SPAD In-Cab Environment Sub – Group

Guidelines for managing the in-cab environment of rail vehicles

Version 3 - July 2015
IN-CAB GUIDELINES

Introduction
Introducing new rollingstock can provide an entirely new working environment for drivers. Likewise, changes to the driver in-cab environment such as the addition of in cab signalling capabilities and new radio equipment can create distractions or other risks such as issues with task prioritisation that can result in a SPAD. Existing in-cab equipment such as windscreen blinds or driver-introduced equipment such as mobile devices can also increase the likelihood of error / risk incidence (e.g. a SPAD).

Scope
This document aims to provide a set of guidelines that identifies good practice for rail operators to manage driver distractions through their policies. It does this by listing potential distractions that can arise in the cabin and lead to inattention and by providing suggested strategies/safe ways to deal with these for consideration by operators when developing their own policies. These are provided for guidance purposes only and should be considered as appropriate for the type of operator and rollingstock involved. This document should also be read in conjunction with the ‘In-Cab Checklist’ that addresses many issues raised in this document.

Policy Context
Managing the in-cab environment is an important aspect of SPAD management. The good design (either as-built or refurbished) of the rail vehicle cab can minimise opportunities for SPAD occurrences or help to mitigate consequences by reducing cognitive load and driver distraction. Conversely, poorly designed or refurbished cabs can increase cognitive load, distraction and increase the probability and consequences of SPAD events. Therefore the importance of good design of rail vehicle cabs and the ongoing management of the in-cab environment as a workplace play an important role in SPAD management.

Developing guidelines
Any proposed set of guidelines for the in-cab environment should be framed in consideration of any in-cab systems that are currently in place, or proposed for the future. It is particularly important to consider how systems integration / systems engineering processes are followed when introducing new systems into an existing cab. Guidelines should also consider their role in modelling an effective workplace culture for a clean, efficient and safe workplace. Areas that should be considered while framing guidelines for the in-cab environment should include the following:

Ergonomics
- How well do the placement and operation of in-cab systems address the ergonomics of train driving?
- Are there in-cab systems that create distraction for drivers and how can these be mitigated or removed?
- Is the in-cab environment comfortable for train crew with a range of body types?
- To what extent does the in-cab environment contribute to driver fatigue and what can be done to mitigate or eliminate fatigue-inducing elements?
- How can lessons learned from the present in-cab environment improve the environment for new or refurbished rolling stock?
- How are systems integration / systems engineering processes followed when introducing new systems into the cab?
Human factors

- To what extent do operator mobile device policies manage the use of personal mobile devices in the in-cab environment?
- How well do operator mobile device policies manage the use of work-issued mobile devices in the cab?
- What operator policies govern the need to keep the in-cab environment clean and odour-free to reduce sensory (particularly olfactory) distraction as part of a safe working environment?
- How do operator policies manage eating and drinking while on duty to ensure drivers are adequately fed and watered, but contribute to a clean and odour-free in-cab environment?
- What training and authority do operators give drivers to control the conduct of other staff travelling in the driving cab? Are drivers empowered to ensure distractions from other staff are minimised?

In-cab displays

- How well do in-cab systems interact to provide a seamless, cognitively compatible and non-competing information stream to the driver that helps to prevent SPADs while maintaining safe and effective network operations?
- How will in-cab information be displayed to ensure that the probability of sensory overload (particularly visual overload) is minimised or mitigated, particularly at times of high cognitive load?
- Can each in-cab system provide accurate and non-contradictory information to the driver to undertake their driving and network navigation tasks?
- What impacts will the introduction of new in-cab systems have on the driver’s cognitive load in the in-cab environment?

Interactions with lineside infrastructure

- How will the risks of in-cab systems distracting drivers from external signalling information will be eliminated or minimised?
- How will in-cab systems interact with lineside signalling and other infrastructure? Are these interactions positive or negative in terms of SPAD prevention?
- Will future in-cab systems require changes to lineside signalling and other infrastructure to ensure safe and efficient rail operations?

Guideline implementation

In developing guidelines for the in-cab environment based on the suggested factors above, it is recommended that operators develop staff policies and procedures that outline an organisation’s policies and the operator’s expectations of staff in managing and mitigating SPAD incidents. As with the development of guidelines, implementation policy and procedure should be compatible with systems integration processes used during guideline development. These policies and procedures should be targeted across the organisation, not only drivers. Suggested documents that operators should develop include policies addressing:

- The appropriate use standards for mobile devices (both personal and work-issued)
- In-cab conduct document for drivers and others travelling in the cab outlining acceptable conduct and behaviours
- Protocols for non-drivers travelling in the active driving cab that details who is able to gain access, expected behaviours while in the cab and sanctions for creating driver distraction
- Developing human factors modules in crew training or professional crew guides that educate drivers on adapting to changing situations and priorities in the in-cab environment
References


Appendix One – Potential distractions and suggested solutions for consideration while framing in-cab environment policies

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<th>POTENTIAL DISTRACTIONS</th>
<th>RESEARCH / OPERATOR EXPERIENCES</th>
<th>SUGGESTED SOLUTIONS FOR CONSIDERATION</th>
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<tr>
<td><strong>EXISTING CABIN</strong></td>
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<td>For existing systems:</td>
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| Cab Ergonomics, including: Operation of windscreen wipers, heating, cooling instruments, in-cab controls / levers / handles, train management systems etc. | • Operators have experienced driver distraction with these elements, e.g. windscreen wiper controls too close to brake controls or instruments that are difficult to adjust/use.  
  • Researchers have observed driver distraction and inefficiencies originating from the design and placement of buttons that create unnecessary head-down activity. | • Thorough and periodic maintenance is recommended to ensure systems operate as intended.  
  • Where ergonomic issues are identified with existing systems, consideration should be given to whether alterations can be made to improve the interface (e.g. by redesigning or replacing relevant parts). This is likely to require Human Factors input, as well as risk assessments and Management of Change processes. For future systems:  
  • The procurement process should include a Human Factors Integration Plan to ensure HF issues are identified and addressed  
  • Designs should take into account best practice Human Factors design principles (e.g., Norman (1988), including reference to appropriate guidelines and standards.  
  • Rollingstock design and construction should take into account ergonomic considerations.  
  • A post-implementation review is recommended to ensure an appropriate ergonomic design.  
  • A regular maintenance program should be established to ensure systems continue to operate as intended. |
| Windscreen blinds (operated manually and electronically) | • The position of a driver’s windscreen blind may impede a driver’s ability to correctly observe a signal  
  • Electronic blinds may not deploy quickly enough | • Thorough and periodic maintenance is recommended to ensure blinds operate as intended.  
  • Design, construction and installation of blinds should take into account Human Factors design principles and signal sighting considerations involving all relevant types of signal.  
  • Consideration of manual vs. electronic blinds and procurement choices should take into account driver preference, deployment speed, maintenance requirements and appropriateness for the type of rollingstock. |
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<td>Glare relating to reflection off the windscreen or images reflecting back off the windscreen, including staff uniforms. The windscreen and other cab glass areas can be a source of internal reflective glare and other sources of distraction or visual interference.</td>
<td>• Inappropriately designed or assessed windscreen may present glare or reflection issues under different lighting conditions (Jenkins, 2015). • The issue of reflection of the cab controls and other items in the cab should be assessed with respect to the rolling stock design, windscreen material and orientation. The pitch angle of windscreen promotes internal reflections in a similar way to those in modern motor vehicles.</td>
<td>• Allow personal adjustments by drivers • Design and procure rollingstock in accordance with Human Factors principles, ensuring that glare risks are considered and assessed appropriately. • Consider the provision of appropriate sunglasses for drivers to minimise glare while supporting appropriate vision. This testing should ensure that drivers can still view internal controls/electronic displays without impediment in all anticipated driving conditions/environments. • Staff uniforms should be in fabrics that don’t reflect on windscreen, and positioning of reflective materials should take into account driver glare issues. Any items which will normally be used in-cab should be assessed for their reflectivity or distraction potential under all operating and environmental conditions. • Items such as driver uniforms and safety equipment should be designed to complement the in-cab environment and not induce any significant potential for driver distraction or loss of signal sighting. • The risk of scratching or indentation of internal surfaces (e.g. anti-spall layers) be minimised through education of drivers and consideration of desk design to help protect windscreen. • Consider shaded spot lighting provided for drivers to check notes etc. to reduce reflection. • Consider shading station lighting to reduce the risk of reflective glare to drivers.</td>
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| In-cab display | • Over-reliance on visual methods to provide secondary information (especially in a head down display) may cause undesirable overload, distraction or inattention from the primary driving task.  
• See research on ‘Multiple resource theory’ as applied to the driving task (Wickens, 2008; Wickens & Horrey, 2008) and Augmented reality for display of a range of in-cab information systems and head up displays (Plavšić, Duschl, Tönnis, Bubb, & Klinker, 2009; Tönnis, Klinker, & Plavšić, 2009)  
• Public transport bus driver research provides background task analysis information which can be applied to train driving scenario (Salmon, Young, & Regan, 2010)  
• Secondary task cognitive processing may impact primary task performance (Blanco, Biever, Gallagher, & Dingus, 2006) | • In-cab displays should be designed with the knowledge that the driver’s primary task is to monitor signals in the external network environment.  
• Motor vehicle driving research into rail scenario and in-cab standards and research into multi-modal display methods may be used to help protect against an over-reliance on visual methods.  
• Displays should be designed with reference to relevant HF tools and guidelines for interface design (e.g. designs should match user expectations, be consistent and standardised, provide clear indication of the status of the system, reduce memory load for the user, present all required information (and nothing more), be easy to read/hear/interpret, be positioned to be easy to see, access and distinguish from other displays, and be appropriate for all expected users in all anticipated conditions, for example). |
| In-cab signalling display | While in-cab signalling displays (such as the Driver Advisory Systems) have benefits for fuel efficiency and may aid in maintaining driver situational awareness, they may also lead to distraction in some conditions, e.g.  
- in high traffic density areas around major stations, when the frequency of advice is raised  
- when the quantity and/or type of information displayed is not appropriate or leads to confusion  
- where the display is inappropriate (e.g. rate of change of information displayed is not appropriate; information cannot be accessed quickly by the driver; display does not provide appropriate feedback; display overemphasises performance and/or time keeping dimensions  
- where the system is not easy to use/understand (RSSB, 2009).  
| Consider requiring that the system is deactivated or the level of information is rescaled in high-workload situations (e.g. high traffic density areas / near major stations) or where the driver should be following a different target safety speed  
- The system should be designed and tested in accordance with HF principles to reduce distraction (e.g. minimise head-down time, include only information that is relevant, have appropriate refresh rate, utilise combined visual and auditory displays, alert user to significant changes etc.).  
- User training should be provided on the appropriate usage of the system, with attention drawn to possible distraction-related risks.  
- Allow personal adjustment of display unit by drivers to mitigate glare or optimise clarity where possible |
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| **EXISTING CABIN (cont’d)** | Seating design  | Seating impacts on the ability of a driver to ‘feel’ the performance of the train and also supplements their visual route knowledge. Ineffective damping of vibration can contribute to fatigue. The changing demographic profile of the driver workforce means there is greater variance from average in height and weight of workforce and creates issue with installation of a ‘standard’ train driver seat. | Seating design should take into account ergonomic principles  
Seating must provide protection from vibration and yet also allow haptic feedback for the driver to supplement visual route knowledge  
Seat must be able to adjusted quickly and easily, particularly with pressure to maintain on-time running (different kinds of rolling stock have different methods of adjusting seats that may impact on time to adjust and methods to adjust).  
Different rolling stock may have different fundamental vibration frequencies and handling characteristics and therefore tuning of vibration harmonics to the set type and typical network conditions should be considered, similar to that typically undertaken for road vehicles according to chassis and vehicle dynamics. |

| **DRIVER INTRODUCED ITEMS** | The presence of mobile devices in cabs, including:  
- mobile phones and smartphones  
- iPads and tablets  
- e-book readers  
- wearable portable electronic devices  
- any other devices capable of receiving/transmitting communications or notifications, or with internet access | Mobile devices pose a clear distraction risk for drivers.  
Mobile phone use has been associated with at least 2 fatal rail accidents in the USA (Clarendon, TX in 2003 and Chatsworth, CA in September 2008 (CRC, 2008).  
Research by the UK RSSB found that mobile phone use resulted in, among other things, less checking for hazards, reduced situational awareness, poorer speed control (greater speed variation), slower reaction time and poorer decision-making. (TSV, 2012) | Refer to mobile-device guidelines  
Introduce an appropriate mobile device policy/procedure, which clearly distinguishes use of mobile devices deployed for professional use against those for personal use.  
Provide appropriate education on the risk of mobile device-related distraction. This may form part of Professional Driver training and/or Non-Technical Skills training (e.g. Rail Resource Management), for example.  
Consider in-cab CCTV monitoring to aid incident investigation and to address trends in poor driver behaviour (RSSB is considering research into this area) (Office of Rail Regulation, 2013) |
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| Food / Drink in the cabin | • Road driver simulator research suggests that driving while eating a cheeseburger results in more driving errors and glances away from the road than when not eating, and is as distracting as using a voice-activated mobile call (Jenness et al. 2002)  
• Road research suggests that eating and drinking while driving presents a physical and visual distraction for drivers and that further distraction is caused if there is a spill (Young et al. 2003)  
• An American road traffic safety study found that a greater proportion of drivers involved in traffic accidents are distracted by eating or drinking than by talking on a mobile phone (Young et al. 2003)  
• Eating and drinking have been noted as occurring during SPAD incidents | • Inclusion of distraction risks associated with eating/drinking in the cabin in Professional Driver training and/or Non-Technical Skills training (e.g. Rail Resource Management)  
• Provision of adequate and timely rest breaks and provision of suitable areas where meals and other activities can be undertaken.  
• Ensuring that drivers are adequately fed and hydrated before commencing duty and while on duty. |
| Odours in the cabin (Including performance of air conditioning systems and location and placement of intakes, as well as human-introduced items) | Odours in the cabin can result from:  
• inability to introduce fresh air into the cabin or freshen the air in the cabin.  
• transfer of odour into the cabin from the saloon (e.g. sick passengers in the saloon/chroming in the saloon near air conditioning intake or odours travelling via the gap under the driver’s door)  
• Actions of previous occupants (e.g. from strong-smelling foods, smoking). | • Local workplace policies regarding food / air fresheners etc.  
• In-cab person to person monitoring during audits  
• Provision of personal hygiene education and health benefits.  
• Policies on leaving rubbish and food waste in the cabin  
• Consider pros and cons of rubbish bags in the cab for drivers and education as to expected in-cab manners  
• Rollingstock design to consider intakes, gaps and air conditioning locations with respect to introducing odours to the cab. |
| Smoking in the cabin | Several road industry studies have found that smoking while driving increases the risk of being involved in a crash (Young et al. 2003).  
• Note that there is a regulatory ‘grey area’ on e-cigarettes/vaporisers as alternative to cigarettes. | Workplace smoking policies (incorporating use of vaporisers)  
• Provision of quit smoking support  
• Education program as to the effects of smoking on health and well-being, in addition to its impacts on driving performance |
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<td>Personal equipment: glasses sunglasses</td>
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<td>• Ensure that glasses are fit for purpose (polarising lenses are an issue)</td>
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<tr>
<td>TECHNOLOGIES / CABIN DEVICES</td>
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<tr>
<td>In-cab communication systems</td>
<td>• Adoption of new communication systems can cause distraction to drivers in initial introduction and transition period.</td>
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<td>• Switching between different radio systems at network boundaries or interfaces between yard &amp; mainline is a recognised distraction source.</td>
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<td>• Design and linkage of in-cab displays and environment to complement crew tasks</td>
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<td>• Operators policies and procedures.</td>
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<td>• Practical training provided to users prior to usage.</td>
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<td>In-cab radio/CD players/MP3 players to play driver’s own music</td>
<td>• Exposure to self-selected music has been shown to result in overestimation of elapsed time and inaccuracy (but benefits to accuracy and experience). Exposure to non-self-selected music results in poorer performance (Cassidy &amp; MacDonald, 2013).</td>
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<td>• Distraction from use of music controls in road driving (Stutts et al., 2003).</td>
<td>• Consider as an option on particular types of services to help maintain alertness. This should be paired with clear education outlining the associated risks and providing clear guidance on good practice.</td>
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<td>• Linkage to communications system to mute during network communications.</td>
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<td>• Operator policies and procedures to ensure appropriate use of music (e.g. ‘sterile cockpit’ during critical periods)</td>
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<td>• Inclusion of distraction risks associated with music playing in the cabin in Professional Driver training and/or Non-Technical Skills training (e.g. Rail Resource Management) – including how drivers should respond if they are being distracted by someone else in the cab.</td>
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<tr>
<td>OTHER</td>
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<td>Other people in the cab</td>
<td>Experience from the in-cab group members is that other people in the cab can be a source of distraction</td>
<td>• Workplace policies and procedures on the appropriate behaviour of additional people in the cab to reduce distraction</td>
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<td>• Inclusion of the risks presented by additional people in the cab as a distraction within Professional Driver training and/or Non-Technical Skills training (e.g. Rail Resource Management) – including how drivers should respond if they are being distracted by someone else in the cab.</td>
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