OFFICE OF RAIL AND ROAD

Managing rail staff fatigue

Guidance for companies in the rail industry.

Purpose of this guidance

1.1 This guidance provides an approach for companies in the rail industry to manage their fatigue risk and provides advice on good practice. However, the approach and content may be relevant to other safety critical industries that do not have industry specific guidance and the document builds on the more general guidance applicable to all industries, including rail, in the Health and Safety Executive's (HSE's) guidance publication HSG256 'Managing shift work – health and safety guidance'.

1.2 This guidance supersedes the Office of Rail and Road's (ORR's) guidance on Managing Rail Staff Fatigue published in 2012. The revision has been undertaken in light of the need to update and modernise the previous guidance. The revised guidance does not introduce any new policy positions. However, for simplification, the document integrates what is known as the ROGS 9 stage approach provided in the 2012 guidance to provide an overarching approach to managing rail staff fatigue. It should be noted that the ROGS 9 stage approach is not a specific legal requirement set out by ROGS, nor is it a general ROGS policy principle or an inherent part of ROGS. Furthermore, as HSE has moved away from using the POPMAR (Policy, Organising, Planning, Measuring performance, Auditing and Review) model of managing health and safety to a 'Plan, Do, Check, Act' approach, we have revised this guidance accordingly. Finally, ORR's Fatigue Factors, or good practice guidelines, have been included.

1.3 This document reflects significant elements of the legislation that duty-holders need to be aware of. However, it does not seek to cover every aspect of the legislation. It is the responsibility of dutyholders to ensure that they are compliant with the law. This guidance does not place additional burdens on dutyholders or introduce new duties.

1.4 Following this guidance will normally be sufficient to demonstrate compliance with the law. Should you choose to take an alternative approach then you should ensure that it is equally effective to achieve compliance. Railway Inspectors seek to secure compliance with the law and may refer to this guidance as illustrating good practice.

1.5 The 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). This Regulation is detailed in Section 2.

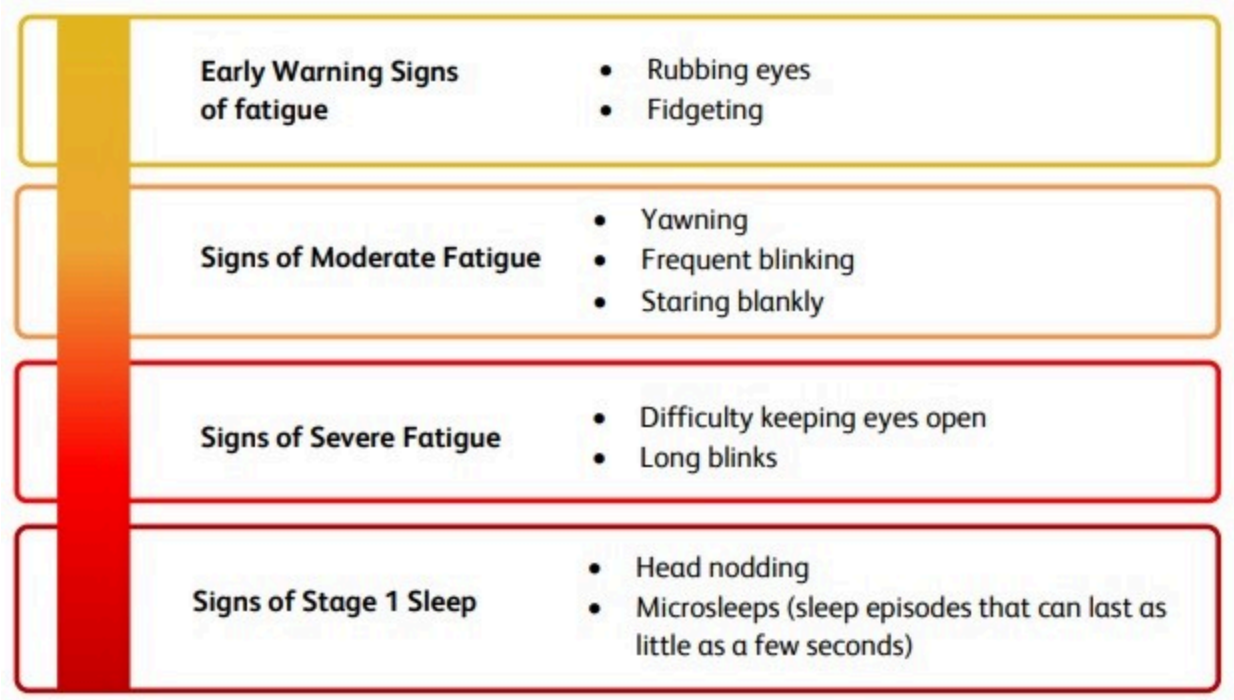
What do we mean by fatigue?

1.6 There is no single agreed definition of fatigue, but for the purposes of this guidance, fatigue will be considered as 'a state of reduced mental or physical capability resulting from sleep loss or extended wakefulness, disruption to circadian rhythms (the 'internal body clock'), workload (mental and/or physical activity) and/or prolonged working that can impair alertness and the ability to perform safely and/or 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.

1.7 Alertness, as well as or instead of fatigue is increasingly being referred to by sectors of the rail industry. The American Psychological Association Dictionary of Psychology (2018) defines alertness as 'the state of being awake, aware, attentive, and prepared to act or react'. Gurubhagavatula and others (2021) define it as 'the ability to direct and sustain attention, which is influenced by prior sleep and sleep loss, circadian rhythmicity, time on task (duration of continuous work), and other factors. Alertness manifests as the ability to maintain the attention necessary to perform a task at a specified level. Sleepiness is associated with reduced alertness'. Whilst it is for individual dutyholders to determine how they manage fatigue and alertness it is important to note that reduced alertness occurs at a point along the fatigue continuum. If staff are too fatigued to work, they should continue to report themselves as such. Furthermore, whilst alertness focuses on attention and vigilance it does not necessarily cover the health implications of fatigue which are also important to address for good health and safety.

1.8 Some physical signs of fatigue (taken from Network Rail's guide on Fatigue Reduction: Stay Alert. Stay Safe) are outlined in Figure 1.1.

Figure 1.1 Physical Signs of Fatigue



Source: Network Rail's Stay Alert, Stay Safe, Issue 5: October 2021

1.9 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'.

1.10 Fatigue can be hard to detect in staff unlike other causes of temporary mental impairment such as drugs and alcohol. As yet there is no 'blood test' for fatigue, although research funded by the Office of Road Safety in Australia is attempting to develop a blood-based test. The difficulty in detecting fatigue makes it a particular concern in any safety critical work.

1.11 Fatigue increases the likelihood of errors and adversely affects performance (HSE Guidance publication HSG256, 2006), especially in tasks requiring:

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

1.12 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, work environment.
- 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.

1.13 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
- not including training days within the roster

1.14 Research in the rail industry (McGuffog and others, 2005 and Robertson and others, 2010) has identified similar factors across safety-critical roles that contribute to an increased likelihood of fatigue: long periods of duty, time of day (night duties and early starts), the timing and duration of breaks (e.g. too early or too late in the shift, or a single long break rather than shorter, more frequent breaks), consecutive duties, and inadequate recovery time.

1.15 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 it 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?

1.16 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. ORR has identified 17 Rail Accident Investigation Branch (RAIB) recommendations specifically concerning fatigue arising from accidents and incidents between 2010 and 2022; however, given that RAIB investigates only a proportion of accidents and incidents, fatigue was likely a causal or contributory factor to a significantly larger number. Fatigue is identified as a factor in twenty-one percent of high-risk rail incidents (Rail Safety and Standards Board (RSSB), 2022). There is mounting evidence that working long weekly hours over long periods increases the **risk of accidents and incidents** (Dembe and others, 2005).

1.17 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 (Dawson and Reid 1997).

1.18 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 (Costa 2003; Knutsson 2003; Harrington 2001). Based on population studies, shortened sleep increases a person's chance of getting a chronic disease (Itani and others, 2017). The Working Time Society, as commissioned by the International Commission on Occupational Health, developed a consensus statement citing strong evidence linking shiftwork and negative health outcomes, such as cardiovascular diseases, gastrointestinal and metabolic disorders, e.g. type 2 diabetes (Moreno and others, 2019). 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 in maintaining social relationships and activities can also influence individuals' health.

1.19 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). ORR's successful prosecution of 'Renown Consultants Limited' in 2020 on three charges relating to their failure to manage fatigue risks resulted in a £450,000 fine for the company as well as £300,000 in costs. RAND Europe estimated that lack of sleep would cost the UK economy £30 billion in 2020, in mortality and reduced

productivity (RSSB, 2020). Fatigue makes expensive mistakes more likely, reduces productivity and morale, and increases absenteeism (Dawson and others, 2000). Thus, there are sound financial, as well as legal and moral, reasons to manage fatigue properly.

2. Legal duties

2.1 This section provides the legal duties of employers and employees with regards to the management of fatigue, and makes reference to:

- The Health & Safety at Work Act 1974 ('HSWA 1974').
- The Management of Health & Safety at Work Regulations 1999 ('MHSWR 1999').
- The Railways & Other Guided Transport Systems (Safety) Regulations 2006 ('ROGS 2006').
- The Working Time Regulations 1998 ('WTR 1998').

The Health & Safety at Work Act 1974 ('HSWA 1974')

2.2 Sections 2(1) and 3(1) HSWA 1974, place general duties on all employers, including the self-employed, so far as reasonably practicable, to protect the health, safety, and welfare at work of their employees. This also includes a duty, so far as reasonably practicable, to ensure that others are not exposed to health and safety risks through their undertaking (e.g. risks from staff fatigue).

2.3 Section 7 HSWA 1974, places a duty on employees to take reasonable care of their own health and safety and that of other persons who may be affected by their activities at work. Accordingly, employees should take positive steps to understand the risk factors in their work (e.g. causes of fatigue), comply with safety rules and procedures, and ensure their actions or omissions at work do not put others at risk.

Section 2 HSWA 1974 - General Duties of Employers to their Employees

(1) It shall be the duty of every employer to ensure, so far as is reasonably practicable, the health, safety and welfare at work of all his employees.

(2) Without prejudice to the generality of an employer's duty under the preceding subsection, the matters to which that duty extends include in particular—

(a) the provision and maintenance of plant and systems of work that are, so far as is reasonably

practicable, safe and without risks to health;

(b) ...

(c) the provision of such information, instruction, training and supervision as is necessary to ensure, so far as is reasonably practicable, the health and safety at work of his employees;

(d) ...

(e) ...

(3) Except in such cases as may be prescribed, it shall be the duty of every employer to prepare and as often as may be appropriate revise a written statement of his general policy with respect to the health and safety at work of his employees and the organisation and arrangements for the time being in force for carrying out that policy, and to bring the statement and any revision of it to the notice of all of his employees.

(4) ...

(5) ...

(6) It shall be the duty of every employer to consult any such representatives with a view to the making and maintenance of arrangements which will enable him and his employees to co-operate effectively in promoting and developing measures to ensure the health and safety at work of the employees, and in checking the effectiveness of such measures.

(7) ...

2.4 Therefore, in summary, this requires dutyholders, so far as reasonably practicable, to:

- **Provide safe systems of work** that are without risks to health (e.g. appropriate work patterns/rosters) and to keep those systems under review.
- **Provide information, instruction and training on fatigue and supervision** to ensure the health and safety of their employees.
- Develop, carry out and revise (as often as appropriate) a **Fatigue Risk Management Policy**, either as a standalone document or integrated within a wider Health and Safety Policy.
- Bring the Fatigue Risk Management Policy (and any consequent revisions) **to the attention of all employees.**

- **Consult with staff** on the development and maintenance of safe working patterns or rosters to facilitate effective co-operation.
- **Check the effectiveness** of such measures.

2.5 Sections 4 to 9 provide detailed guidance in these areas.

Section 7 HSWA 1974 - General Duties of Employees at Work

It shall be the duty of every employee while at work—

(a) to take reasonable care for the health and safety of himself and of other persons who may be affected by his acts or omissions at work; and

(b) as regards any duty or requirement imposed on his employer or any other person by or under any of the relevant statutory provisions, to co-operate with him so far as is necessary to enable that duty or requirement to be performed or complied with.

2.6 Therefore, in summary, this requires employees, so far as reasonably practicable, to:

- **Co-operate with their employer**, e.g. by ensuring that they are adequately rested to do their work safely.
- **Report any concerns** about fatigue promptly to their employer.

2.7 Sections 4 to 9 provide detailed guidance in these areas.

The Management of Health & Safety at Work Regulations 1999 ('MHSWR 1999')

2.8 MHSWR 1999, requires 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.

Regulation 3 - Risk Assessment

(1) Every employer shall make a suitable and sufficient assessment of -

(a) the risks to the health and safety of his employees to which they are exposed whilst they are at

work; and

(b) the risks to the health and safety of persons not in his employment arising out of or in connection with the conduct by him of his undertaking,

for the purpose of identifying the measures he needs to take to comply with the requirements and prohibitions imposed upon him by or under the relevant statutory provisions...

Paras (3) – (6) not copied herein.

Regulation 5 - Health and Safety Arrangements

(1) Every employer shall make and give effect to such arrangements as are appropriate, having regard to the nature of his activities and the size of his undertaking, for the effective planning, organisation, control, monitoring and review of the preventive and protective measures.

(2) Where the employer employs five or more employees, he shall record the arrangements referred to in paragraph (1).

Regulation 10 - Information for Employees

(1) Every employer shall provide his employees with comprehensible and relevant information on—

the risks to their health and safety identified by the assessment;

the preventive and protective measures;

(c) – (e)...

Paras (2) - (3) not copied herein.

Regulation 13 - Capabilities and Training

(1) Every employer shall, in entrusting tasks to his employees, take into account their capabilities as regards health and safety.

(2) Every employer shall ensure that his employees are provided with adequate health and safety training—

(a) on their being recruited into the employer's undertaking; and

(b) on their being exposed to new or increased risks because of—

(i) their being transferred or given a change of responsibilities within the employer's undertaking,

(ii) the introduction of new work equipment into or a change respecting work equipment already in use within the employer's undertaking,

(iii) the introduction of new technology into the employer's undertaking, or

(iv) the introduction of a new system of work into or a change respecting a system of work already in use within the employer's undertaking...

(3) The training referred to in paragraph (2) shall—

(a) be repeated periodically where appropriate.

(b) be adapted to take account of any new or changed risks to the health and safety of the employees concerned; and

(c) take place during working hours.

2.9 Therefore, in summary, the MHSWR 1999 requires dutyholders to:

- Carry out **suitable and sufficient risk assessments** to assess the risks of fatigue in their organisation.
- Put in place **appropriate preventative and protective controls.**
- **Develop and record a Fatigue Risk Management System (FRMS)** which could be based on the Plan, Do, Check, Act framework outlined in this guidance (in sections 5 to 9) which should be proportionate to the degree of risk.
- **Train their staff in fatigue risks and controls.**

2.10 Sections 4 to 9 provide detailed guidance in these areas.

The Railways & Other Guided Transport Systems (Safety) Regulations 2006 ('ROGS 2006')

2.11 ROGS 2006 provides the regulatory regime for rail safety, including the mainline railway, metros (including London Underground), tramways, light rail and heritage railways. It places specific duties on controllers of safety critical work in the railway industry, as defined in regulation 23 of ROGS 2006, for the management of competence and fitness, as specified in regulation 24, and for the management of fatigue, as specified in regulation 25, and repeated here:

'Controllers of safety-critical work' means 'any person controlling the carrying out of safety critical work on a transport system or in relation to a vehicle used on a transport system'

'Safety critical work' means any safety critical task carried out by any person in the course of their work . . . on or in relation to a transport system and related expressions shall be construed accordingly.

'Safety critical task' means—

(a) in relation to a vehicle used on a transport system—

(i) driving, dispatching or any other activity which is capable of controlling or affecting the movement of that vehicle;

(ii) signalling, and signalling operations, the operation of level crossing equipment, receiving and relaying of communications or any other activity which is capable of controlling or affecting the movement of that vehicle;

(iii) coupling or uncoupling;

(iv) installation of components, other than where the installation of those components is subject to supervision and checking by a safety critical worker or a controller of safety critical work;

(v) maintenance, other than where the carrying out of that maintenance is subject to supervision and checking by a safety critical worker or a controller of safety critical work; or

(vi) checking that that vehicle is working properly and, where carrying goods, is correctly loaded before being used;

(b) in relation to a transport system—

(i) installation or maintenance of any part of it or of the telecommunications system relating to it or used in connection with it, or of the means of supplying electricity directly to that transport system or to any vehicles using it or to the telecommunications system other than where the carrying out of that task is subject to supervision and checking by a safety critical worker or a controller of safety critical work;

(ii) controlling the supply of electricity directly to it or to any vehicles used on it;

(iii) receiving and relaying of communications; or

(iv) any person ensuring the safety of any persons working on or near to the track, whether or not the persons working on or near to the track are carrying out safety critical work;

(c) in relation to training, any practical training or the supervision of any such training in any of the tasks set out in sub-paragraphs (a) to (b), which could significantly affect the health or safety of persons on a transport system;

Regulation 24 - Competence and Fitness

(1) Every controller of safety critical work shall, so far as is reasonably practicable, ensure that a person under his management, supervision or control, with the exception of where that person is receiving practical training in a safety critical task, only carries out safety critical work where—

(a) that person has been assessed as being competent and fit to carry out that work following an assessment by an assessor.

(b) there is an accurate and up to date record in writing of that person's competence and fitness which references any criteria for determining competence and fitness against which that assessment of competence was made.

(c) the record, or an accurate summary of the record referred to in sub-paragraph is available for inspection, on reasonable request, by any other controller of safety critical work or any operator who may be affected by any safety critical work carried out or to be carried out by that person, for the purposes of establishing that person's competence and fitness to carry out safety critical work; and

(d) there are in place (suitable and sufficient) arrangements for monitoring the competence and fitness of that person.

(2) Every controller of safety critical work shall without unreasonable delay review any person's competence or fitness assessment where—

(a) they have reason to doubt the competence or fitness of a person to carry out that safety critical work; or

(b) there has been a significant change in the matters to which the assessment relates, and where, as a result of any such review a reassessment of competence or fitness is required, that reassessment of competence or fitness shall be carried out to ensure that the requirements of paragraph (1) are met.

(3) Where a reassessment of competence or fitness under paragraph (2) is required, the controller of safety critical work shall, so far as is reasonably practicable ensure that, as a result, the health and safety of persons on a transport system is not prejudiced.

2.12 Therefore, in part, ROGS 2006 accordingly require controllers of safety critical work to:

- Ensure that people carrying out such work have been assessed as **competent and fit for that work.**
- Have arrangements in place for **monitoring the ongoing competence and fitness** of such staff. These fitness assessments and monitoring arrangements should take potential risks from fatigue into account, e.g. in fitness for duty checks.

2.13 Sections 4 to 9 provide guidance in these areas.

Regulation 25 - Fatigue

(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.

2.14 Therefore, in summary ROGS 2006 accordingly require controllers of safety critical work:

- To **have in place arrangements** to ensure, so far as is reasonably practicable, that a safety critical worker under their management, supervision or control **does not carry out safety critical work** in circumstances where they are **'so fatigued' or where they would 'become so fatigued'** that their health or safety or the safety of other persons could be significantly affected. This requires the dutyholder to understand what is 'so fatigued'. This guidance aims to provide dutyholders with an understanding of what is 'so fatigued' and provides an approach to help avoid reaching that point, including good practice work patterns/ arrangements based on current research.
- To **review their arrangements** for complying with regulation 25 where there is reason to doubt the effectiveness of those arrangements, e.g. if staff surveys indicate high levels of fatigue or if an incident occurs where fatigue is identified as an underlying cause. This review could be via HSEs 'Plan, Do, Check, Act' approach as detailed in this guidance.

The Working Time Regulations 1998 ('WTR 1998')

2.15 When considering fatigue management, reference is often made to the WTR 1998 as amended, which among other aspects, places maximum limits on the amount of time an employer can ask an employee to work. Employers and other dutyholders need to consider and comply with the requirements of WTR 1998, but compliance is not in itself sufficient to adequately control risks from staff fatigue - some work patterns could comply with WTR 1998 but still be potentially fatiguing. For more information, see ORR's RGD-2004-16 and the other WTR 1998 references in 'Further Information'.

3. How to use this guidance

3.1 All rail employers have a duty to assess and control risks arising from staff fatigue, whether their staff carry out safety critical work as defined in ROGS 2006, or not. The complexity of these arrangements will depend on the type of work but will require greater rigour where there is shift work, significant overtime, or safety critical work being carried out.

3.2 It is recommended that dutyholders set up and operate an overarching Fatigue Risk Management System covering both safety critical and non-safety critical work and use similar management systems to control fatigue risks in both groups. An FRMS need not be standalone but

could be integrated into the wider Safety Management System. Alternatively, dutyholders may choose to adopt a different approach, but should ensure that those measures are equally effective.

3.3 Dutyholders should devise and implement an FRMS which is proportionate to the likely risks from fatigue. There is no 'one-size-fits-all' for fatigue risk management systems. 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.

3.4 Section 4 in this document 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 or carry out safety critical work under ROGS 2006.

3.5 Sections 5 to 9 are relevant to all rail employers whose staff work shifts or work significant overtime, whether their staff carry out safety critical work under ROGS 2006 or not. It outlines the features of a company-wide Fatigue Risk Management System, following the Plan, Do, Check, Act approach outlined in the HSE publication HSG65.

3.6 In the 2012 version of this guidance, a separate section was provided to cover the ROGS 2006 9 stage approach. However, sections 5 to 9 of this guidance amalgamates sections 5 and 6 of ORR's 2012 guidance so that there is now one overarching approach to managing rail staff fatigue.

3.7 Appendix E provides the key definitions and abbreviations used in this guidance.

4. Basic fatigue controls

4.1 All dutyholders need to 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 safety critical work. These basic fatigue controls may include, but are not limited to:

- A brief statement in the company's health and safety policy about controlling identified and documented risks to staff and others from staff fatigue.
- Basic arrangements for ensuring that staff do not work when fatigued, including:
    - 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 e.g. hold fatigue conversations with their staff, assign them to other duties etc.
- 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 A for more advice, and the HSE's web pages on 'Driving and riding safely for work'.
- 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 Dutyholders should decide whether the above steps are sufficient to ensure that any fatigue risks in relation to their operations are identified and acted upon before they cause problems or whether additional controls are necessary to ensure they meet their duties to reduce risks from staff fatigue, so far as is reasonably practicable. More information on reasonable practicability can be found on ORR's Risk Management web page.

4.3 If staff in an organisation carry out shift work or significant overtime or safety critical work, fatigue risks are likely to be higher if uncontrolled, and a more comprehensive FRMS as described in sections 5 to 9 will be appropriate.

5. Fatigue Risk Management Systems

What is a Fatigue Risk Management System?

5.1 A Fatigue Risk Management System (FRMS) is a more formalised arrangement for controlling fatigue than the basic controls described in section 4. Although a FRMS can include all employees, it would be used by organisations whose staff are likely to: carry out safety critical work; work long hours from time to time; work significant overtime; carry out shift work; use potentially dangerous machinery at work; work near moving vehicles/construction plant; work at height; carry

out electrical work.

5.2 A 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 size, risk and nature of the operation. An FRMS should so far as is reasonably practicable:

- 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 (Fourie and others, 2010b) reported several advantages of adopting a FRMS approach, including improved safety, improved staff morale, reduced absenteeism, competitive advantage, and futureproofing against any changes in legislation.

Integrating the FRMS with wider risk control systems

5.4 An effective FRMS should be integrated with the organisation's wider Safety Management Systems (SMS). Under ROGS 2006 Regulations 5 and 6, all operators and dutyholders are required to have in place arrangements for managing safety risks and monitoring the performance of their safety system, known as a Safety Management System. A SMS should be adapted to fit the size and nature of the operation.

5.5 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 (Fourie and others, 2010b). 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. A document could be used to signpost to existing fatigue controls and allow any gaps to be identified.

A proportionate approach to managing risks from fatigue

5.6 Organisations should design an FRMS to fit their own operation and avoid using a generic system. An organisation's FRMS should be tailored to its own operations and context, proportionate to their size, complexity, and degree of fatigue risk, 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 carry out safety critical work, likely risks from fatigue could be relatively high, warranting more rigorous controls and a comprehensive FRMS (Fourie and others, 2010a). Suggested key components are outlined in the remainder of this section.

Fatigue Risk Management Systems – The Plan, Do, Check, Act approach

5.7 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. The HSE publication HSG65 'Managing for health and safety' outlines the Plan, Do, Check, Act approach. This approach helps to achieve a balance between the systems and behavioural aspects of management; it treats health and safety management as an integral part of good management generally, rather than as a stand-alone system. The Plan, Do, Check, Act cycle should not be seen as a once only action and organisations should adopt the cyclical approach to managing their health and safety risks, particularly when starting out, developing a new process, or implementing any change. This cycle is illustrated in Figure 5.1.

Figure 5.1 The Plan, Do, Check, Act cycle for managing fatigue

Source: Reproduced from HSE. Graphic licensed under the Open Government Licence v3.0 and subject to HSE's copyright statement.

5.8 Although other approaches can be used, the same general principles outlined in the Plan, Do, Check, Act cycle can be found in most effective management systems, including Fatigue Risk Management Systems. Guidance on applying the Plan, Do, Check, Act approach to fatigue management is provided in sections 6 to 9 inclusive. In especially complex situations, and where fatigue risks could be high, it may be prudent to seek advice from a competent professional with expertise in assessing and managing fatigue.

6. Plan

6.1 The key actions in the Plan part of the framework are Determining your policy and Planning for Intervention (refer to HSE publication HSG65 for general guidance).

Determining your policy

6.2 Dutyholders should develop a Fatigue Policy. The Fatigue Policy could be part of the overall health and safety management policy or a standalone document. It will provide a framework for the development of the FRMS.

6.3 The purpose of a Fatigue Policy is to set out a dutyholder's intention regarding their aims for managing fatigue, what they will do, who will do it and how they will do it. Those tasked with responsibilities for fatigue should be suitably competent. The policy should also identify targets, prioritise actions and demonstrate senior management commitment to fatigue management. It should be communicated to staff and consulted on appropriately.

6.4 Dutyholders should develop a fatigue policy which:

Recognises that there are human performance risks from fatigue which may cause accidents, ill health, and cost consequences

6.5 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 to stay awake, and that excessive fatigue and shift work can adversely affect safety and health, with possible financial consequences.

Recognises that a FRMS works best in a 'just' organisational culture

6.6 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. It should consider the organisation's high level aims in relation to a 'just' culture, emphasising the need for openness, honesty and trust between managers and staff.

6.7 The organisation's expectations on individuals' and managers' behaviour in relation to fatigue should be clear. The status of any relevant company standards and limits should also be made clear, and their relationship to any relevant negotiated agreements with trade unions or other staff representative groups, for instance terms and conditions of employment. 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. Refer to Appendix B for more information on a positive safety culture.

Recognises that senior management commitment and leadership is needed for managing fatigue risks

6.8 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 should be signed by a person at the top of the organisation – the owner or a director.

6.9 Senior management commitment and leadership is needed 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. Refer to Appendix B for more information.

Commits ongoing adequate resources to manage fatigue

6.10 The policy should recognise that the organisation should commit the resources to develop and sustain the FRMS on an ongoing basis. The resource commitment needed will depend on the nature, size and complexity of the operation and the degree of fatigue risk.

6.11 Once people have been identified to progress FRMS activities, they will need time to develop policies, staff training and education programmes on fatigue, 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 should be willing to commit resources to procure and support these.

6.12 Much of this staff time and resource commitment will be 'up-front' while the system is being devised and set up but 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.

Involves staff in devising, implementing and monitoring fatigue controls

6.13 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 should 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.

Considers a joint management and staff group and 'fatigue champions'

6.14 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.

6.15 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 (Fourie and others, 2010b).

Sets out the expectation on individuals

6.16 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.

6.17 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 (see section 2) 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.
- Making 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 fatigued 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.

6.18 Some organisations in other industries use 'sleep contracts', requiring significantly more formality in the arrangements between employers and staff regarding sleep obligations. An 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, dutyholders considering a formal 'sleep contract' arrangement should approach the concept with caution and be responsive to the complexity of the business and/or task. 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.

Recognise the links between staff resources, workload, fatigue and stress

6.19 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 considering these likely links will be particularly important during significant organisational changes e.g. restructuring, downsizing, modernising or periods of additional demands (e.g. higher workloads, heavy training needs, high levels of sickness absence).

Sets out how the organisation will collect and use data

6.20 The fatigue policy should set out 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.

Describes how the adequacy of fatigue controls will be periodically reviewed

6.21 The fatigue policy should describe how the adequacy of fatigue controls will be reviewed, particularly if there is reason to doubt their effectiveness, for example after an incident or accident where fatigue is identified as an underlying cause or if staff surveys reveal fatigue levels to be high. (See 'Reviewing performance' in section 9 (paragraphs 9.2 to 9.5).

Planning for implementation

6.22 Once the statement of intention has been set out in the Fatigue Policy, dutyholders should plan how they will achieve the aims of the policy. It may be helpful to consider questions such as 'where are we now', 'where do we want to be' and 'how do we get there?'

6.23 'Where we are now' may be answered by gathering information about the systems the organisation already has in place, for example, to carry out risk assessments, design rosters, conduct training, investigate accidents, consult staff, supervise staff, measure health and safety performance. Consider what additional actions have been taken to consider fatigue risk in all these areas.

6.24 Comparing current efforts to manage fatigue risk with suitable benchmarks, for example, this guidance, will enable the organisation to decide 'where do we need 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 FRMS– aiming for excellence reduces the chance of occasionally dipping below bare legal compliance if one or more controls fail.

6.25 Deciding 'how do we get there?' involves practical decisions about how to move the management of fatigue risk forward. For example, organisations might decide to devise new components of the FRMS (e.g. develop and collect data on Key Performance Indicators (KPIs) to enable better monitoring of fatigue risk) or to improve existing ones (e.g. improve the fatigue training provided to roster clerks to aid better roster design).

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

here.

6.27 Answering these questions should enable dutyholders to develop (or amend) and document a FRMS which should include:

- Establishing a reliable fatigue risk assessment process.
- Processes for designing working patterns which minimise fatigue risk.
- Means for consultation with staff when devising, checking, and revising work patterns.
- Plans for training, instructing, and providing information to staff.
- An approach to measuring and supervising levels of fatigue to ensure safe working, e.g. via fitness for duty checks.

Risk assessment

6.28 Dutyholders are legally required to carry out suitable and sufficient risk assessments under ROGS 2006 and other health and safety legislation. 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. All workers should be considered, but safety-critical workers in particular should be clearly identified, as well as those that work shifts, with controls designed appropriately to manage fatigue risk for each type of worker depending on the type of work that they carry out. Arrangements should seek to identify significant factors contributing to fatigue, tracing back fatigue to its underlying causes, by gathering information from diverse sources.

6.29 The risk assessment should be carried out by staff competent in risk assessment with specific knowledge of fatigue risks and associated effective controls. Dutyholders should identify personnel responsible for implementing the risk controls and specify timescales.

6.30 Under ROGS 2006 Regulation 19(4) risk assessment must be documented. Dutyholders must maintain a record of their arrangements for managing the risks arising from fatigue and should incorporate the arrangements into their safety management system.

6.31 Guidance on risk assessment can be found on HSE's website Managing risks and risk assessment at work. ROGS specific risk assessment requirements can be found in 'A guide to ROGS' on ORR's website.

Design work patterns

6.32 Plans for designing work patterns or rosters should consider who should draw up the rosters, whether they are competent to do so (and if not, what training might be needed), what benchmarks should be used, and finally, how the rosters could be risk assessed before implementation, and evaluated once in place.

6.33 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 considered. 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 uncontrolled voluntary overtime arrangements to cover normal working periods – all duty turns should be covered in a planned way. For further information, see the Management Standards – Demands section of HSE's website.

6.34 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. Dutyholders should only use information collected from pay systems if they are certain that it accurately reflects true working patterns. The same applies for monitoring adherence to agreed work patterns.

Communication, consultation, and co-operation with staff

6.35 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 C on Fatigue reporting. An open reporting culture is a key aim – see Appendix B on Safety Culture. Setting up a joint management / staff Fatigue Safety Action Group or similar, tasked with ensuring adequate fatigue communication arrangements, should help (See section 6: Determining your policy, paragraphs 6.2 to 6.21).

6.36 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. 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. Consultation is also important when standards and limits are to be changed and dutyholders should take account of the views and experiences of staff affected, either expressed directly or through their trade union / safety representatives.

Train, educate and brief staff

6.37 The FRMS should describe the arrangements made for training staff in fatigue awareness (see section 7 – Train, educate and brief staff, paragraphs 7.98 to 7.101). All staff will need a basic level of awareness training in fatigue but 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 for staff who devise and amend rosters.

6.38 Training in fatigue should be provided by a suitably competent practitioner. As per MHSWR, a person shall be regarded as competent where he has sufficient training and experience or knowledge and other qualities. The FRMS should state how opportunities will be taken to check that fatigue training has been embedded and how refresher training or briefings will be implemented to ensure staff awareness of fatigue remains current.

6.39 General guidance on competence management is given in ORR's Railway Safety Publication 1 'Developing and Maintaining Staff Competence'. Here it highlights that it is up to companies to define and select the competence standards for individuals to enable them to control risks consistently.

Manage and supervise staff

6.40 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. It should include arrangements for the management of overtime (including exceedances) shift exchange, travel time and on-call duties. Finally, the arrangements to ensure the fitness of workers via medical assessment during the selection process and using fitness for duty checks should also be specified.

Measure and review performance

6.41 As part of continuous improvement, the FRMS should be a self-correcting process which periodically reviews the effectiveness of the organisation's existing fatigue policy and the fatigue-related management (e.g. Plan, Do, Check, Act) process. Organisations should establish metrics or key performance indicators (KPIs) to 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 system should also trigger a review of the FRMS when there is reason to doubt the effectiveness of the arrangements, ROGS 2006 Regulation 25(2).

7. Do

7.1 The key actions in the Do part of the framework are Profiling your organisations health and safety risks; Organising for health and safety and; Implementing your plan (refer to HSE publication HSG65 for general guidance).

Profiling your organisation's health and safety risk

7.2 Work, including safety critical work, can be undertaken on a transport system at any time during the day or night, sometimes in 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. As described in Planning for implementation (paragraphs 6.22 to 6.41), dutyholders must carry out a risk assessment to determine the greatest fatigue risks in their organisation, set their priorities and identify

appropriate measures to control those risks. This will involve identifying both the staff at risk of fatigue and the risks that the staff and organisation face.

Identify the staff at risk of fatigue

7.3 Dutyholders should identify workers at risk of fatigue. For example, those working shifts, overtime, and those carrying out safety-critical work. In particular, 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.

7.4 Contractors should be considered as well as employees. For example, arrangements for awarding contracts and subsequent compliance monitoring arrangements should ensure, so far as reasonably practicable, there are no financial incentives for contractors to operate with high or unmanaged levels of fatigue. Organisations responsible for awarding contracts, where contractor fatigue could increase risk, should make their expectations on fatigue management arrangements clear to contractors during the bidding process. These expectations should be so far as is reasonably practicable embedded in contractual requirements.

7.5 In circumstances where the consequences of contractor fatigue are high, and to fulfil their duties under ROGS 2006, infrastructure managers and those otherwise in control of premises may legitimately require dutyholders accessing their infrastructure / premises to adhere to fatigue controls e.g. regarding staff travel and lodgings. In a commercially competitive market, less responsible companies may try to secure work by cutting costs without properly considering fatigue risks. They may try to use fewer staff, working longer hours or travelling long distances before and after work, thereby increasing fatigue risks. Work should only be awarded where sufficient allowance has been made for staff travel and accommodation in the costs.

7.6 Clarity in such expectations helps create a 'level playing field' for contractors by reducing opportunities for under-cutting, while allowing more realistic resource planning and costing. Contractors should in turn co-operate and comply with these expectations.

7.7 It is recommended that employers require employees to declare any second jobs which could affect fatigue risks. Employers should assess the potential impact on their own operation which the likely increase in fatigue from a second job would bring, e.g. due to the reduced opportunity for sleep. A smart-card system could help reduce 'second job' risks from staff working for more than one rail employer.

7.8 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 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 dutyholders 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).

Identify the risks faced by staff and the organisation

7.9 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 can impact on 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 increase fatigue.

7.10 The design of working patterns or rosters is a significant contributor to the risk of fatigue. Dutyholders should take steps, so far as reasonably practicable, to manage the risk of fatigue from the design of working patterns. A three-part approach to managing the fatigue risk from working patterns, consulting with staff at appropriate stages, can be summarised as follows:

1. design the work pattern, maximising good fatigue management practices
2. assess likely fatigue risks from the resulting work pattern, using a fatigue assessment tool
3. ask staff whether the working pattern is controlling fatigue, identifying any particular features which may need further improvement

7.11 A three-part approach is represented and described in Figure 7.1 below.

Figure 7.1 Triangulation approach to managing the fatigue risk from working patterns

Source: ORR's superseded (2012) Managing Rail Staff Fatigue

1. Design the work pattern, maximising good fatigue management practices

7.12 Numerical limits on hours worked can help managers decide day to day what may or may not be acceptable. However, taken in isolation, a set of simplistic limits on work and rest hours cannot account for the impact on fatigue of operational factors such as differences in workload, working conditions and personal factors (age, health, medication, domestic and social activities) (Fourie and others, 2010a). 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, dutyholders need to set up and operate more wide-ranging fatigue risk management systems.

7.13 In recent years rail employers have often placed too much reliance on 'Hidden limits' incorporated into the former railway group standard GH/RT4004 (withdrawn 2007) and many company standards written following the 1988 Clapham accident. It is important to recognise that these limits were based on what was thought to be operationally achievable at the time, rather than on sound fatigue management science. These limits often became norms that companies

routinely planned for and 'worked up to', even though less fatiguing work patterns were available. Knowledge of fatigue has improved to recognise that some working patterns can give rise to significant fatigue even though they comply with the 'Hidden limits'. Employers should devise their own arrangements for managing fatigue that include appropriate numerical limits. Guidance for designing work patterns is set out in 'Implementing your plan' (paragraphs 7.20 to 7.110).

2. Assess likely fatigue risks from the resulting work pattern, using a fatigue assessment tool

7.14 Draft working patterns incorporating, so far as reasonably practicable, good fatigue management principles, should include an assessment of the proposed pattern using a fatigue assessment tool to check whether the pattern would adequately control fatigue, and whether there are any opportunities for further reducing fatigue risks. 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. 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 suits their requirements. The benefits and limitations of fatigue assessment tools are outlined in Appendix D.

7.15 Planned work patterns may vary when workers are on-call or for unplanned overtime e.g. worker shortages or sickness. Actual rather than planned working patterns should be assessed and managed to minimise the risks from fatigue. Proposed changes to planned work patterns should, wherever possible, be risk assessed before work commences to check whether good fatigue management practices have adequately been considered (see paragraphs 7.20 to 7.92 in Implementing your plan, including the summary in 7.92). Short-notice changes should be avoided so far as is reasonably practicable. Software packages are now available to help dutyholders estimate the likely fatigue risks from changes to planned rosters, provided their limitations are appreciated (see Appendix D on fatigue risk assessment tools).

3. Ask staff whether the working pattern is controlling fatigue, any particular features which may need further improvement

7.16 Whatever limits are used, they should not be used in isolation and from the outset should be complemented by building-in good fatigue management principles (see Designing working patterns (paragraphs 7.20 to 7.92 in 'Implementing your plan'), and by consulting and seeking feedback from staff on how tiring they find the working patterns in practice.

7.17 Even if working patterns are designed according to good practice principles, with a fatigue risk assessment tool suggesting fatigue levels are unlikely to be a concern, and staff agreeing to the pattern, the working pattern can be fatiguing. 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. Soon after the introduction of a work pattern, employers should ask staff directly how tiring they find it in reality. This can be done either directly or through trade union / staff safety representatives.

7.18 Further information on obtaining staff feedback can be found in Appendix C Fatigue reporting.

Organising for health and safety

7.19 'Determining your policy' 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, there is no 'one-size-fits-all'. Whatever their name or constitution, such joint groups can 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 include:

- 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

- 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, employee representatives and trade unions informed on progress with fatigue controls

Implementing your plan

Designing your work patterns

7.20 Dutyholders should identify, set and adhere to appropriate standards for working hours and working patterns, observing any relevant working time limits that apply.

7.21 The standards and limits set should take into account recognised national industry good practice guidance applying to railways and other guided transport systems designed to minimise features of working patterns known to contribute to fatigue.

7.22 They should take account of guidance in (for instance):

- HSE booklet HSG256 'Managing Shift Work'
- this ORR guidance (specific information on good practice working patterns can be found in paragraphs 7.28 to 7.92 including the summary in 7.92)
- ORR's Fatigue Factors – good practice guidance – included in the appropriate sections

below and in the summary in 7.92. More information can be found on ORR's website (see further information)
- any role-specific fatigue guidance (for example RSSB, 2015 Research Report T059 for passenger train drivers, or RSSB, 2010 Research Report T699 for freight train drivers and contract track workers)

7.23 To control the risks from fatigue, 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
- minimise sleep disturbance

7.24 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
- the maximum period of time between breaks, including breaks for meals

7.25 The standards and limits that the dutyholder sets should, so far as is reasonably practicable, take into account foreseeable causes of fatigue, including:

- job design
- the workload (physical and mental) 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
- the nature and duration of any time spent travelling either commuting or travelling to site

7.26 Dutyholders should consider these questions 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?

7.27 To answer these questions, there are six aspects of the working pattern that are relevant to the question of fatigue, and they should be considered so far as is reasonably practicable. These aspects and the corresponding ORR guidance, based on good practice, are described below. Definitions of the various shifts and other relevant terminology can be found in Appendix E.

Shift length factors

7.28 Shift duration is a key factor influencing fatigue. Long shifts have been linked with an increased risk of accidents; therefore, companies should understand their working time risk profile when examining, assessing, and establishing shift patterns. This guidance also applies to split shifts as per the Definitions section.

7.29 Limit shift durations to 12 hours.

7.30 There is evidence that human performance deteriorates significantly when people have been at work for more than 12 hours. Staff who regularly work 12 hours or more per day were found, in a large US study (Dembe and others, 2005), to have a 37% higher injury rate compared to other staff. 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, with 12-hour shifts showing a 27% increase relative to eight-hour shifts (RSSB, 2010 Research Report T699 p29, Folkard and others, 2006). Hence, there is a strong case for limiting shift duration to 12 hours, with further restrictions on duties, such as nights and early starts, that impinge significantly on the normal hours of sleep. RSSB proposes good practice for day shifts to be a maximum of 12 hours (RSSB, 2005 Research Report T059). A 12h day shift can be considered acceptable if other factors contributing to fatigue are correctly identified and mitigated, and if they are balanced by sufficient time off for recovery.

7.31 Limit shift duration to 8-10 hours especially for early and night shifts.

7.32 As described above, the risk of incidents increases with increasing shift lengths of over eight hours. 10-hour shifts were associated with a 13% increased risk relative to eight-hour shifts (RSSB,

2010 Research Report T699 p29, Folkard and others, 2006). Studies in the Australian rail industry have shown exponential safety declines with time on shift, with roughly double the likelihood of accident or injury after 10 hours relative to the first 8 hours (Dorrian and others, 2011).

7.33 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, 2010 Research Report T699 page 44) so far as is reasonably practicable, and RSSB proposes good practice for early and night shifts to be a maximum of 10 hours (RSSB, 2005 Research Report T059).

7.34 Limit shift duration to 8 hours for early shifts starting before 05:00.

7.35 The interaction between shift start time, and time of day of the shift, has a strong influence on levels of fatigue (RSSB, 2012). RSSB proposes good practice for shift duration for early shifts starting before 0500 to be a maximum of 8 hours (RSSB, 2005, Research Report T059).

7.36 Other factors for consideration:

- Dutyholders should consider whether any shift (including overtime) 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 for example, suitable assessment and consideration should be given to any safety critical duties undertaken 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, the working environment, individual variables and sleep history).
- 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.
- 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 A on travel time for more information.

7.37 ORR Fatigue Factors for shift lengths:

Very early shifts starting before 05:00 and over 8h long (FF4)

Day shift over 12h long (FF5)

Night shift over 10h long (FF6)

Early shift over 10h long (FF7)

Intervals between duties

7.38 The daily rest interval for safety critical workers needs to be risk assessed to enable them to return to work rested after a full rest period.

7.39 Provide a minimum rest period of 12 hours between consecutive shifts.

7.40 Studies suggest that the average amount of sleep required per 24 hours is 8.2 hours (Van Dongen and others, 2003). Where sleep is restricted to seven hours or less, there are cumulative effects on cognitive performance over successive days (Belenky and others, 2003; Van Dongen and others, 2003). In order to give opportunity for sufficient sleep, it is proposed that a minimum rest period of 12 hours between consecutive shifts is provided (RSSB, 2010 Research Report T699 page 45).

7.41 Provide a minimum rest period of 14 hours between consecutive night shifts.

7.42 For those working early starts, late finishes or night shifts, obtaining sufficient sleep may be more difficult and unless properly managed, staff may get well under eight hours sleep. In order to give opportunity for sufficient sleep between consecutive night shifts, it is proposed that a minimum rest period of 14 hours is provided (RSSB, 2010 Research Report T699 page 45).

7.43 Other factors for consideration:

- Some shift patterns provide a rest interval of only eight hours. This will not be adequate to obtain sufficient sleep (see paragraph 7.39), and patterns involving such short rest intervals should be revised as soon as is reasonably practicable. Until shift patterns are revised, other rest intervals within the shift pattern should be assessed for suitability.
- Long travel times to and from work can reduce the opportunity for required daily rest periods and so increase the risk of fatigue. There is evidence that time spent travelling to and from work does not provide rest in the same way as time spent at home. Therefore,

travel time should be monitored and taken into account when considering changes to working time patterns, particularly for a group of safety critical workers with long travelling times. See Appendix A on Travel Time for more information.

- Providing temporary accommodation near to the workplace for overnight stays can help workers obtain the maximum sleep in the time available which may reduce the likelihood of fatigue.

7.44 ORR Fatigue Factors for intervals between duties:

Less than 14h rest in any 24h period for night shifts (FF9)

Less than 12h rest in any 24h period for day shifts (FF13)

Recovery time, i.e. rest days between successive shifts

7.45 Rest days allow the 'cumulative fatigue' which accumulates over successive shifts worked to dissipate.

7.46 The maximum number of consecutive day (including mixed patterns) shifts before a rest day should be seven.

7.47 There is clear evidence regarding the value of rest days in enabling workers to 'recharge their batteries' and to maintain their work performance (RSSB, 2010 Research Report T699).

7.48 The maximum number of consecutive early shifts before a rest day should be five.

7.49 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. Staff may need longer to recover from a very early shift than a day shift (RSSB, 2010 Research Report T699 page 15).

7.50 The maximum number of consecutive night shifts before a rest day should be three.

7.51 The risk of accidents and injuries has been found to increase over spans of four consecutive night shifts (Folkard and Akerstedt, 2004). Some studies also indicate that performance errors increase, and alertness decreases over four consecutive night shifts (Walsh and others, 2004).

7.52 Staff may need longer to recover properly from a night shift than a day shift (RSSB, 2010 Research Report T699 page 15). Workers may have difficulty in adjusting to varying sleep patterns,

or to daytime sleep; this is an effect of the internal 'body clock' (circadian rhythm) 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.

7.53 Consider shortening the first night shift in a series of night shifts or implementing other risk controls.

7.54 Some individuals 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, 2010 Research Report T699 pages 31, 34, 37). It may be that staff changing from a 'daytime awake / night-time asleep' pattern feel less fatigued on their second- and third-night shifts than their first night shift, as their 'body clock' (circadian rhythm) 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.

7.55 It is unlikely that individuals will adapt fully to night shifts – a study found that less than 3% of permanent night workers adapted completely (Folkard 2008, and RSSB, 2010 Research Report T699 page 37).

7.56 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. Individuals vary in their ability to cope with successive night shifts. 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.

7.57 Employers should assess the relative pros and cons of such trade-offs and make a judgement on the best overall solution, documenting their reasoning.

7.58 Allow two rest days before an early start which follows a night shift.

7.59 An RSSB study found that most drivers work for five or six days before a break of at least one day, although the maximum number of days worked consecutively was nine. One quarter of drivers worked on their scheduled rest day between two and three times each month. This loss of rest days increases risk associated with working on consecutive days. This is particularly

problematic when returning to early shifts after late or night shifts (RSSB, 2005 Research Report T059).

7.60 Allow one rest day before an early shift which follows a late shift.

7.61 As described above, this is also problematic when returning to early shifts after a late shift (RSSB, 2005 Research Report T059).

7.62 Minimise rest day working.

7.63 Rest day working should be kept to a minimum to ensure that planned recovery time achieves its objective and staff return to work refreshed.

7.64 Other factors for consideration:

- 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.
- 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, 2010 Research Report T699 page 34). 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.

7.65 ORR Fatigue Factors for recovery time:

Less than 2 days rest after a block of consecutive nights (FF8)

Less than 2 days rest after a block of consecutive early starts (FF8b)

More than 4 consecutive 12h day shifts (FF10)

More than 13 consecutive shifts without a 48h break (FF11)

Only one day rest after night shifts (FF12)

More than 3 consecutive night shifts over 8h long (FF16)

First night shift (FF20)

More than 7 consecutive 8h shifts (MRSF)

More than 12 consecutive day shifts (MRSF)

More than 55 hours worked in any 7-day period (MRSF)

Shift work and shift patterns

7.66 It is the nature of the railway business that some safety critical workers work rotating shifts, and that these may include night work. As described above, workers may have difficulty in adjusting to shiftwork due to the effect of the internal 'body clock' (circadian rhythm) regulating sleep and wakefulness, which corresponds to the natural cycle of night and day. The design of shift patterns can greatly impact on a person's ability to achieve enough sleep.

7.67 Adopt forward rotating shifts rather than backward rotating shifts.

7.68 Current thinking (Driscoll and others, 2007, page 191) 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). More rapidly (e.g. two days per shift type) or more slowly changing shift patterns (e.g. 21 days per shift) may be preferable to a rotating shift pattern that changes about once a week (ORR, 2006).

7.69 For three-shift systems, better patterns rotate rapidly in a forward direction e.g. MMMAANNRR, MMAAANNRR or MMAANNNRR (where M is a morning shift, A is an afternoon, N is a night shift 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 close to 07:00, 15:00 and 23:00 (DERA advice for nuclear installation guidance, 2000).

7.70 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).

7.71 Avoid consecutive duties with large variations in start times; ideally avoid variations of more than two hours.

7.72 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 are drivers on a 'spare turn', who can have large variations (up to four hours) in their duty start time. When consecutive duty start-times vary by so much, 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.

7.73 Employers should make reasonable efforts to accommodate personal preferences as these may stem from an ability to cope with certain shifts.

7.74 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) (RSSB, 2010 Research Report T699 pages 21, 36 and Appendix G page 9; Monk 2005).

7.75 ORR Fatigue Factors for shiftwork patterns:

Night shift covering the whole period between 00:00 and 05:00 (FF1)

Early shift starting between 05:00 and 07:00 (FF2)

Very early shift starting before 05:00 (FF3)

More than 4 consecutive nights in a rotating pattern (FF14)

More than 4 consecutive early shifts in a rotating pattern (FF15)

Backward rotating pattern (FF17)

Rotating pattern of about a week (FF18)

Successive shift start times vary by more than 2 hours (FF19)

More than 6 consecutive night or early shifts in a permanent pattern (MRSF)

Time of day

7.76 The risk of fatigue-related accidents is well correlated to the time of the day.

7.77 Plan safety critical work to avoid times when alertness is low, i.e. particularly from midnight to 6am, but also from 2pm to 6pm, where practicable.

7.78 An 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, 2010 Research Report T699 page 26). A 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, 2010 Research Report T699 page 40). These time of day effects are largely seen as a product of our circadian rhythms of performance and alertness, with increased crash prevalence during the primary window of circadian low during the late night and early morning hours (02:00 to 06:00) and a lesser peak during the afternoon secondary window of circadian low (Pack and others, 1995; Summala and others, 1999).

7.79 Where not practicable to avoid safety critical work at times of low alertness, consider other control measures or changes to the working environment.

7.80 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 circadian rhythm or internal 'body clock' is telling them they should be asleep. If safety critical work cannot be avoided at these times, other control measures can help mitigate the effects of feeling sleepy and improve alertness. Examples of such control measures include planned rest breaks, working in pairs and encouraging workers to stand up and move around. Changes that can be made to the working environment to help include higher levels of lighting and lower ambient temperatures.

Rest breaks

7.81 Breaks enable workers to reduce their fatigue and maintain attention. The length and timing of breaks should be appropriate to the nature of the work and the length of time spent on duty.

7.82 Provide breaks during periods of duty, except where the work provides natural opportunities for relaxation or reduced vigilance.

7.83 Frequent short breaks during a shift help manage fatigue and maintain attention. Research (HSE, 1999) found 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. Less demanding tasks are likely to require shorter breaks than more demanding tasks.

7.84 Wherever reasonably practicable, safety critical workers who work at a workstation (e.g. in a driver's cab or signal control room) should be given the opportunity to spend breaks away from the workstation.

7.85 Schedule breaks in the middle of a shift, where possible, but at a suitable time with respect to the task activities.

7.86 Scheduling breaks at the start or end of a shift reduces any beneficial effects (RSSB, 2010 Research Report T699 page 6). Schedule a break in the middle of a shift or plan regular breaks throughout a shift.

7.87 Provide breaks, as appropriate, that are ten to fifteen minutes long, where possible.

7.88 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 10-to-15-minute break every two hours during the day and every hour during the night. For driving tasks, good practice would be to plan a short break about every three hours.

7.89 An alternative to providing breaks is to rotate workers around different tasks, provided not all tasks require similar sustained attention. However, it is unlikely that the majority of safety critical tasks in the transport system would be of this nature.

7.90 Provide suitable areas for workers to take quality breaks.

7.91 The quality of breaks is 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 will all provide a positive environment for a break. Daytime naps between 10 and 20 minutes result in decreases in subjective sleepiness, increases in objective alertness, and improvements in cognitive performance (Hilditch and others, 2017). In the case of safety critical workers on a night shift, the facility to take a short nap during a break can be especially beneficial. Even a short nap of 10 minutes can improve functioning (Flin and others, 2008) but 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 latent fatigue on waking from a nap ('sleep inertia'). Recognition and management of sleep inertia symptoms in the period immediately after waking is critical to re-establish alertness before undertaking safety-critical tasks (Ruggiero and others, 2014). Sleep inertia is likely to be more severe at night when waking from a nap following extended wakefulness due to the interactions with the body clock and prior sleep/wake patterns (Hilditch and others, 2016).

Summary guidance for work patterns

7.92 A summary of the above guidance is provided below. The guidelines are not proposed as prescriptive limits but are intended to provide a framework to help guide dutyholders in defining their own schemes for controlling fatigue risks; the more a working pattern deviates from the guidelines, the greater the likely need to assess and control the potential risks from fatigue.

Length of periods of duty

Aspect of working pattern and associated guidance:

- limit shift durations to 12 hours
- limit shift duration to 8-10 hours especially for early and night shifts
- limit shift duration to 8 hours for early shifts starting before 05:00

Relevant ORR Fatigue Factors (as appropriate):

- very early shifts starting before 05:00 and over 8h long (FF4)
- day shift over 12h long (FF5)
- night shift over 10h long (FF6)
- early shift over 10h long (FF7)

Intervals between duties

Aspect of working pattern and associated guidance:

- provide a minimum rest period of 12 hours between consecutive shifts
- provide a minimum rest period of 14 hours between consecutive night shifts

Relevant ORR Fatigue Factors (as appropriate):

- less than 14h rest in any 24h period for night shifts (FF9)
- less than 12h rest in any 24h period for day shifts (FF13)

Recovery time, i.e. rest days between successive shifts

Aspect of working pattern and associated guidance:

- the maximum number of consecutive day (including mixed patterns) shifts before a rest day should be seven
- the maximum number of consecutive early shifts before a rest day should be five
- the maximum number of consecutive night shifts before a rest day should be three
- consider shortening the first night shift in a series of night shifts or implementing other risk controls
- allow two rest days before an early start which follows a night shift
- allow one rest day before an early shift which follows a late shift
- minimise rest day working

Relevant ORR Fatigue Factors (as appropriate):

- less than 2 days rest after a block of consecutive nights (FF8)
- less than 2 days rest after a block of consecutive early starts (FF8b)
- more than 4 consecutive 12h day shifts (FF10)
- more than 13 consecutive shifts without a 48h break (FF11)

- only one day rest after night shifts (FF12)
- more than 3 consecutive night shifts over 8h long (FF16)
- first night shift (FF20)
- more than 7 consecutive 8h shifts (MRSF)
- more than 12 consecutive day shifts (MRSF)
- more than 55 hours worked in any 7-day period (MRSF)

Shift work and shift patterns

Aspect of working pattern and associated guidance:

- adopt forward rotating shifts rather than backward rotating shifts
- avoid consecutive duties with large variations in start times; ideally avoid variations of more than two hours
- make reasonable efforts to accommodate personal preferences as these may stem from an ability to cope with certain shifts

Relevant ORR Fatigue Factors (as appropriate):

- night shift covering the whole period between 00:00 and 05:00 (FF1)
- early shift starting between 05:00 and 07:00 (FF2)
- very early shift starting before 05:00 (FF3)
- more than 4 consecutive nights in a rotating pattern (FF14)
- more than 4 consecutive early shifts in a rotating pattern (FF15)
- backward rotating pattern (FF17)
- rotating pattern of about a week (FF18)
- successive shift start times vary by more than 2 hours (FF19)
- more than 6 consecutive night or early shifts in a permanent pattern (MRSF)

Time of day

Aspect of working pattern and associated guidance and relevant ORR Fatigue Factors (as appropriate):

- plan safety critical work to avoid times when alertness is low, i.e. particularly from midnight to 6am, but also from 2pm to 6pm, where practicable
- where not practicable to avoid safety critical work at times of low alertness, consider other control measures or changes to the working environment

---

Rest breaks

Aspect of working pattern and associated guidance and relevant ORR Fatigue Factors (as appropriate):

- provide breaks during periods of duty, except where the work provides natural opportunities for relaxation or reduced vigilance
- schedule breaks in the middle of a shift, where possible, but at a suitable time with respect to the task activities
- provide breaks, as appropriate, that are ten to fifteen minutes long, where possible
- provide suitable areas for workers to take quality breaks

Implementing your work patterns

7.93 Once the work patterns have been designed, a number of further measures should be taken to ensure they are successful. Firstly, any technology, systems and arrangements that can be made to keep them in place should be implemented. Staff should be trained and instructed to ensure everyone understands fatigue risks and is competent to carry out their work, for example, roster clerks or managers of safety critical workers. Staff should be supervised to make sure that arrangements are followed, and supervisors should have sufficient knowledge and understanding (see 7.98) of how to spot issues with fatigue with their direct reports. Any issues encountered should be reported to the correct authority and investigated or resolved.

Systems, technologies and arrangements

7.94 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), albeit with mixed results due to potential habituation effects. More recently Automatic Train Protection (ATP) Systems including the European Train Control System (ETCS) have been introduced. Manufacturers, leasing companies and operators should consider the potential benefits available of developing and introducing improved hardware aids for detecting the early stages of fatigue, and for detecting and mitigating fatigue-induced errors. Additionally, alertness measuring technologies are becoming more viable and can provide useful insights into how to address fatigue issues. Some of the opportunities and challenges of using technology to help detect and monitor fatigue are outlined by Belenky and others (2003). More recent work by RSSB (2021, Research Report T1193) has reviewed the existing technologies and concluded that whilst the rail industry understanding of technology has advanced significantly, the evidence for their adoption is still developing. It is important not to place excessive reliance on such technologies which could lead to wider organisational fatigue controls being neglected with such technologies supplementing, rather than replace, wider organisational fatigue controls.

7.95 RSSB continue to work closely with the rail industry to explore if and how monitoring technologies can support train drivers to improve safety and wellbeing. More information can be found on the RSSB website, Supporting Drivers: Monitoring Attention and Alertness.

7.96 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.

7.97 See Further Information for references to RSSB and ORR resources and guidance.

Train, educate and brief staff

7.98 Comprehensive fatigue education and awareness arrangements are an essential foundation for managing and mitigating fatigue risks. Dutyholders should provide their staff with clear and relevant information on risks to health or safety due to fatigue, and on their arrangements for

managing fatigue.

7.99 Safety critical workers in particular 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. 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 programme, 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 themselves (see Figure 1.1) or others. This is especially important for staff responsible for undertaking fitness for duty checks and for those responsible for ensuring staff remain fit for duty throughout their shifts.
- 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
    - the effect of medications on fatigue
    - the role of physical fitness in coping with shift work
    - 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.

7.100 Refresher briefings 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 with

staff in safety critical roles.

7.101 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 and other staff representatives have a role to play in making reasonable efforts to ensure that fatigue risk management good practice is considered by their representatives during negotiations on working patterns and other issues having a bearing on the control of fatigue risks so that negotiated terms and conditions and resulting working patterns do not give rise to excessive fatigue.

Manage and supervise staff working hours

7.102 Once work patterns are in place, arrangements should be made to manage staff working hours, that is, overtime (including exceedances), shift exchange, travel time and on-call duties. This is discussed below. Without proper control, these factors can negate well-designed shift patterns and significantly increase fatigue risk in workers. The arrangements made, including the allocation of responsibilities, roles and functions regarding fatigue management, should be documented in the FRMS.

7.103 In addition, arrangements should be made to ensure the fitness of workers via medical assessments during the selection process and via fitness for duty checks. Both are discussed below.

7.104 Manage overtime:

- Planned work patterns may vary when workers are on call or when unplanned overtime needs to be worked, e.g. because of worker shortages or sickness. 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 and risk assessing overtime 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 paragraphs 7.20 to 7.92 in Implementing your plan including the summary in 7.92). Short-notice changes should be avoided so far as is reasonably practicable. See para 7.105 on limiting exceedances.
- If a fatigue assessment tool, or scheduling software, is used as part of the overtime

authorisation decision to estimate likely fatigue risks from changes to planned rosters more easily, its limitations should be appreciated (see Appendix D).

7.105 Manage exceedances:

- Dutyholders 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 only. 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.
- 'Infrequent basis and exceptional circumstances' relate 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.
- Dutyholders 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. an exceedance authorisation form).
- 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.

- 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.

  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.

7.106 Manage shift exchange:

- 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 Designing your work patterns paragraphs 7.20 to 7.92). 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 D.

7.107 Manage travel time:

- There may be an increasingly important role for technology in easily recording and

monitoring working time. Electronic swiping of Sentinel or other personal smartcards 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.

- Recording and reviewing the start and end times of individuals working periods (e.g. booking on and off) is common in some rail occupations and helpful for gathering information on overtime worked but, at present, it is not done for 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 reviewing and monitoring the time spent working and time spent travelling associated with work helps a company honestly assess the demands on their employees and the fatigue these demands are likely to generate. This 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 A on Travel Time for further information.

7.108 Manage on-call arrangements:

- Many rail occupations involve some form of on-call duty, especially supervisory and management roles. Unless carefully managed, on-call work can easily operate outside 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 on-call as a 'just in case' measure 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 risk control by ensuring that only well-rested individuals manage important calls, therefore reducing staff fatigue and improving 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 anticipating calls 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.

7.109 Medical assessment:

- ROGS 2006 Reg 24 states controllers of safety critical work are to ensure that a person under their management, supervision or control who carries out safety critical work, is competent and fit to carry out the work so far as is reasonably practicable. Therefore, 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 obstructive sleep apnoea (intermittently stopping breathing during sleep, which disturbs sleep and causes fatigue) is higher than in the general population. RSSB has researched obstructive sleep apnoea (RSSB, 2006 Research Report T299) and has produced useful guidance (RSSB, 2014 GOGN 3655 Issue 2).
- 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 obstructive 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 Apnoea Association detailed in Further Information). 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.

7.110 Fitness for duty:

- 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. 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 undertake, nor continue with, safety critical work (ROGS 2006 Reg 25). Fitness for duty checks should include both objective (e.g. hours of sleep or wakefulness) and subjective measures (e.g. how alert or sleepy people feel). Both are considered below.
- 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.
- 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. The reason(s) why the safety critical worker is or has become fatigued should be established, so far as is reasonably practicable.
- 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 visual assurance that individuals are in a physically fit state for work. 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.
- In addition, various fatigue question-sets and rating scales are available which may help staff checking fitness for duty (see RSSB, 2022, Fitness for duty and assessing fatigue) but a culture of honesty is important to the success of such an approach. The best example to set for staff working when they are fatigued is to develop 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 fatigued 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.

- 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 affected. 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 relies on staff not abusing the arrangements.

8. Check

8.1 The key actions in the Check part of the framework are Measuring performance and Investigating accidents and incidents (refer to HSE publication HSG65 for general guidance).

Measuring performance

8.2 For effective fatigue risk management, organisations should measure their performance, evaluating how their plans have been implemented, whether risks have been controlled and if the organisation's aims are being achieved. Actual rather than planned working patterns should be monitored and assessed for deviations from good fatigue management practice, potentially using a fatigue assessment tool. Other methods can also be used to measure fatigue, e.g. simply asking staff or using staff reporting systems and staff surveys. Allowing staff to respond anonymously when appropriate may facilitate open and honest feedback. Keeping records can provide useful fatigue data from shift exchange, overtime, sickness absence and travel time. Ideally, organisations should establish metrics or key performance indicators (KPIs) which reflect the degree of fatigue in the organisation and enable organisation to measure performance over time.

Monitor working patterns – actual rather than planned

8.3 To be effective, an FRMS should incorporate procedures for measuring and monitoring the levels of fatigue of actual, not only planned, working patterns.

8.4 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.

Monitor deviations from good fatigue management practices.

8.5 It can be difficult to detect fatigue in operational settings because, unlike alcohol impairment, there is no 'blood test' to measure 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 Designing your work patterns) 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.

8.6 It might also be appropriate to monitor any periods of non-safety critical work that could have a bearing on a safety critical worker's fatigue and ability to undertake the safety critical work.

Consider using a fatigue assessment tool to assess rosters and/or samples of actual hours worked.

8.7 Similarly, fatigue assessment tools can be used retrospectively on actual working patterns to help identify relative fatigue risks. Some 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. These 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. More information is provided in Appendix C.

8.8 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.

Obtain staff feedback

Ask staff

8.9 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. Asking staff occasionally about fatigue during everyday contacts helps monitor whether fatigue is a concern for them, and 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.

Fatigue reporting systems

8.10 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 as it is often under reported. RSSB has produced guidance in their document 'Encouraging your staff to report their fatigue concerns' (detailed in Further Information). Appendix C provides more guidance on fatigue reporting systems, and Appendix B details features of a positive safety culture to encourage open reporting.

Fatigue surveys

8.11 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 fatigued. 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 (2010, Research 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 perceptions of fatigue and its causes. 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 9-point Karolinska Sleepiness Scale (KSS) see Figure 12.1) 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 C provides more advice on fatigue reporting. 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.

Evaluate data from company records

Monitor trends in shift exchange

8.12 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.

Monitor trends in overtime

8.13 Excessive overtime levels could have a bearing on workers' fatigue. Monitoring trends in overtime (whether planned or unplanned) 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.

8.14 If working hours information for monitoring fatigue is derived from payment systems,

employers should ensure that the information accurately reflects actual hours worked. There have been instances where overtime payment systems and unrecorded on-call duty has distorted the true picture of actual hours worked.

Examine sickness absence records

8.15 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).

Monitor travel time

8.16 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 a person's fatigue and ability to undertake safety critical work. Appendix A provides more information on travel time.

Interrogate other data sources

8.17 Other data, for example errors in procedures, near misses, impact of service disruption on workload and other safety-concern reporting systems can all help form a more complete picture of fatigue and its likely causes. If there are 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.

8.18 Useful background on methods for measuring fatigue can be found in Appendix C.

Monitor Key Performance Indicators (KPIs)

8.19 The continuous improvement process should include a system for evaluating and reporting the overall effectiveness of the FRMS. Organisations should monitor their metrics or key performance indicators (KPIs) which have been set up to 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. Sources of data for these KPIs could include any of those suggested in this section (Evaluate data from company records). 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. ORR produced a KPI Information sheet in 2017 which may be useful to organisations devising or reviewing their own fatigue KPIs. It outlines a suggested approach for deriving fatigue KPIs, suggests some possible KPIs collated from railway and wider sectors, and provides links to further information.

Investigate the causes of accidents, incidents or near misses

8.20 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. Designing your work patterns), and a fatigue risk assessment tool may be used to assess likely fatigue (refer to Appendix D). These findings should be supplemented by a 'reality check', asking the individuals involved, and individuals with experience of similar work patterns, 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 C 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 B on features of a positive safety culture.

9. Act

9.1 The key actions in the Act part of the framework are Reviewing performance and Learning lessons (refer to HSE publication HSG65 for general guidance).

Reviewing performance

9.2 Organisations should actively use data collected during 'Check' to review their performance regarding the levels of fatigue experienced by their staff and to inform their understanding of whether or how fatigue contributes to near misses, incidents, and accidents in their organisation.

9.3 A review should be undertaken when:

- 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 contributory 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.
- KPIs or other metrics indicate adverse trends which suggest the need for change to existing controls.
- 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.
- There is any other reason to doubt the effectiveness of the arrangements.

9.4 So far as is reasonably practicable, the findings of the fatigue review process should be fed

back into the Fatigue Risk Management System (FRMS) to ensure that fatigue controls continuously improve. However, dutyholders and controllers of safety critical work should consult with staff, including safety critical workers, and their trade union / safety representatives on the arrangements needed to manage fatigue and when standards and limits are to be changed. Following consultation, dutyholders should take account of the views and experiences of the safety critical workers and other staff affected, as expressed either directly or through their trade union / safety representatives.

9.5 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.

Learning lessons

Feedback review results into the FRMS

9.6 An effective FRMS ensures that the results of the review processes are fed back into FRMS improvements. This involves acting on findings of fatigue accident investigations and near miss reports (See Investigating accidents and incidents, para 8.20) and organisational vulnerabilities identified throughout the process. Organisational learning is a key aspect of health and safety management (and why a just culture is so important – see Appendix B) because if underlying causes are not identified and communicated throughout the organisation this makes a recurrence more likely.

9.7 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.

9.8 Organisations may find the suggestions in the FRMS checklist at Appendix F 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.

9.9 Useful sources of guidance on Fatigue Risk Management Systems are listed in Further Information.

10. Appendix A: Travel time

Driving for work and associated risks

10.1 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 fatigued 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.

10.2 An estimated 25 to 33% of fatal and serious UK road traffic accidents involve drivers who are on the road for work related reasons (HSE, 2001). Fatigue is thought to cause 20% of all road crashes and 25% of all serious or fatal crashes (RSSB, 2013).

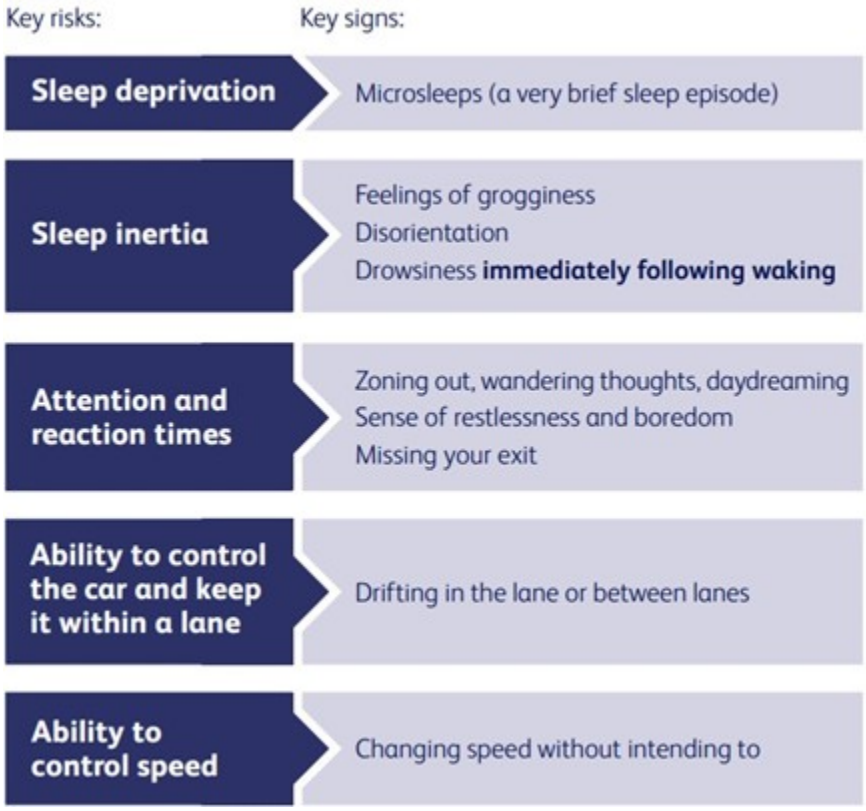
10.3 The courts take a serious view of employers not adequately controlling fatigue in staff driving home after work. In March 2020, ORR successfully prosecuted 'Renown' for failing to manage worker fatigue. This was a landmark case following the tragic deaths of two mobile rail maintenance staff driving home after an overnight welding job. The driver did not appear to have had any significant sleep for more than 24 hours before their vehicle collided with one parked in a layby. 'Renown' was prosecuted on three offences, under sections 2 and 3 of the Health and Safety at Work Act (1974) (risks to employees and non-employees respectively), and under regulation 3 of the Management of Health and Safety Regulations (1999) for failing to carry out a suitable and sufficient risk assessment in respect of fatigue risks. The successful prosecution resulted in a £450,000 fine for the company as well as £300,000 in costs. 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. Again, the firm was prosecuted under the Health and Safety at Work Act (1974) and convicted of failing to ensure the health and safety of their employee and the public.

10.4 Driver fatigue is a serious issue amongst those who drive on the road for work as they are

more likely to drive in fatiguing situations due to (for example) long working and driving hours, irregular shifts, time pressures, at times of day when sleepiness levels naturally peak due to circadian rhythms and / or following sleep loss and potentially covering long distances.

10.5 Individual differences, other health conditions, social and domestic circumstances and poor driver awareness of both fatigue and effective countermeasures to manage the risks can also put drivers at an increased risk of a sleep related road traffic collisions at work. Risks and signs to look out for when driving are illustrated in the diagram below (RSSB, 2022).

Figure 10.1 Risks and signs to look out for when driving



Source: RSSB (2022) Helping you manage fatigue risk while on call Good Practice Guidance

10.6 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. Seventeen hours of sustained wakefulness leads to a decrease in driving performance equivalent to a blood alcohol level of 0.05% (two glasses of wine) which is 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 (Fourie et al, 2010a, Dawson and Reid 1997).

Controlling the risks from travel time

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

- The safety of the rail transport system.
- 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.

10.8 Fatigue risk management systems should therefore include arrangements for assessing and controlling risks from travel time. Employers should:

- Take steps to control their staff 'door to door' time, factoring in shift length/time on site as well as driving time.
- Have booking on arrangements to control the risks, e.g. fitness for duty checks, i.e. that control for staff who are, or could become, unduly fatigued due to travel time (or other issues).
- Make reasonable efforts to ensure that travel times (and sleeping arrangements) are realistic and will not give rise to excessive fatigue.
- Consider the travel time from home when recruiting staff, especially into safety critical roles.

10.9 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 or 'door to door' time. 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:

- 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.

10.10 As discussed in section 7.110 at booking-on, companies should have fitness for duty checks to ensure that staff reporting for safety critical work are not suffering, or likely to suffer during their shift, from fatigue. The checks should 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 - being awake too long before work greatly increases the risk of fatigue later in the work period. RSSB's mini self-assessment tool could provide a useful means for assessing fatigue during fitness for duty checks – see Figure 12.2.

10.11 If remote booking-on procedures are used, random face-to-face checks should be carried out sufficiently frequently to provide visual assurance that individuals are in a physically fit state for work. If a safety critical worker is not fit for work, appropriate control measures (such as providing sufficient rest) should be applied before the safety critical worker commences or recommences safety critical work. The reason(s) why the safety critical worker is or has become fatigued should be established, so far as is reasonably practicable.

10.12 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.

10.13 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.

10.14 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. A 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, 2010 Research Report 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. Free internet journey-planning sites can easily be used to assess whether journeys are feasible in the claimed time if staff are required to record their sleeping locations (postcode / town).

10.15 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. The Royal Society for the Prevention of Accidents estimate the risk of a driver falling asleep at the wheel at 2am to be 50 times greater than at 10am. 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, 2010 Research Report T699 p36), though the significance of travel time will obviously vary depending on the shift length.

10.16 Finally, employers should also consider their wider duties to assess and control work-related road risks in their operation, considering guidance from the HSE's web pages on 'Driving and riding safely for work'. This guidance states that as part of an organisation's health and safety arrangements, they must carry out a risk assessment which should look at the journey, the driver or rider and the vehicle. Hazards that can cause harm to the driver or rider, passengers, other road users and/or pedestrians when driving for work include fatigue and distraction.

10.17 The HSE 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 considered in overall assessments of fatigue risk.

11. Appendix B: Features of a positive safety culture

11.1 Culture can be best understood as 'the way we do things around here'. An organisation's culture will influence human behaviour and human performance at work. Poor safety culture has contributed to many major incidents and personal injuries. Success normally comes from good leadership, good worker involvement and good communications.

11.2 Creating a positive safety 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.

11.3 ORR uses the Risk Management Maturity Model (RM3) to understand the culture in the organisations it regulates. ORR will look at the issues involved in culture in a number of the RM3 assessment criteria including, but not limited to: SP Health and safety policy, leadership and board governance; OC: Organising for control and communication. Seven attributes of an integrated health and safety culture are identified.

11.4 Features of a positive safety culture include a reporting, just, flexible and learning culture; these terms are referred to in this guidance and are explained below.

A reporting culture

11.5 In a reporting culture, people are encouraged and willing to lookout for, and routinely report, errors, near misses, unsafe conditions and behaviours and any other safety concerns. With regards to fatigue, a culture of reporting should be encouraged, underpinned by simple fair processes that are easy to access and that staff are briefed on. Effective reporting systems for incidents, near-misses and concerns regarding fatigue should be easy to use, and give rapid, useful, and accessible feedback to potential reporters.

11.6 Fatigue should not be treated as sickness or as being subject to attendance at work processes. Mutual trust is essential. This means that staff are confident that reporting fatigue will not result in negative consequences (such as being punished or losing pay) and will be followed up and acted upon by the organisation. The behaviour of front-line staff themselves is also important, whereby they do not criticise or demean colleagues who report experiencing fatigue,

or alertness and/or attention issues.

A just culture

11.7 A 'just' culture treats people such that the majority believe justice will usually be dispensed – the system is seen as fair. In a 'just' culture, the company line is more clearly drawn between a 'blame' culture (where fear prevents open risk communication) and a 'no-blame' culture (where sloppy practices and negligence tend to creep in). Such a culture can increase psychological safety, where staff feel more able and comfortable to talk about safety issues such as losing alertness, attention, being fatigued or distracted (RSSB's website provides further information). It is important to gain agreement and trust from staff on fair disciplinary systems; formalising acceptable and unacceptable behaviours in policies and procedures creates transparency and sets expectations.

11.8 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

11.9 In a flexible culture, decisions are made by the people best equipped to make them, irrespective of their position or grade. For example, those suffering from fatigue may be best placed to identify it and self-report. 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.

11.10 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. First-line supervisors will often be those responsible for determining whether staff are too fatigued to work and hence, their competence, specifically in understanding fatigue and its risks, will be key in

effective decision-making. This requires a common understanding of decision premises and assumptions, so that decentralised control is consistent with overall central expectations.

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

11.12 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

11.13 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 and development. Good competence management systems (see ORR's Developing and maintaining staff competence Railway Safety Publication 1, 2016) 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.

11.14 Incidents and failures are seen as valuable opportunities to improve operations, learn lessons and rectify flaws in the safety management system. This includes in depth analysis of underlying causes and learning from accidents, incidents and near misses.

11.15 The lessons learnt from investigations should be communicated widely and recommendations implemented swiftly. 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.

12. Appendix C: Fatigue reporting

12.1 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). Additionally, staff may be disincentivised to report fatigue for shift patterns that they consider favourable, e.g. that

provide sizeable gaps between blocks of shifts. Over time, staff may be more willing to report fatigue for shifts they consider favourable but are in fact fatiguing if they experience the benefits of less fatiguing shift patterns on their home life and rest days, i.e. less need to recoup sleep. 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.

12.2 Staff Fatigue Report Forms (FRF) provide a formal method for collecting data on fatigue and its likely causes and allow staff to suggest possible solutions. They allow staff to report fatigue-related incidents, errors, behaviours, and other concerns. An FRF 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.

12.3 To encourage a culture of self-reporting of fatigue, dutyholders should have clear, simple, quick, and fair processes for reporting fatigue and the actions required when employees are too fatigued to carry out safety critical tasks. For example, to encourage reporting, forms could be kept on hand in all train cabs, depots etc. They 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 description of concerns and possible solutions.

12.4 A fatigue reporting system should be supported by the means for managing and responding to reports including acknowledgment and providing feedback on changes made in response to identified fatigue hazards without compromising the anonymity of individuals. 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.

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

12.6 Some possible information organisations may wish to include on fatigue report forms is as

follows:

- The reason for the report form e.g. unable to attend work due to fatigue, stood down due to fatigue, an incident or a general fatigue concern.
- Relevant details e.g. name, role, date, time, location, contact details.
- Description of the incident of concern e.g. journey to and from work with postcodes and mode of travel, work activity and activity at time of event, contributing factors (multiple consecutive duties, variation in duty timing, long shift, high/load workload), quality of sleep at home or lodging, health, home/personal issues, start and finish time, etc.
- Any signs of fatigue observed. See Table 12.1 below.
- The individual's self-assessment of fatigue e.g. via the nine-point Karolinska Sleepiness Scale (KSS) or RSSB mini self-assessment tool. See below and Figures 12.1 and 12.2.
- Any suggestions for fatigue reduction, corrective actions etc.

12.7 These are some suggestions only, and dutyholders should tailor the information collected so it is appropriate to their needs and the degree of risk.

Table 12.1 Signs of Fatigue

Stage	Signs of fatigue
Early signs	• being quiet or less chatty than usual • fidgeting • rubbing their eyes, or having red sore-looking eyes • being moody, irritable or emotional • being a little more forgetful than usual • not taking as much care with their personal appearance or hygiene
Signs of serious fatigue	• eyes slow to open and close

Stage	Signs of fatigue
	• frequent yawning • frequent or long blinks • eyes rolling back • staring into space • head dropping • being unsteady on their feet • slurring their speech • shaky hands

Arrangements should be made for a welfare conversation to take place with those showing early signs of fatigue, to determine whether they can continue with their duty. Those showing signs of serious fatigue should not be allowed to continue with their duty.

Source: Reproduced from RSSB (2022) Fitness for Duty and Assessing Fatigue: a Good Practice Guide

12.8 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 nine-point Karolinska Sleepiness Scale (KSS), see Figure 12.1. If you are at KSS Level 7 or above you are more likely to experience microsleeping and make errors, particularly while driving. 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 requires honesty in its use.

Figure 12.1 Nine-point Karolinska Sleepiness Scale (KSS)

Source: RSSB (2022) Helping you manage fatigue risk while on call Good Practice Guidance

Information about sleep before a particular duty could be collected in a self-assessment tool such as that developed by RSSB that can help in decision making. It combines rules of thumb on how much sleep you have had recently and how long you're likely to be awake, simple fatigue questions and the KSS. This mini self-assessment tool could be included in fitness for duty checks, see Figure 12.2.

Figure 12.2 Mini self-assessment tool

1 By the time I finish my duty (or if driving, by the time I get back home or to my hotel), how much sleep will I have had in the previous 24 hours? Working it out: Note the time you will finish work. If you are driving to get back home or to a hotel, instead, note the time you will reach there. Work out how much sleep you will have had between the time you finish (or the time you get back, if driving) and the same time on the day before.		
More than 7 hours	6 – 7 hours	Less than 6 hours
2 By the time I finish my duty (or if driving, by the time I get back home or to my hotel), how much sleep will I have had in the previous 48 hours? Working it out: Note the time you will finish work. If you are driving to get back home or to a hotel, instead note the time you will reach there. Work out how much sleep you will have had between the time you finish (or the time you get back, if driving) and the same time two days before.		
More than 14 hours	12 – 14 hours	Less than 12 hours
3 By the time I finish my duty (or if driving, by the time I get back home or to my hotel), will I have been awake for more than 16 hours? Or, will I have been awake for more hours than the number of hours of sleep I have had in the last 48 hours? Working it out: Note the time you wake up from your last sleep. Note the time you will finish work (or if you are driving to get back home or to a hotel, instead note the time you will reach there). Work out the difference between these two. Is the answer longer than 16 hours? Is it longer than the answer to question 2?		
No	Unlikely	Yes
4 In the last 48 hours, have I had less than the usual amount and quality of sleep I need? For sleep quality, think about how restful your sleep felt and how often it was interrupted.		
I got at least my usual amount and quality of sleep	Yes, less than usual	Yes, much less than usual
5 Am I experiencing any physical or mental symptoms of fatigue right now?		
No	Yes, minor signs	Yes, significant signs
6 Do I think I may be suffering from fatigue, or do I have concerns that I am likely to be fatigued in my shift or on my journey home?		
No	I don't think so	Yes

7 How do I feel right now? Make sure you have been awake for at least 20 minutes before answering this question.

1	2	3	4	5	6	7	8	9
Extremely alert	Very alert	Alert	Rather alert	Neither alert nor sleepy	Some signs of sleepi-ness	Sleepy, but no effort to keep awake	Sleepy, some effort to keep awake	Very sleepy, great effort to keep awake, fighting sleep

If one or more of your answers is in the right-hand box, you may be fatigued or at risk of fatigue. In this case, you should speak to your manager or on-call contact to discuss options for managing the risk. If you are at KSS Level 7 or above you are more likely to experience microsleeping and make errors, particularly while driving.

Source: RSSB (2022) Helping you manage fatigue risk while on call Good Practice Guidance

13. Appendix D: Benefits and limitations of fatigue risk assessment tools

Benefits of fatigue risk assessment tools

13.1 Possible benefits of fatigue risk assessment tools and the bio-mathematical fatigue models that underlie them 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 - dutyholders 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 in **incident investigation** as one approach to determine whether fatigue may have been a contributory factor.
- Some fatigue risk assessment tools can be incorporated into **resource planning and monitoring software**, to help organisations devise fatigue-friendly rosters more easily and quickly from the outset. Some packages can be tailored to automatically monitor deviations from 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 and 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 consider 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.

Limitations of fatigue risk assessment tools

13.2 It is imperative to understand that bio-mathematical fatigue models and the fatigue risk assessment tools which use them have significant limitations, so there are several important notes of caution to bear in mind when considering using fatigue risk 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 assume it produces an authoritative 'satisfactory/unsatisfactory' decision. Taking the HSE's Fatigue and Risk Index tool (FRI) (see Spencer and others (2006) for more details) as an example:
    - 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.

    - In 2008, the Health & Safety Laboratory (HSL) produced a report (HSL, 2008) evaluating the UK Rail Sector Initial Fatigue & Risk Index Thresholds, which referred to 'indicative threshold' values for the HSE 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 – staff may still be suffering from significant fatigue, and it will often be reasonably practicable to improve fatigue controls further.
    - It should be noted that the Fatigue Risk Index was withdrawn from the HSE website in June 2021. The HSE determined that the software platform on which it runs is an older version of Excel that can no longer be supported and maintained on the HSE website. Additionally, the design of the FRI requires improvement to promote better understanding of its outputs, its limitations, and its role in a Fatigue Risk Management System. In its current format, there have been cases of the FRI being misused to justify work patterns that clearly require further action to reduce fatigue-related risk. FRI users who have access to the FRI in its current format can continue to use it provided they have the necessary expertise and understand the outputs and limitations.
- The choice of any **threshold should** so far as reasonably practicable **be validated** against the specific activities of the company. The same level of fatigue may produce very different levels of risk depending on the activity conducted. A sensible approach would be for an organisation to develop its own 'acceptable' limitations based on a retrospective analysis of statistical correlations between its performance (or data from similar operations which are representative) and/or safety indicators, and the model outputs (RSSB, 2016 Research Report T1083). However, organisations should still treat any '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.
- 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 risk 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 consider 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. RSSB also note that accumulation of fatigue over extended periods (several weeks) are currently not well represented in the models (RSSB, 2016 Research Report T1083). 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.
- Fatigue risk assessment tools mostly predict the potential for fatigue risk, but **do not directly assess the risk of performance issues** that may contribute to safety events. Several research projects referenced in RSSB's 2016 Research Report T1083 have demonstrated that the link between fatigue and safety is neither simple nor linear. It may also differ depending on the type of cognitive and/or physical tasks performed, the possibility to co-operate with co-workers and the use of automated systems.

Summary

13.3 Reviews of fatigue models, tools and their uses (CASA 2014; Dawson and others, 2011 and RSSB, 2016 Research Report T1083) emphasise their limitations, and that they are only appropriate as **one element in a wider fatigue risk management system**. It is essential that additional strategies are used to identify and manage fatigue to complement this approach for example fatigue awareness programmes for schedulers and staff, fatigue reporting systems and consistency with good fatigue management practices.

13.4 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.

13.5 Overall, although fatigue assessment tools are a **useful aid to making decisions** about

fatigue, it is important to consider 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. Trusting the outputs of fatigue models in isolation can result in decisions which either promote fatigue or place un-necessary limitations on work.

14. Appendix E: Definitions and abbreviations

Definitions

14.1 Regulation 2 of ROGS 2006 gives the full legal definitions of most of the terms used in the regulations. This section provides a simple explanation of terms as used in this guidance. These explanations do not replace any full legal definitions.

Alertness - a state of being awake, aware, attentive and prepared to act or react.

Block of consecutive shifts - 2 or more consecutive shifts, without interruption by a rest day.

Change to existing working patterns refers to the working pattern of people undertaking 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.
- 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).

Circadian rhythm - the 24-hour natural, internal clock in our brain that controls alertness and sleepiness. It is based on light changes in the environment.

Day shift - shifts where all work hours fall between 07:00 and 19.59

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

Existing limits:

- For operations already in existence, the limits already established in that operation.
- 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 - a state of reduced mental or physical capability resulting from sleep loss or extended wakefulness, disruption to circadian rhythms (the 'internal body clock'), workload (mental and/or physical activity) and/or prolonged working that can impair alertness and the ability to perform safely and/or effectively.

Fixed shifts - that workers work the same shift on a permanent basis.

Late shift - shifts where all work hours fall between 20:00 and 02:00

Night shift - any duties which covers the period 00:00 to 05:00 inclusive.

On call - waiting to respond to an emergency call out or answering a query from people working in the field. Being on call (or on standby) means an employee is expected to be available to carry out working duties if their employer contacts them, usually at short notice.

Rest - a continuous period between 2 shifts during which the operator is free of all duties.

Rest day - continuous rest of 24 hours, including a full night's sleep. The day following a night shift cannot be counted as a rest day.

Rotating shifts - workers work a pattern of changing shifts e.g. rapid rotation - two days per shift type: slow rotation approximately 21 days per shift.

Shift (or period of duty) - a continuous period beginning when the employee reports for work and ending when he is free of all duties. Meal and rest breaks within the shift count towards the total length, as does overtime. However, commuting times do not unless specified.

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

Very early or early shift - shifts starting between 04:00 and 06:59.

Abbreviations

- ATP: Automatic Train Protection
- AWS: Automatic Warning System
- CASA: Civil Aviation Safety Authority
- DERA: Defence Evaluation and Research Agency
- DfT: Department for Transport
- DVD: Drivers Vigilance Device
- ETCS: European Train Control System
- FF: Fatigue Factor
- FRF: Fatigue Report Forms
- FRI: Fatigue and Risk Index tool
- FRMS: Fatigue Risk Management System
- HSE: Health and Safety Executive
- HSL: Health and Safety Laboratory
- HSWA: The Health and Safety at Work Act
- IARC: International Agency for Research on Cancer
- KPIs: Key Performance Indicators
- KSS: Karolinska Sleepiness Scale
- MHSWR: The Management of Health and Safety at Work Regulations
- MRSF: Managing Rail Staff Fatigue
- NTS: Non-Technical Skills
- ORR: Office of Rail and Road
- POPMAR: Policy, Organising, Planning, Measuring performance, Auditing and Review
- RAIB: Rail Accident Investigation Branch
- RM3: Risk Management Maturity Model
- ROGS: The Railways and Other Guided Transport Systems (Safety) Regulations
- RSSB: Rail Safety and Standards Board
- SMS: Safety Management System
- SPAD: Signal Passed at Danger

- TPWS: Train Protection and Warning System
- WTR: The Working Time Regulations

15. Appendix F: A Fatigue Risk Management System checklist

15.1 Some features of a Fatigue Risk Management System (FRMS) are summarised in the document 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.

A Fatigue Risk Management System checklist (docx 1.34 MB)
Published 15 August 2024
DOCX 1.34 MB
More info
Download

16. References

Belenky G, Westensen NJ, Thorne DR, Thomas ML, Sing HC, Redmond DP, Russo MB and Balkin TJ (2003) 'Patterns of performance degradation using sleep restriction and subsequent recovery: a sleep dose-response study. Journal of Sleep Research', 12; pages 1 to 12

Civil Aviation Safety Authority (CASA) (2014) Biomathematical Fatigue Models Guidance Document (viewed on 13 August 2024)

Costa G (2003) 'Shift work and occupational medicine: an overview' Occupational Medicine, 53, pages 83 to 88

Dawson D and Reid K (1997) 'Fatigue, alcohol and performance impairment' Nature, 388, page 235

Dawson D, Fletcher A and Hussey F (2000) 'Beyond the Midnight Oil: Parliamentary Inquiry into Managing Fatigue in Transport', Adelaide: Centre for Sleep Research, University of South Australia

Dawson D, Noy YI, Harma M, Akerstedt T and Belenky G (2011) 'Modelling fatigue and the use of

fatigue models in work settings. Accident Analysis and Prevention', 43, pages 549 to 564

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, pages 588 to 597

Dorrian J, Baulk SD, and Dawson D (2011) 'Work hours, workload, sleep and fatigue in Australian Rail Industry employees' Applied ergonomics, 42(2), pages 202 to 209

Driscoll RT, Grunstein RR and Rogers NL (2007) 'A systematic review of the neurobehavioural and physiological effects of shiftwork systems' Sleep Medicine Reviews, 11, pages 179 to 194

Flin R, O'Connor P and Crichton M (2008) 'Safety at the Sharp End - A Guide to Non-Technical Skills', CRC Press, Taylor and Francis Group

Folkard S (2000) 'Foreword to: The impact of shiftwork and fatigue on safety' Railtrack PLC, January 2003

Folkard S, Akerstedt T (2004) 'Trends in the risk of accidents and injuries and their implications for models of fatigue and performance' Aviation, Space and Environmental Medicine, 75, 3 supplement; A161-A167

Folkard S, Lombardi DA (2006) 'Modelling the impact of the components of long work hours on injuries and accidents' American Journal of Industrial Medicine, 49, pages 953 to 963

Folkard S (2008) 'Do permanent night workers show circadian adjustment? A review based on the endogenous melatonin rhythm' Chronobiology International, 25 (2-3), pages 215 to 224

Fourie C, Holmes A, Hilditch C, Bourgeois-Bougrine S and Jackson P (2010a) 'Fatigue risk management systems: a review' Research Report Number 110, London: Department for Transport

Fourie C, Holmes A, Hilditch C, Bourgeois-Bougrine, S and Jackson P (2010b) 'Interviews with operators, regulators and researchers with experience of implementing fatigue risk management systems' Research Report Number 120, London: Department for Transport

Gurubhagavatula I, Barger L K, Barnes C M, Basner M, Boivin D B, Dawson D, Drake C L, Flynn-Evans E E, Mysliwiec V, Patterson P D, Reid K J, Samuels C, Shattuck N L, Kazmi U, Carandang G, Heald J L, and Van Dongen H P A (2021) 'Guiding principles for determining work shift duration and

addressing the effects of work shift duration on performance, safety, and health: Guidance from the American Academy of Sleep Medicine and the Sleep Research Society' Sleep, 44(11), page 16

Harrington J M (2001) 'Health effects of shift work and extended hours of work' Occupational and Environmental Medicine 58, pages 68 to 72

Health & Safety Executive (HSE) (1999) 'Validation and Development of a Method for Assessing the Risks Arising from Mental Fatigue'

Health & Safety Executive (HSE) (2001) 'Work-related Road Safety Task Group – Reducing at-work road traffic incidents' (viewed on 13 August 2024)

Health & Safety Laboratory (HSL) (2008) 'Evaluation of the UK Rail Sector Initial Fatigue & Risk Index Thresholds: Identifying Good Practice'

Hilditch C J, Dorrian J, Centofanti S A, Van Dongen H P A and Banks S (2017) 'Sleep inertia associated with a 10-min nap before the commute home following a night shift: A laboratory simulation study' Accident Analysis & Prevention, 99 (Part B), pages 411 to 415

IARC (2010) 'IARC monographs on the evaluation of carcinogenic risks to humans' Volume 98 on Shiftwork, International Agency for Research on Cancer. Lyon, France (viewed on 13 August 2024)

Itani O, Jike M, Watanabe N, Kaneita Y (2017) 'Short sleep duration and health outcomes: A systematic review, meta-analysis, and meta-regression' Sleep Medicine, 32, pages 246 to 256

Jackson, P (2008) 'Designing a Company Fatigue Reporting System' Presentation by Clockwork Research Ltd

Knutsson A (2003) 'Health disorders of shift workers' Occupational Medicine 53, pages 103 to 108

McGuffog A, Spencer M B, Stone B M and Turner C (2005) 'Guidelines for the Management and Reduction of Fatigue in Train Drivers' T059, RSSB (viewed on 13 August 2024)

Monk (2005) 'Shift Work: Basic Principles In book: Principles and Practice of Sleep Medicine' pages 673 to 679

Moreno C, Marqueze E, Sargent C, Wright K, Ferguson S and Tucker P (2019) 'Working Time Society: Consensus Statements: Evidence-based effects of shiftwork on physical and mental health' Industrial Health 57, pages 139 to 157

ORR (2006) 'Managing fatigue in safety critical work Railways and Other Guided Transport Systems (Safety) Regulations 2006'

Pack A I, Pack A M, Rodgman E, Cucchiara A, Dinges D F and Schwab C W (1995) 'Characteristics of crashes attributed to the driver having fallen asleep' Accident Analysis and Prevention, 27(6), pages 769 to 775

Robertson K, Spencer M, McGuffog A and Stone B (2010) 'Fatigue and Shiftwork for Freight Locomotive Drivers and Contract Trackworkers: Implications for Fatigue and Safety' (T699), RSSB

RSSB (2005) 'Research Report T059, Human factors study of fatigue and shift work. Human factors study of fatigue and shift work' (T059) (viewed on 13 August 2024)

RSSB (2006) 'Human factors study of obstructive sleep apnoea in train drivers Human factors study of obstructive sleep apnoea in train drivers' (T299) (viewed on 13 August 2024)

RSSB (2010) 'Fatigue and shift work for freight locomotive drivers and contract trackworkers Fatigue and shiftwork for freight locomotive drivers and contract trackworkers' (T699) (viewed on 13 August 2024)

RSSB (2012) 'Fatigue Management – A Good Practice Guide' RS504 Issue 1 (viewed on 13 August 2024)

RSSB. (2013) 'Managing Occupational Road Risk Associated with Driver Fatigue: A Good Practice Guide' (Needs login account. Viewed on 13 August 2024)

RSSB (2014) 'Guidance on Medical Fitness for Railway Safety Critical workers' GOGN3655 Issue 2 (under review) (viewed on 13 August 2024)

RSSB (2016) 'Guidance document on biomathematical fatigue models' T1083 (Needs login account. Viewed on 13 August 2024)

RSSB (2020) '9 Things You Should Consider for Your Fatigue Risk Management Plan'

RSSB (2021) 'Understanding the Functional Requirements for Train Driver Attention and Alertness Monitoring Devices' (T1193) (viewed on 13 August 2024)

RSSB (2022) 'Fitness for Duty and Assessing Fatigue: A Good Practice Guide' Issue 2 (Needs login account. Viewed on 13 August 2024)

RSSB (2022) 'Good Practice Guidance - Helping you manage fatigue risk while on call' (Needs login account. Viewed on 13 August 2024)

Ruggiero J S and Redeker N S (2014) 'Effects of napping on sleepiness and sleep-related performance deficits in night-shift workers: A systematic review' Biological Research for Nursing, 16(2), pages 134 to 142 (viewed on 13 August 2024)

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

Spencer M B, Robertson K A and Folkard S (2006) 'The development of a fatigue/risk index for shiftworkers' HSE Books Research Report 446 (viewed on 13 August 2024)

Summala H, Hakkanen H, Mikkola T and Sinkkonen J (1999) 'Task effects on fatigue symptoms in overnight driving' Ergonomics, 42(6), pages 798 to 806

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, pages 117 to 126

Walsh J K, Randazzo A C, Stone K L, Schweitzer P K (2004) 'Modafinil improves alertness, vigilance, and executive function during simulated night shifts' Sleep, 27, pages 434 to 439

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.
- Chartered Institute of Ergonomics and Human Factors, 7 The Courtyard, Wootton Park, Wootton Wawen, Warwickshire B95 6HJ.
- Society of Occupational Medicine, 2 St Andrew's Place, Regent's Park, London NW1 4LB.