Transport Canada Transports Canada

427 Laurier Avenue, 14th Floor
Ottawa, Ontario, K1A 0N5

DEC 2 0 2018

Your file Votre référence

Our file Notre référence
RDIMS 14402784

Please See Attached List

Dear Sir/Madam:

As you know, the issue of employee fatigue in the railway industry has been a cause for concern for some time. In its Notice of Intent published in the *Canada Gazette I* on November 11, 2017, Transport Canada (TC) announced its most current policy direction with respect to the management of fatigue in the rail industry.

In addition, the Transportation Safety Board of Canada (TSB) has cited sleep-related fatigue as a contributing factor or risk in 23 TSB railway investigations conducted since 1994, 19 of which involved crew operating freight trains. As a result, the TSB has placed fatigue in the rail industry on its Watchlist.

More recently, the 2018 *Railway Safety Act* Review recommendations advised that TC should take a leadership role with respect to fatigue in the railway industry and regulate "prescriptive minimum criteria and non-prescriptive measures based on fatigue science".

In accordance with subsection 19(1) of the *Railway Safety Act*, the Minister may, by order, require a company to formulate rules respecting hours of work and rest periods to be observed by persons employed in positions declared to be critical to safe railway operations (hereafter referred to as Work/Rest Rules (*WRRs*)). Since being approved in 2002, only minor changes have been made to *WRRs*, with the introduction of Fatigue Management Plans (FMPs) in 2011. Consequently, existing *WRRs* do not reflect the latest fatigue science which has evolved over the past 20 years to the point where certain key principles are agreed upon by the scientific community. Moreover, the existing regulatory regime is limited with respect to prescriptive limits (only rest periods and duty day limits are addressed) and any limitation beyond the length of the duty and rest periods is either voluntary on the part of railway companies or addressed through collective agreements between railway employees and their employers. As a result, railway fatigue management plans and collective agreements have evolved to partially fill some of the gaps in the *WRRs*, creating a patchwork of approaches to manage fatigue, most of which are not subject to TC oversight.

Canada

For these reasons, and as authorized by the Minister of Transport, I am issuing this Ministerial Order under paragraph 19(1)(a) of the *Railway Safety Act* instructing railway companies to revise the *WRRs* by May 19, 2019, to reflect the latest fatigue science and fatigue management practices and, at a minimum, address the following elements:

1. Length of a Duty Period

The current *WRRs* do not respect fatigue science as they allow workers to be on shift for 18 hours and do not provide for shorter shift periods during the evening or during the Window of Circadian Low (WOCL).

The *WRRs* currently contain the following provisions related to on-duty time:

- The maximum continuous on-duty time for a single shift is 12 hours; however, the *WRRs* allow operating employees to work additional shifts, up to a maximum of 18 hours.

The science tells us that human performance will begin to degrade after being awake for 12 to 14 hours, as evidenced through research and incident and accident data analysis. Studies have shown that after being awake for 17 hours, performance degrades to a level equivalent to having a blood alcohol concentration of 0.05%, and after 24 hours performance is degraded to a level equivalent to a blood alcohol concentration of 0.10%.

In addition to research relating to hours of duty, there is also scientific literature which demonstrates that performance significantly decreases during the Window of Circadian Low (WOCL), which occurs between midnight and 06:00. It is not possible in the rail industry to avoid working during those hours, but consideration should be given to fatigue management methods to counteract this risk such as reduced duty periods during these hours.

2. Split Duty (Split Shifts)

The current *WRRs* do not account for the amount of sleep obtained or the ability to obtain quality sleep during split shift breaks. Nor do they account for the total time the employee is awake and on duty.

The *WRRs* currently state:

- Where a tour of duty is designated as a split shift, as in the case of commuter service, the combined on-duty-time for the two on-duty periods cannot exceed 12 hours.

Studies conducted on train drivers and traffic controllers operating split duty shifts indicated that the existence of severe sleepiness was associated with both shift type and shift length. Night shifts were definitely the most significant single factor, leading to a 6–14 times higher risk for severe sleepiness, compared with the day shift.

The problem associated with a split duty shift is it cannot be guaranteed that the employee working a split duty period will be able to sleep during the time period between the two parts of the duty period (the employee may or may not go home depending on the length of the break or obtain suitable accommodation to nap). Therefore, a maximum duty time limitation must be established that not only takes into account the combined time on duty, but also the rest period in between the shifts and the potential for quality rest.

Research has shown that there is limited ability to sleep during the day during a split shift and more potential during the night. Also, studies conducted on train drivers and traffic controllers operating split duty shifts indicated that the existence of severe sleepiness was associated with both the shift type and the shift length. Night shift was definitely the most significant single factor, leading to 6–14 times higher risk for severe sleepiness, compared with the day shift.

3. Minimum Rest Period

The current *WRRs* do not reflect fatigue science as the current amount of rest provided is insufficient to obtain 8 hours of sleep.

The *WRRs* currently state that:

- An employee who goes off-duty after being on-duty in excess of 10 hours must be given a rest period of 6 hours away from home terminal, and 8 hours at home terminal.

Numerous TSB accident reports point to sleep deprivation as a causal factor in rail accidents. The 2011 derailment of a CN freight train on the Wainright Subdivison in Kinsella, Alberta found that the lack of sleep in the 24 hour period prior to the accident (the locomotive engineer had 3.5 hours of sleep and the conductor had not slept at all) played a contributing role in this occurrence.

It is well known, and one of the basic tenets of fatigue science, that a regular 8 hour rest period is required to sustain human performance and that human beings need 8 hours of sleep in a 24 hour period to fully recover. In order to get 8 hours of sleep at home base, research shows that it takes a person 12 hours off duty to get 8 hours of sleep, taking into account commuting, social demands, nutrition and hygiene needs.

4. Deadheading

The current *WRRs* do not account for time spent deadheading after a shift.

The *WRRs* currently state that:

- Deadheading at the commencement of a tour of duty is included in the total on-duty time in Section 5.3 of the WRRs but deadheading is permitted following the expiration of maximum hours on-duty without regard to the maximum duty time.

The *WRRs* do not fully account for additional hours of wakefulness resulting from travel time incurred when employees travel between the location where their shift ends and their place of rest while away from home. Furthermore, when instituting the practice of deadheading employees, consideration needs to be given to the science relating to maximum duty and minimum rest times.

5. Cumulative Time on Duty

The current *WRRs* do not include provisions for addressing cumulative fatigue resulting from excessive hours of weekly, monthly and annual work.

The current *WRRs* only contain provisions designed to address acute fatigue. There are no weekly or monthly maximum limits on hours of work that would provide a defense against the effects of cumulative fatigue. Cumulative fatigue results from working multiple successive, extended periods of duty without time free from work and is compounded by inadequate rest periods. A failure to obtain sufficient sleep results in an inability to recuperate – this is known as a "sleep debt." An extended rest period is required to recover from a sleep debt and to counteract cumulative fatigue.

There is a large body of research on this issue and the current literature concludes that the limit of cumulative duty time for a week (defined as 7 consecutive days) should be 60 hours, although the *Canada Labour Code* and the *European Union Working Time Directive* set a limit of 48 hours and 40 hours respectively.

Research shows that working in jobs with overtime schedules (beyond 40 hours a week) was associated with a 61% higher injury hazard rate compared to jobs without overtime. Working at least 12 hours per day was associated with a 37% increase in the hazard rate and working at least 60 hours per week was associated with a 23% increase in the hazard rate.

6. Minimum Time Free from Work

The current *WRRs* do not provide an extended period of time free from work.

In order to address cumulative fatigue, it is necessary to provide time off or a substantive period away from work to obtain recuperative rest. Time free from work is distinct from breaks. More specifically, it refers to the time the employee is not working after the relevant number of consecutive shifts before the clock is reset.

There are many examples of existing standards in use in other transportation sectors, for example the *United Kingdom Office of Rail Regulation* state that shift workers benefit from regular recovery periods of at least 48 hours. Additionally, the *Canada Labour Code*, Part III, Division I recognizes the need for at least one day of rest per week.

7. Advance Notice of Work Schedules

The current *WRRs* do not require that employees be provided with a schedule of work.

Providing employees with advance notice of work schedules provides certainty and the opportunity for employees to appropriately plan sleep. The *Railway Safety Management System Regulations, 2015*, only requires railway companies to create scheduling plans based on fatigue science principles when a schedule:

- Is not communicated to the employee at least 72 hours in advance;
- Requires the employee to work beyond their normal work schedule; or
- Requires the employee to work between midnight and 6:00 a.m.

Currently, discretion resides with the railway companies and collective agreements to implement additional fatigue management considerations.

8. Fatigue Management Plans (FMP)

The current *WRRs* FMP requirements do not incorporate best practices with respect to fatigue management.

The *WRRs* currently require that:

- Railway companies implement fatigue management plans "... that reflect the nature of the operations under consideration", and be designed to reduce fatigue and improve on-duty alertness of operating employees.

Established in 2011, FMPs do not reflect present-day fatigue science and modern fatigue management practices. Although the current rules represent an initial attempt at managing fatigue risks in a 24/7 operational environment, FMPs are not always effective.

Modern and comprehensive FMPs go beyond the existing *WRRs* requirements. In particular, FMPs should clearly address both the individual and the company's responsibilities regarding fatigue management and provide more detail with respect to what is fitness for duty, how employees can attest to being fit for duty, and the policy and processes in place to deal with employees who declare themselves not fit for duty.

The November 11, 2017 Notice of Intent published by TC indicated that a review of Fatigue Risk Management System (FRMS) best practices was underway to support the potential future introduction of regulatory requirements for FRMS. The Department is aware that FMP requirements and future FRMS requirements may eventually overlap. However, until such time as the FMPs are replaced, FMP requirements are necessary to ensure effective fatigue management and shall remain an element of the *WRRs*.

To support railway companies in the development of revised *WRRs*, and to provide additional insight on the elements and limitations included in this Ministerial Order, please find in Appendix B additional background information as well as brief discussion around basic fatigue principles and the science that supports them.

Also, given that the WRRs greatly impacts employee performance, and in order to ensure the best possible results during TC's consideration of the rules, I strongly encourage that the mandatory 60 day consultation between railway companies and relevant associations or organizations, as required under paragraph 19(2)(a) of the *Railway Safety Act*, take place early on in this process.

Should you have any questions regarding this Ministerial Order please contact Jacqueline Booth at (613) 990-8690 or by e-mail at jacqueline.booth@tc.gc.ca

Sincerely,

Brigitte Diogo
Director General
Rail Safety

Encl.

MINISTER OF TRANSPORT

ORDER PURSUANT TO SECTION 19 OF THE

RAILWAY SAFETY ACT, CHAPTER R-4.2, [R.S., 1985, C. 32 (4th SUPP.)]

Paragraph 19(1)(a) of the *Railway Safety Act* (RSA) gives the Minister of Transport the authority to order a railway company to formulate rules respecting any matter referred to in subsection 18(1) or (2.1) or to revise its rules respecting that matter.

Pursuant to the provisions of paragraph 19(1)(a) of the RSA, the railway companies listed in Appendix A are hereby ordered to revise the *Work/Rest Rules for Railway Operating Employees*.

The revised rules shall reflect passenger and freight operations, the latest fatigue science (as discussed in the cover letter and in Appendix B of this Order), consider the latest developments in research and technology around fatigue and fatigue management, and shall, at a minimum, address the following elements:

(1) the maximum length of a duty period (in hours), that considers increases or decreases based on the time of day the duty period starts;
(2) when employees are assigned split shifts, the maximum combined duty period;
(3) the minimum rest periods, both at the home terminal and away from the home terminal;
(4) the impact of deadheading on the maximum duty period, both when deadheading occurs at the beginning and at the end of a shift;
(5) the maximum cumulative time on duty, for periods of 7 consecutive days (1 week), 28 consecutive days (4 weeks), and annually;
(6) the minimum time free from work on a weekly and monthly basis;
(7) advance notice to employees of their planned work schedule; and
(8) a fatigue management plan that reflects current best practices in the management of fatigue.

Subsection 19(2) of the RSA states that a railway company shall not file rules with the Minister of Transport unless it has first, during a period of 60 days, given a reasonable opportunity for the railway company to consult with each relevant association or organization that is likely to be affected by the implementation of the proposed rules.

Pursuant to the provisions of paragraph 19(1)(b) of the RSA, the revised rules shall be filed with the Minister of Transport for approval within 150 days of this Order, i.e. May 19, 2019.

Director General, Rail Safety

DEC 2 0 2018

Date

APPENDIX A

9961526 Canada Limited
BNSF Railway Company
Canadian Pacific Railway Company
Canadian National Railway Company
Chemin de fer Québec North Shore & Labrador
Central Maine and Quebec Railway Canada Inc.
CSX Transportation, Inc.
Eastern Maine Railway Company
Goderich-Exeter Railway Company Limited
Great Canadian Railtour Company Ltd.
Hudson Bay Railway Company
Kettle Falls International Railway Company
Knob Lake and Timmins Railway Company Inc.
National Railroad Passenger Corporation (Amtrak)
Nipissing Central Railway
Norfolk Southern Railway Company
Pacific & Arctic Railway Navigation, British Columbia & Yukon Railway, British Yukon Railway dba White Pass & Yukon Route Railroad (WP&YR)
RaiLink Canada Ltd.
St. Lawrence & Atlantic Railroad (Québec) Inc.
The Essex Terminal Railway Company
The Toronto Terminals Railway Company Limited
Transport Ferroviaire Tshiuetin Inc. (Tshiuetin Rail Transportation Inc.)
Union Pacific Railroad Company
VIA Rail Canada Inc.

APPENDIX B

FATIGUE SCIENCE TO SUPPORT THE NEW REQUIREMENTS FOR THE *WORK/REST RULES FOR RAILWAY OPERATING EMPLOYEES*

The following sections provide a review of scientific research and other material to support each of the requirements in the Ministerial Order. The review and the material referenced is not intended to be exhaustive, but includes research that specifically supports the requirements, recent research, and relevant research carried out within the rail industry, other modes of transport, and other high hazard industries. Much of the material was taken from the Report of the Canadian Aviation Regulation Advisory Council (CARAC) Flight Crew Fatigue Management Working Group as the working conditions within aviation are similar to those of the rail industry. This document formed the basis of the flight duty limitations for the civil aviation industry and provides an excellent source of fatigue literature up to 2012, when this document was published. A literature survey has been carried out to define any relevant documentation that was published more recently.

1. Maximum Duty Period

The length of time that a person has been continuously awake is the important determinant of the potential for fatigue, and not time on duty[1,2]. Human performance will begin to degrade after being awake for 12 to 14 hours, as demonstrated in laboratory studies and in analyzing incident and accident rates[3-15,18,19]. Studies have shown that after being awake for 17 hours, performance degrades to a level equivalent to having a blood alcohol concentration of 0.05%, and after 24 hours performance is degraded to a level equivalent to a blood alcohol concentration of 0.10%.

Research has shown that fatigue increases as shifts increase in length, with associated increases in accident likelihood. Studies have found a transient increase in risk 2 to 4 hours into the shift[8], with much larger increases after 9 to 10 hours[9, 10] and 12 hours[11] on shift. Other research from the United States (US) found deteriorating performance when working long hours, and specifically the 9th to 12th hours were associated with feelings of decreased alertness, increased fatigue, lower cognitive function, decline in vigilance, and increased injuries.

Aviation studies have shown a pattern of increased probability of an accident the greater the hours of duty, in particular when pilots have been on duty for 13 hours or more[16]. The data indicates that fatigue reaches the point where performance is impaired after 12 hours[18]. In addition, a study carried out by Samel in 1997 concludes that fatigue becomes critical after 12 hours of constant work[19].

In 1998, an Overview of the Scientific Literature Concerning Fatigue, Sleep and Circadian Cycle[20] found that the relative risk of an accident at 14 hours of duty rises to 2.5 times that of the lowest point in the first 8 hours of duty. Accident risks were found to be threefold at 16 hours of duty, and also threefold in over 10 hours of driving. These levels of risk are similar to that associated with having narcolepsy or sleep apnea.

Fatigue due to working excessive duty hours has been shown to lead to accidents in the United Kingdom (UK) and Australia. For example, in 2017, an investigation of a train crash at King's Cross station in London, UK, revealed that fatigue was a contributing factor. A study from the UK Rail Safety and Standards Board, based on 246 high-risk railway incidents, noted that the most common form of fatigue is home related (40%) with work related fatigue (38%) having the most effect on train driver performance. This conclusion was derived from analysis of incident data that showed fatigue played a role in 21% of these incidents and the quality and amount of sleep as well as roster patterns played a key role in the incident[22]. In addition, a study has shown that train drivers in Sydney, Australia[21] suffered from fatigue due to working duty periods that exceeded 10 hours.

In addition, a study conducted by Collision Avoidance Working Group (CAWG), with the Federal Railroad Administration's support, examined 65 main-track train collisions and found that 29 percent involved "impaired alertness" (defined as failing to take appropriate actions to avoid the accident). Nearly all of the 19 CAWG collisions occurred between midnight and eight in the morning, which indicates a strong circadian effect[23].

The Canadian Nuclear Safety Commission (CNSC), the nuclear industry regulator, has produced REGDOC-2.2.4: Fitness for Duty: Managing Worker Fatigue, based on fatigue science[24]. This document states that a normal work shift should not extend beyond 12 hours.

In addition to research relating to hours of duty, there is also scientific literature which demonstrates that performance significantly decreases during the Window of Circadian Low (WOCL), which occurs between midnight and 6am[25, 26]. It is not possible in the rail industry to avoid working during those hours but consideration should be given relating to methods of ensuring safety.

References

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2. Split Duty

Split duty schedules offer an alternative to longer shift periods, but introduce additional wake-ups and may therefore increase the risk of sleep inertia. In a recent study on sleep inertia across a split duty schedule it was demonstrated that morning wake-ups (2 am and 8 am) were associated with higher levels of sleep inertia than later wake-ups (2 pm and 8 pm). These findings suggest that split duty workers should recognize the potential for sleep inertia after waking, especially during the morning hours[1].

Studies conducted on split duty on train drivers and traffic controllers indicated that the existence of severe sleepiness was associated with both the shift type and the shift length[2]. Night shift was definitely the most significant single factor, leading to 6–14 times higher risk for severe sleepiness, compared with the day shift. This relationship was dependent upon the amount of free time prior to start of the shift. Morning shift had approximately double the risk compared with the day shift. Shift length was related to a somewhat smaller effect: the increase of shift length by 3 hours increased the risk of severe sleepiness by half. The effect of shift length on the occurrence of severe sleepiness at work was not modified by the shift type. However, if a night shift is extended, the purely additive effects of the two factors yield the greatest occurrence of sleepiness.

Naps can reduce sleepiness and improve cognitive performance. The benefits of brief (5–15 min) naps are almost immediate after the nap and last a limited period (1–3 h). Longer naps (>30 min) can produce impairment from sleep inertia for a short period after waking but then produce improved cognitive performance for a longer period (up to many hours). Other factors that affect the benefits from the nap are the circadian timing of the nap with early afternoon being the most favourable time. Longer periods of prior wakefulness favour longer naps over brief naps[3]. Despite the benefits of naps, it is also worth noting the results of a study involving one hundred and seventy-nine freight engineers which indicated that days with naps resulted in significantly more total sleep but less sleep in the main sleep period of the day and somewhat more difficulty with going to sleep, staying asleep and with feeling well-rested upon awakening[4].

In 2008, Mollicone et al. conducted the first split-sleep, dose-response experiment. Results from this study suggested that reductions in total daily sleep result in a near-linear accumulation of impairment regardless of whether sleep is scheduled as a consolidated nocturnal sleep period or split into a nocturnal anchor sleep period and a diurnal nap. These findings suggest that split sleep schedules are feasible and can be used to enhance the flexibility of sleep/work schedules involving restricted nocturnal sleep due to mission-critical task scheduling[5].

Short et al. showed that while there appears to be no cumulative cost to performance across days of splitting sleep, participants of their study obtained less sleep and reported lowered alertness on shift days. As well, tests near the circadian nadir showed higher sleepiness and increased performance deficits[6]. The circadian nadir is the period a few hours before going to sleep when hormonal influences maximize to keep you awake. As such, if your normal bedtime is 10pm trying to get to sleep about 6pm could be problematical due to your physiology.

It cannot be guaranteed that the employee working a split duty period will be able to sleep during the time period between the two parts of the duty period (the employee may or may not go home depending on the length of the break), and therefore the maximum duty time limitation must prevail. Additionally, fatigue management best practices need to be applied where spilt duty periods are required to ensure the employee obtains sufficient sleep in appropriate accommodations (if away from the home terminal) and when at home base, consideration is given for commute times between shifts and the ability to obtain sufficient sleep to mitigate the fatiguing effects of the extended period of duty.

References

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3. Minimum Rest Period

The knowledge that a regular 8 hour rest period is required to sustain human performance is one of the basic tenets of fatigue science. However, in order to get 8 hours of sleep, Dr. Greg Belenky (reference 1) has indicated that it takes a person 12 hours off duty to get 8 hours of sleep taking into account commuting, social demands, nutrition and hygiene.

It has long been recognized that human beings need 8 hours of sleep in a 24 hour period to fully recover. In 1937 when the US Interstate Commission first regulated hours of work of commercial drivers, the Commission stated: *''it is obvious that a man cannot work efficiently or be a safe driver if he does not have an opportunity for approximately 8 hours sleep in 24. It is a matter of simple arithmetic that if a man works 16 hours per day, he does not have the opportunity to secure 8 hours sleep. Allowance must be made for eating, dressing, getting to and from work, and the enjoyment of the ordinary recreations.'* [1].

Van Dongen, et.al.,[2] found similar results concerning the sufficiency of an 8 hour sleep opportunity: "For the average healthy young adult in the experiments, limiting daily wakefulness to this level would be expected to prevent the build-up of neurobehavioral deficits. Accordingly, per 24 h day, the average value for human sleep need to prevent cumulative neurobehavioral deficits would appear to be 8.16 h." Van Dongen shows that performance impairment occurs when a person has been awake for 16 hours or more.

A report by Wright, et.al.[3] found that an 8 hour sleep opportunity was not sufficient to sustain performance over a 32 day period. Meaning that extended rest is also required to recuperate from consecutive days of work as well as daily hours of work. Their research results suggest that an 8-hr scheduled sleep opportunity may not be sufficient to maintain performance levels for work-rest schedules that do not include days off or time for extra sleep, although other explanations related to repetitive performance of the task itself have yet to be excluded. These results are consistent with those from other research studies that show a trend for worsening performance near the end of a two-week period of 8-hr scheduled sleep. Taken together, these findings suggest that scheduling sleep to 8-hr per day in the laboratory may result in cumulative sleep restriction and that a longer scheduled sleep episode or days off may be necessary to prevent cumulative sleep restriction. The nuclear Industry recommend 11 hours off between shifts[4].

The Flight Crew Fatigue Management Working Group reviewed the relevant literature and agreed that 12 hours off duty at the home terminal and 10 hours off duty at the away from home terminal was the safest approach for minimum rest periods[5].

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4. Deadheading

Deadheading consists of either travelling to a location other than the home terminal, without assuming duty until the deadheading is completed, or travelling from a location other than the home terminal to the home location after duty time has been completed. This requires the employee to be awake and alert for a period of time in addition to their duty time, particularly if the employee is driving a personal motor vehicle. Thus the requirements relating to deadheading should correlate with the evidence contained in sections 1 and 2 of this document relating to maximum duty time and minimum rest time respectively. Deadheading, after the expiration of the maximum hours on duty, is acceptable but the rest period must be extended by the same amount of time it took to deadhead. Moreover, where the deadheading involves the operation of a motor vehicle mitigations should be considered.

5. Cumulative Time on Duty

The literature is in agreement that the limit of cumulative duty time for a week (defined as 7 consecutive days) should be 60 hours, although the Canada Labour Code and the EU Working Time Directive set a limit of 40 hours and 48 hours respectively.

During a study of medical interns, the weekly scheduled hours on the traditional schedule were reduced from an average of between 77 to 81 hours to an average of between 60 to 63 hours per week. This reduction of weekly work hours had a marked effect on diagnostic errors. Interns also made 5.6 times as many serious diagnostic errors during the traditional schedule as during the intervention schedule (18.6 vs. 3.3 per 1000 patient days, $P<0.001$)[1].

In a study by Dembe, et. al.[2], multivariate analytical techniques were used to estimate the relative risk of long working hours per day, extended hours per week, long commute times, and overtime schedules on reporting a work related injury or illness, after adjusting for age, gender, occupation, industry, and region. The results showed that working in jobs with overtime schedules was associated with a 61% higher injury hazard rate compared to jobs without overtime. Working at least 12 hours per day was associated with a 37% increased hazard rate and working at least 60 hours per week was associated with a 23% increased hazard rate. A strong dose-response effect was observed, with the injury rate (per 100 accumulated worker-years in a particular schedule) increasing in correspondence to the number of hours per day (or per week) in the usual schedule.

The conclusions support the fact that study of nationally representative data from the US adds to the growing body of evidence indicating that work schedules involving long hours or overtime substantially increases the risk for occupational injuries and incidents. Unlike previous studies, the investigation had the advantage of covering a large variety of jobs, and controlling for the potential compounding effect of age, gender, occupation, industry, and region. Nearly 100 000 job records were analyzed extending over a 13 year period, and employed several statistical techniques for quantifying the extent of risk. The results of this study suggest that jobs with long working hours are not more risky merely because they are concentrated in inherently hazardous industries or occupations, or because of the demographic characteristics of employees working those schedules. The findings are consistent with the hypothesis that long working hours indirectly precipitate workplace accidents through a causal process, for instance, by inducing fatigue or stress in affected workers.

Caruso et al[3] found a pattern of deteriorating performance on psycho-physiological tests as well as injuries while working long hours and in particular when 12 hour shifts were combined with more than 40 hours of work in a week. Four studies reported that the 9th to the 12th hour were associated with feelings of decreased alertness and increased fatigue. Two studies examining physicians who worked very long shifts reported a deterioration of cognitive performance.

The Moebus Report[4] supports cumulative duty limitations stating that "the risk of accidents and injuries increases over successive work days, and these increase are dissipated over periods of rest days". The report also states that "it is deemed that the protection provided by the 190 hours duty limit in 28 days is reasonable".

One study in the US examined the impact of overtime and extended working hours on the risk of occupational injuries and illnesses among a nationally representative sample of working adults which spanned 13 years and drew on information contained within 110 236 job records. One of the main findings from this study was overtime schedules had the greatest relative risk of occupational injury or illness, followed by schedules with extended (≥12) hours per day and extended (≥60) hours per week. Working at least 12 hours per day was associated with a 37% increased hazard rate and working 60 hours per week was associated with a 23% increased hazard rate[5].

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6. Time Free From Work

Time free from work is distinct from breaks. The term "break" refers to a period of rest within the shift for nutrition and other personal activities. Section 2 refers to minimum rest periods between each shift, but the "time free from work" refers to the time the employee is not working after the relevant number of consecutive shifts before the clock is reset. This provides time for recuperative rest.

The NASA Technical Memorandum[1] recommends that a period of recovery should be 36 continuous hours to include two consecutive nights of recovery sleep within a 7 day period, and if the preceding duty contained any time within the Window of Circadian Low (WOCL), then this period should be increased to 48 hours.

In the UK the Office of Rail Regulation state that shift workers benefit from regular recovery periods of at least 48 hours[2]. The Canadian Nuclear Industry require a minimum of 48 hours off following 2 consecutive night shifts or 72 hours following a block of 3 or more night shifts[3]. The current EU-OPS1.1110 and the European Aviation Safety Agency (EASA) Comment Response Document (CRD) to the Notice of Proposed Amendment (NPA) 2010-014 requires a fatigue management plan and calls for a 36 hour period of rest away from duty that include 2 full nights. The FAA Final Rule 117.25 provides for at least 30 consecutive hours free from all duties in any 168 consecutive hour period.

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7. Advance Notice of Work Schedules

Providing employees with advance notice of work schedules provides certainty and the opportunity for employees to appropriately plan sleep.

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8. Fatigue Management Plans (FMP)

Modern and comprehensive FMPs go beyond the existing *WRRs* requirements. A FMP should clearly address how fatigue risk will be assessed, managed and how mitigations will be monitored for effectiveness. The FMP should also reflect both the individual and the company's responsibilities regarding fatigue management and should address what fitness for duty is, how employees are able to attest to being fit for duty, and the policy and processes in place to deal with employees who declare themselves not fit for duty.

Common elements of FMPs are:

1) Fatigue management policies, procedures and processes;
2) Communication processes;
3) Defined roles and responsibilities
4) Risk Management - Hazard identification, risk assessment, risk control, evaluation
5) Documentation
6) Training
7) Audit and evaluation

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