impaired situation awareness
      Other

Activity at time of event / concern
      Journey to work
      Work activity (specify/multiple choice)
      Journey back from work
      Etc

How did you feel? (Samn-Perrelli scale)
      1.Fully alert, wide awake
      2. Very lively, responsive, but not at peak
      3. OK, somewhat fresh
      4. A little tired, less than fresh
      5. Moderately tired, let down
      6. Extremely tired, very difficult to concentrate
      7. Completely exhausted

Factors which may have contributed
      Multiple consecutive duties
      Variation in duty timing
      Quality of sleep (home? Lodging?)
      Start time
      Finish time
      Travel to / from work (mode of travel?
      Location e.g. postcodes of
      home/lodging//work site)?
      Insufficient rest time
      Roster disruption

Suggestions for fatigue reduction (corrective actions)?

Long turn
Workload – overload
Workload – underload
Health
Home issues – rest
Home or personal issues – other
Long term fatigue
Other - specify

10.8 It may be relatively simple to identify any "problem" shifts or work patterns / features by for instance asking all staff to take a few seconds to anonymously complete a **fatigue rating scale** before / during / at the end of a duty, with simple identification of the depot / route / link etc, for immediate deposit in a box in the cab/depot (e.g. the 7-point Samn-Perrelli scale outlined in the "How did you feel?" section of Figure 5 above). In this way a large amount of information can be easily and cheaply collected on perceived fatigue in the whole of the operation. Such an approach obviously requires honesty in its use.

10.9 Information about **sleep before a particular duty and the duty itself**, could be collected using a format similar to that illustrated in Figures 6a and 6b below, adapted to suit the company's purposes (from sleep and duty diary in RSSB report T699 Appendix A).

SLEEP PRIOR TO DUTY

SLEEP PRIOR TO DUTY

Please indicate the following times of your sleep period:

IN BED AT	ASLEEP AT	AWOKE AT	GOT UP AT
hrs mins	hrs mins	hrs mins	hrs mins
:	:	:	:

Where did you sleep?

Home ◯   Lodgings/Hotel ◯   Other ◯

After your final awakening, how much more sleep did you require? *(circle one number)*

no more   1 2 3 4 5   considerably more

Within the sleep period, please estimate the:

TOTAL NUMBER OF AWAKENINGS	TOTAL DURATION OF AWAKENINGS
	hrs mins
	:

Please rate the quality of your sleep:
(circle one number)

Sleep quality

extremely good   1 2 3 4 5 6 7   extremely poor

Was your sleep disturbed by any of the following factors? *(tick all that apply)*

◯ Thoughts on mind
◯ Aches/pains/physical discomfort
◯ Noise

◯ Light
◯ Temperature
◯ Not tired

◯ Other
Please specify:

Was the time available for sleep restricted by any of the following commitments? *(tick all that apply)*

◯ Family/social
◯ Work

◯ Hobbies/DIY
◯ Other employment

◯ Other
Please specify:

NAPS PRIOR TO DUTY

If you take any naps/short sleeps prior to your next duty, please record the start time and duration of each nap:

	1st NAP hrs mins	2nd NAP hrs mins
START TIME	:	:
DURATION	:	:

Please add any additional information about your sleep or the following shift here:

Fig 6a. Sleep prior to duty information

DUTY

Date duty started: ___ day ___ mon ___ year ___ / ___ / ___

To what extent do you feel you have recovered from your last duty/run of duties?

completely 1 2 3 4 5 6 7 not at all

	PLANNED		ACTUAL	
	hrs	mins	hrs	mins
Duty START time	:		:	
Duty END time	:		:	

How much overtime did you work?   hrs : mins

Was this originally a rest day?   NO ◯   YES ◯

If 'YES', did you volunteer to work today?   NO ◯   YES ◯

What time did you leave home prior to this duty?   hrs : mins

Please indicate the type of duty

DRIVING/ SHUNTING ◯   SPARE ◯   DRIVING UNDER SUPERVISION ◯   OTHER * ◯

* If 'OTHER', please specify

_____

If you were driving/shunting, please complete the following:

Approx. how much time did you spend driving/shunting during this period?   hrs ___

What was the longest continuous period of time spent in the cab?   hrs : mins

Were there occasions when you experienced 'heavy eyelids' while driving/shunting?   NO ◯   YES ◯

If 'YES', for how long did this last?   mins ___

** MENTAL FATIGUE RATING

1= fully alert, wide awake;
2= very lively, responsive, but not at peak;
3= okay, somewhat fresh;
4= a little tired, less than fresh;
5= moderately tired, let down;
6= extremely tired, very difficult to concentrate;
7= completely exhausted, unable to function effectively.

How many breaks did you have during the duty period?   SCHEDULED ___   UNSCHEDULED# ___

	SCHEDULED		UNSCHEDULED#	
	hrs	mins	hrs	mins
What was the duration of the longest break?	:		:	
What was the total duration of all breaks?	:		:	

Consider the longest period of duty without a break (scheduled or unscheduled#)

What was its duration?   hrs : mins

How much of this time was spent driving/shunting?   hrs : mins

Only include unscheduled breaks when you are not required to do any work, and which last for 10 minutes or more.

Did you nap during the duty period?   NO ◯   YES ◯

If 'YES', what was the total duration of all your naps?   mins ___

If 'NO', would you have napped if you had the opportunity?   NO ◯   YES ◯

What was your level of fatigue at the START of the duty period? (circle one number)   Mental fatigue rating**   1 2 3 4 5 6 7

What was your level of fatigue at the VERY END of the duty period? (circle one number)   Mental fatigue rating**   1 2 3 4 5 6 7

Was there a period during this duty when you felt particularly fatigued?   NO ◯   YES ◯

If 'YES', record the approx. start and end times

	START TIME		END TIME	
	hrs	mins	hrs	mins
	:		:	

what was your level of fatigue at that time? (circle one number)   Mental fatigue rating**   1 2 3 4 5 6 7

Considering the duty period as a whole, how mentally tiring was it?

Not at all tiring ◯   A little tiring ◯   Moderately tiring ◯   Very tiring ◯   Extremely tiring ◯

Fig 6b. Duty information

11. Appendix E. Definitions

11.1 In this guidance:

Change to existing working patterns refers to the working pattern of people undertaking safety critical work, and includes:

- increases in daily or weekly hours of work, increases in the number of consecutive shifts worked before a complete day's rest is taken, reductions in the length or frequency of intervals before (and breaks during) **periods of duty**, or changes in the timing of breaks taken during **periods of duty**;

- changes in shift patterns, such as a change from **fixed shifts** to **rotating shifts**, a change in the frequency with which shifts rotate, increased variability in start and finish times, or the introduction of a **split-shift** system; or

- other changes in the organisation of working time that may affect performance, such as an increase in the amount of time spent carrying out safety critical work (as opposed to other activities) or in the amount of time spent carrying out safety critical work requiring continuous vigilance (as opposed to other types of safety critical work);

Exceedance means exceeding or other non-compliance with a standard or limit.

Existing limits means:

- for operations already in existence, the limits already established in that operation; and

- for new operations, limits that do not exceed the limits applying to people carrying out the same or similar work in comparable established operations;

Fatigue means a state of perceived weariness that can result from prolonged working, heavy workload, insufficient rest and inadequate sleep. It involves a general feeling of tiredness, resulting in a reduced ability to perform work effectively.

Fixed shifts means that safety critical workers work the same shift on a permanent basis.

Rotating shifts means that safety critical workers work a pattern of changing shifts.

On call means waiting to respond to an emergency call out or answering a query from people working in the field.

Day or **early-morning shift** means a shift that usually starts around 05:00 to 08:00 and ends around 14:00 to 18:00.

Night shift means a shift that usually starts around 22:00 to 02:00 and ends around 05:00 to 08:00.

Split shift means one duty period that has two distinct work periods separated by a long break.

Period of duty means a period of duty, which consists wholly, or partly, of safety critical work as defined in regulation 23 of the Regulations, including overtime and meal or rest breaks. Where a **split-shift** system is in operation, the total length of time between the start of the first and the end of the last part of that **split shift** counts as one **period of duty** for the purpose of this guidance.

11.2 The definitions in this guidance and related expressions shall be construed accordingly. Other defined terms are detailed in the ROGS Regulations.

12. Appendix F. An FRMS Checklist

12.1 Some features of a Fatigue Risk Management System (FRMS) are summarised in the table below which may be useful as a checklist when organisations are considering the adequacy of their fatigue management arrangements. The FRMS should be proportionate to the size and complexity of the operation and the likely risks from fatigue – it is recognised that not all items in the checklist will be appropriate for all organisations.

No.	Para in this guidance	Issue	Company FRMS / SMS ref?	Comments?
		General		
1	5.7	Is the FRMS integrated with wider Safety Management Systems?		
2	5.8	Does the FRMS identify & draw together the preventive & protective measures which help control fatigue? Does a document provide "signposting" to these various fatigue controls?		
3	5.9	Is the FRMS proportionate to the organisation's nature, size, and complexity, and likely fatigue risk?		
		Policy		
4	5.16	Is there a policy on managing fatigue risks which recognises accident, ill health and cost consequences?		
5	5.18	Is there senior management commitment and leadership on managing fatigue risks?		

6	5.19	Is there willingness to commit adequate resources to managing fatigue risk? On an ongoing rather than "one-off" basis?		
7	5.20 to 5.25	Is there commitment to a collaborative fatigue approach, involving both management & staff? Are expectations on staff and trade union roles outlined?		
8	5.26 App C	Are any organisational / local cultural issues impeding fatigue controls? How "just" is the culture towards fatigue?		
9	5.27	Do senior management recognise the links between staff resources, workload, fatigue & stress?		
10	5.28	Does the policy commit to reviewing the FRMS periodically, and if there is reason to believe improvement is needed?		
		Organising		
11	5.30	Are roles & responsibilities for managing fatigue suitably allocated?		
12	5.31 5.45 to 5.47	Has the organisation considered the benefits of a joint fatigue management group and / or fatigue champion?		
13	5.30 Section 6	If ROGS Safety Critical work is done, are arrangements consistent with the "ROGS 9 stages" guidance?	.	

14	5.32 App A	Does the FRMS outline how/when/by whom fatigue risk assessments should be done? Are expectations on any fatigue assessment tools addressed? Are root causes sought?		
15	5.33	Are there arrangements to assess any effects of staffing levels on fatigue risks?		
16	5.33	Do staff feel able to cope with demands?		
17	5.33	Are minimum staffing levels specified for safety critical work?		
18	5.33	Are there adequate contingency arrangements for foreseeable abnormal conditions?		
19	5.33	Are all normal working periods covered, without reliance on voluntary overtime?		
20	5.34	Do pay structures inadvertently encourage fatigue?		
21	5.35	Are there adequate arrangements within the organisation for co-operation on fatigue (e.g.a joint fatigue group)?		
22	5.35 5.24	Are staff terms and conditions "fatigue-friendly?" If not, how is this being addressed, including where necessary by trade unions?		
23	5.36	Are there adequate arrangements for co-operating with other duty holders on managing fatigue risk?		

24	5.37 8.12	Do contract award and monitoring arrangements adequately consider fatigue? Are fatigue management expectations made adequately clear to contractors? Do arrangements minimise any incentive for contractors to operate with high or unmanaged fatigue?		
25	5.38 App D App C	Are there easy-to-use fatigue reporting channels and methods? How "just" is the culture, to encourage open reporting?		
26	5.39	Are there adequate competence management arrangements for fatigue, especially for managers, supervisors & rostering staff?		
27	5.40	Is there an adequate fatigue education and awareness programme?		
28	5.41	Is refresher training/education on fatigue provided, proportionate to risk, rather than as a "once only" activity?		
29	5.43	Are there adequate processes to help detect, correct & mitigate errors caused by fatigue? Is appropriate use made of technology? Has the role of peoples' non-technical skills been considered?		
30	5.44 5.68	Are there adequate controls for overtime?		
31	5.44 5.67	Are there adequate controls for shift exchange?		
32	5.44 5.60 App B	Are there adequate controls for travel time?		

33	5.44 5.63	Are there adequate controls for on-call duty?		
		Planning & Implementing		
34	5.51	Does the organisation know "where we are now" on fatigue?		
35	5.51	Has the organisation compared current fatigue against suitable benchmarks? ("where we want to be"). Is the aim bare legal compliance or, for instance, excellence?		
36	5.52 5.53	Are there procedures for fatigue improvement planning? ("how do we get there") ? Are suitable fatigue management plans in place, with objectives for developing, maintaining & improving controls?		
37	5.54 to 5.57 App A	Are there suitable processes for designing work patterns & rosters? Are the staff who design patterns adequately aware of good fatigue management practice?		
38	5.55 5.24 6.14 to 6.61 for safety critical work	Are company working pattern rules / limits / standards consistent with good fatigue management practices?		
39	5.56 5.57 App A	If a fatigue assessment tool is used, are the assumptions and limitations appreciated?		
40	5.57 App A	Are staff's experiences of fatigue sought and taken into account? Overall, will planned patterns control fatigue so far as reasonably practicable?		

41	5.59	Are fatigue risks adequately considered during selection and any subsequent medical assessments (sleep disorder screening etc)?		
42	5.60 App B	Are work start and end times recorded for all relevant staff? Are travel times at/to/from work considered?		
43	5.62 5.61	Are staff required to declare any "second jobs"? Are potential fatigue implications assessed & controlled?		
44	5.63	Are fatigue risks taken into account in on-call arrangements? Is on-call duty recorded and monitored?		
45	5.64 to 5.66	Are fitness for duty check arrangements adequate? Are staff trained in the signs of fatigue? Does the company culture encourage honesty?		
46	5.67	Are there effective arrangements for controlling fatigue risks from shift exchange? Is there a prior fatigue assessment by a nominated manager?		
47	5.68	Are there effective arrangements for managing fatigue risks from overtime? Is there a prior fatigue assessment by a nominated manager?		
		Measuring and monitoring performance		

48	5.70 5.71	Does the organisation minimise deviations from planned working patterns? Are there procedures to measure & monitor fatigue from ACTUAL as well as planned work patterns?		
49	5.72	Are deviations from good fatigue management practices monitored (including e.g. Section 6 Stage 2)?		
50	5.73 5.74 App A	Is a fatigue assessment tool used as part of roster risk assessments, and on samples of actual hours worked?		
51	5.75 App D App C	Are there appropriate non-punitive fatigue reporting arrangements? Are they easy to use? Does company culture encourage open reporting?		
52	5.76 App D	Are staff's experiences of fatigue sought in a proportionate way to help identify any fatiguing patterns/features/routes? e.g. staff fatigue survey in higher risk operations? During day-to-day management contact?		
53	5.77	Do incident investigation procedures consider the possibility of fatigue? Are there suitable prompts & guidance on deviations from good practice, fatigue assessment tools, and asking people?		
54	5.78	Are trends in shift exchange monitored?		
55	5.79	Are trends in overtime monitored? Are rosters evolved to reduce reliance on overtime?		

56	5.80	Are sickness absence rates monitored? Is sickness absence contributing to fatigue? Is fatigue contributing to sickness absence?		
57	5.81 5.82	Are other existing data sources used to help assess risks from fatigue e.g. near misses, train delays, irregular working? For particular concerns e.g. Actigraphs? Sleep logbooks?		
		Audit and Review		
58	5.84 to 5.85 6.88 to 6.89	Is there a system for periodically evaluating the overall effectiveness of the FRMS? And to trigger a review if there is reason to doubt its effectiveness e.g. fatigue-related incidents, improvements in good practice, results of fatigue surveys?		
59	5.85	Are metrics / key performance indicators for established for fatigue? Is progress against them monitored?		
60	5.86	Is there periodic independent (rather than internal) review of fatigue risk controls?		
61	5.87	Are the findings of audit & review processes fed back into the FRMS to improve controls?		
62	5.88	Are the findings from audits and reviews of fatigue, and improvements in the FRMS publicised amongst staff to ensure understanding and encourage further involvement?		

13. Appendix G. Further information

Human performance, shift work and fatigue

Managing shift work – health and safety guidance HSG256, HSE Books2006, ISBN 0 7176 6197 0 (also available for free download via HSE's website)

Reducing error and influencing behaviour, HSG48 (Second edition) HSE Books 1999 ISBN 0 7176 2452 8

Belenky, G., Westensen, N.J, Thorne, D.R., Thomas, M.L., Sing, H.C., Redmond, D.P., Russo, M.B. and Balkin, T.J. 2003. Patterns of performance degradation using sleep restriction and subsequent recovery: a sleep dose-response study. *Journal of Sleep Research* 12; 1-12

British Snoring and Sleep Apnoea Association website (includes questionnaires to help identify the risk of sleep disordered breathing) at www.britishsnoring.co.uk/berlin_questionnaire.php . For other screening tools see American Sleep Apnea Association website at www.sleepapnea.org/diagnosis-and-treatment/test-yourself.html

Dembe. A.B., Erickson, R., Delbos, S. and Banks, S., 2005. The impact of overtime and long work hours on occupational injuries and illnesses: new evidence from the United States. *Occupational and Environmental Medicine* 62, 588-597

Driscoll, R.T., Grunstein, R.R. and Rogers, N.L. , 2007. A systematic review of the neurobehavioural and physiological effects of shiftwork systems. *Sleep Medicine Reviews* 11, 179-194

Folkard, S., Lombardi, D.A. and Tucker, P.T. Shiftwork: Safety, sleepiness and sleep. *Industrial Health* 43; 20-23, 2005

Horne, J. 2006. *Sleepfaring – A journey through the science of sleep.* Oxford University Press, Oxford.

Monk TH and Folkard S, *Making shiftwork tolerable*, Taylor and Francis 1992 ISBN 0850668220.

Moore-Ede M, *The 24-hour society: The risks, costs and challenges of a world that never stops*, Piatkus Books 1993 ISBN 0749912553.

van Dongen, H.P., Maislin, G., Mullington, J.M. and Dinges, D.F. 2003. The cumulative cost of additional wakefulness: dose-response effects on neurobehavioral functions and sleep physiology from chronic sleep restriction and total sleep deprivation. *Sleep* 2, 117-126

Fatigue Risk Management Systems

Department for Transport, 2010a. Road Safety Research Report No. 110. *Fatigue Risk Management Systems: A Review of the Literature*. Available at www.dft.gov.uk/pgr/roadsafety/research/rsrr/theme3/literaturereview/

Department for Transport, 2010b. Road Safety Research Report No. 120. *Interviews with operators, regulators and researchers with experience of implementing Fatigue Risk Management Systems.* Available at www.dft.gov.uk/pgr/roadsafety/research/rsrr/theme3/literaturereview/

Jackson, P. 2008. Designing a Company Fatigue Reporting System. Presentation by Clockwork Research Ltd available at
www.faidsafe.com/.../03_How-to-design-Crew-Fatigue-Reporting-System_P._Jackson_08-1003.pdf

Developing and implementing a Fatigue Risk Management System – Fatigue Risk Management Systems for the Canadian Aviation Industry. Transport Canada, April 2007. Includes a useful fatigue toolbox. Available at www.tc.gc.ca/eng/civilaviation/standards/sms-frms-menu-634.htm

ICAO / IATA / IFALPA, 2011. *Fatigue Risk Management Systems – Implementation Guide for Operators,* 1st Edition, July 2011. International Civil Aviation Organisation / International Air Transport Association / International Federation of Air Line Pilots' Associations. Available at
www2.icao.int/en/FRMS2011/Pages/Documentation.aspx

U.S. Department of Transportation Federal Aviation Administration. Advisory Circular 120-103: *Fatigue Risk Management Systems for Aviation Safety. March 2010. Available at*
www.faa.gov/regulations_policies/advisory_circulars/index.cfm/go/document.information/documentID/3192
18

U.S. Department of Transportation Federal Aviation Administration. Information for Operators InFO 10017. *Fatigue Risk Management Plans (FRMP) for Part 121 Air Carriers.* Available at
www.faa.gov/other_visit/aviation_industry/airline_operators/airline_safety/info

Fatigue Risk Management Systems Forum. Organisations can learn from other organisations' practical experiences of managing fatigue risks from this web-based forum, set up to share experience and good practice on fatigue management. Current (2011) membership is primarily within the aviation sector, but the forum seeks members from Rail, Road, Health and other industries to share experiences and good practice in fatigue management. See website at www.frmsforum.org/

Risk assessment methods for shift work and fatigue

Validation and development of a method for assessing the risks arising from mental fatigue, CRR254 HSE Books 1999 ISBN 0 7176 1729 7 (also available on the HSE website at:
http://www.hse.gov.uk/research/crr_pdf/1999/crr99254.pdf).

Spencer MB, Robertson KA and Folkard S *The development of a fatigue/risk index for shiftworkers.* Research report 446 (2006). HSE Books (also available on HSE website at
http://www.hse.gov.uk/research/rrhtm/rr446.htm).

Health & Safety Laboratory, 2008. "Evaluation of the UK Rail Sector Initial Fatigue & Risk Index Thresholds: Identifying Good Practice" available from ORR's website at www.rail-reg.gov.uk/server/show/nav.1184

ITSR, 2010 (Independent Transport Safety Regulator of New South Wales, Australia). *Transport Safety Alert No 34 : Use of Bio-mathematical Models in Managing Risks of Human Fatigue in the Workplace.* Available at http://www.transportregulator.nsw.gov.au/rail/publications/tsas

CASA (Civil Aviation Safety Authority, Australia), 2010. *Biomathematical Fatigue Modelling in Civil Aviation Fatigue Risk Management – Application Guidance.* Available at www.casa.gov.au/wcmswr/_assets/.../fatigue/fatigue_modelling.pdf

Dawson, D., Noy, Y.I., Harma, M., Akerstedt, T. and Belenky, T. 2011. Modelling fatigue and the use of fatigue models in work settings. *Accident Analysis and Prevention* 43, 549-564

Samn, S.W. and Perelli, L.P. 1982. *Estimating aircrew fatigue: a technique with application to airlift operations.* USAF School of Aerospace Medicine Technical Report No. SAM-TR-82-21

Management of health and safety

Successful health and safety management, HSG65 (Second edition) HSE Books 1997 ISBN 0 7176 1276 7. Available free from HSE's website at www.hse.gov.uk/pubns/books/hsg65.htm

Management of health and safety at work: Management of Health and Safety at Work Regulations 1999: Approved Code of Practice and guidance, L21 (Second edition) HSE Books 2000 ISBN 0 7176 2488 9.

Developing and Maintaining Staff Competence. Office of Rail Regulation Railway Safety Publication 1. Available free from ORR's website at www.rail-reg.gov.uk/server/show/nav.2297

Reason, J. 1997. *Managing the Risks of Organisational Accidents*. Ashgate, Aldershot.

Working Time Regulations

Your guide to the Working Time Regulations, URN No: 06/1237A and 06/1237B; DTI 2006 (available from DTI's publications orderline Tel: 0870 150 2500 and on the DTI website at: www.dti.gov.uk/employment/employment-legislation/employment-guidance/page28978.html *and*

www.dti.gov.uk/employment/employment-legislation/employment-guidance/page28979.html

ORR Railway Guidance Document RGD-2004-16 "*Handling of rail enquiries and complaints under the Working Time Regulations 1998 (as amended)*", available from ORR's website at www.rail-reg.gov.uk/server/show/ConWebDoc.8630

Railway Safety and Standards Board (RSSB)

Fatigue Management – Good Practice Guide RS/504. (draft)

Further information on fatigue management including a number of resources to help individuals and their managers manage fatigue can be obtained from the RSSB website at www.rssb.co.uk/EXPERTISE/HF/Pages/HFTOOLSANDRESOURCES.aspx

GO/RC3561 *Recommendations for train movement – staff suitability and fitness requirements.* Appendix I provides useful guidance on Obstructive Sleep Apnoea and excessive daytime sleepiness.

RSSB Good practice leaflets '*Feeling Tired'* resources. Comprises a safety briefing presentation, trainers and trainees notes relating to the presentation, and a leaflet with key points and tips to help individuals manage fatigue.

Coping with Shift Work & Fatigue: A good practice guide for drivers. This guide to shift work and fatigue describes the important factors that affect sleep and performance at work and suggests ways that individuals can maximise alertness.

RSSB Research Report T059, *Human factors study of fatigue and shift work*. Available at
www.rssb.co.uk/SiteCollectionDocuments/pdf/reports/research/T059_rpt_final.pdf

RSSB Research Report T699, *Fatigue and shift work for freight locomotive drivers and contract trackworkers*. Available at www.rssb.co.uk/sitecollectiondocuments/pdf/reports/research/T699_rpt_final.pdf

Railway Industry Advisory Committee (RIAC)
Further information on fatigue and shift patterns can be obtained from on ORR's website at
www.rail-reg.gov.uk/server/show/nav.1174

Information on resourcing and staffing can be found in the RIAC Information Sheet "*People Resource Planning*" on ORR's website at www.rail-reg.gov.uk/server/show/nav.2020

Stress
Information on managing demands in order to control work related stress is available on HSE's website, in the "Demands" section of the *Stress Management Standards* at
www.hse.gov.uk/stress/standards/demands.htm

Technological approaches to detecting fatigue

Balkin, T.J., Horrey, W.J., Graeber, R.C., Czeisler, C.A. and Dinges, D.F. 2011. The challenges and opportunities of technological approaches to fatigue management. *Accident Analysis and Prevention* 43, 565-572

Health effects of shiftwork

Costa G. Shift work and occupational medicine: an overview. *Occupational Medicine* 53; 83-88, 2003.

Harrington JM. Health effects of shift work and extended hours of work. *Occupational and Environmental Medicine* 58; 68-72, 2001.

IARC. 2010. *IARC monographs on the evaluation of carcinogenic risks to humans* Volume 98 on Shiftwork. International Agency for Research on Cancer. Lyon, France. Available from
http://monographs.iarc.fr/ENG/Monographs/vol98/index.php

Knutsson A. Health disorders of shift workers. *Occupational Medicine* 53; 103-108, 2003.

Work related road risk and travel time

Health & Safety Executive, 2001. *Work-related Road Safety Task Group – Reducing at-work road traffic incidents.* Available from HSE's website at www.hse.gov.uk/roadsafety/report.htm

Health & Safety Executive, 2002. Research Report RR018 "*Management of work related road safety*", available from HSE's website at www.hse.gov.uk/research/rrpdf/**rr018**.pdf

Health & Safety Executive, 2003. *Driving at work: Managing work-related road safety*. Leaflet INDG382, available from HSE's website at www.hse.gov.uk/pubns/indg382.pdf

Occupational Road Safety Alliance. Collection of useful information at www.orsa.org.uk/index.htm

Rail Accident Investigation Branch (RAIB) reports relevant to fatigue

Derailment of a freight train at Brentingby Junction, near Melton Mowbray, 9 February 2006. Available at
www.raib.gov.uk/latest_news/news_archive/news_archives_2007/070123_pn_brentingby.cfm

Freight train collision at Leigh-on-Sea, 26 April 2008. Available at
www.raib.gov.uk/publications/investigation_reports/reports_2009/report242009.cfm

Derailment of two locomotives at East Somerset Junction, 10 November 2008. Available at
http://www.raib.gov.uk/publications/investigation_reports/reports_2009/report282009.cfm

Uncontrolled freight train run-back between Shap and Tebay, Cumbria, 17 August 2010. Available at
www.raib.gov.uk/latest_news/110815_pn_shap.cfm

Other useful resources

Network Rail e-learning guide "*Fatigue Management*" (CD-ROM)

Relevant professional societies

Professional societies whose membership includes experts in human performance, fatigue, shift work and human reliability include:

- The British Psychological Society, St Andrews House, 48 Princess Road East, Leicester LE1 7DR.

- Institute of Ergonomics and Human Factors, Elms Court, Elms Grove, Loughborough, LE11 1RG.

- Society of Occupational Medicine, 6 St Andrew's Place, Regent's Park, London NW1 4LB.