Recommendation(s) Status: Derailment at Grayrigg

This report is based on information provided to the RAIB by the relevant safety authority or public body.

The status of implementation of the recommendations, as reported to us, has been divided into six categories:

Key to Recommendation Status

Implemented:	All actions to deliver the recommendation have been completed.
Implemented by alternative means:	The intent of the recommendation has been satisfied in a way that was not identified by the RAIB during the investigation.
Implementation ongoing:	Work to deliver the intent of the recommendation has been agreed and is in the process of being delivered.
In-progress:	The relevant safety authority has yet to be satisfied that an appropriate plan, with timescales, is in place to implement the recommendation; and work is in progress to provide this.
Non-implementation:	Regulation 12(2)(b)(iii) = recommendation considered and no implementation action to be taken.
Awaiting response:	Awaiting initial report from the relevant safety authority or public body on the status of the recommendation.

RAIB concerns on actions taken by organisations in response to recommendations are reflected in this report and are indicated by one of the following:

The red triangle shows recommendations where the RAIB has concerns that no actions have been taken in response to a recommendation.

The blue triangle shows recommendations where the RAIB has concerns that the actions taken, or proposed, are inappropriate or insufficient to address the risk identified during the investigation.

The white triangle shows recommendations where the RAIB notes substantive actions have been reported, but the RAIB still has concerns.

Note: The tables which follow, report the status of recommendations on 31 December 2015. In some other cases the end implementer has already sent information to the relevant safety authority about the actions it has taken, or proposes to take and the safety authority is considering whether it is satisfied that those actions and the associated timescales are accepted.

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1 23/02/2007 20/2008 Derailment at Grayrigg Status: Implemented	1. The intention of this recommendation is that Network Rail should modify the design of the non-adjustable stretcher bar assembly, including its joints, so that it can withstand normal operational loads (and credible faults) with a safety margin and without excessive reliance on human intervention. Network Rail should review its S&C non-adjustable stretcher bar assembly design, so as to understand the relationships between the design, loading, usage, and the inspection and maintenance regimes, and implement any appropriate modifications to the design or the regimes. The following elements (A to G) should be considered to achieve this: A. Define the system level functional and safety requirements for S&C with non-adjustable stretcher bars. B. Determine all of the functions that the non-adjustable stretcher bar assembly is required to deliver for the functional and safety performance of the S&C system, including from traffic, fastenings and operating/motor forces. C. Determine a set of load cases for the non-adjustable stretcher bar assembly, including its rail fastening arrangement. This should include forces which it experiences during both normal and reasonably foreseeable fault conditions. All foreseeable combinations of normal and fault conditions that could exist within the stretcher bar assembly itself, other components and the S&C system, should be considered. This should include, but not be limited to: a. configurations of S&C on which it is fitted; b. traffic usage patterns and track geometries; c. manufacturing and installation variations. The load cases should be established and validated by field measurements, supported by appropriate other testing, modelling and/or calculation. D. Assess the performance of the current non-adjustable stretcher bar assembly against the forces that arise from the load cases. E. If justified by the outcomes of the previous work, modify the current design of the non-adjustable stretcher bar assembly to include an appropriate factor of safety. The revised design should be risk assessed, taking into account the quality and reliability of human intervention in inspection and maintenance (refer also to Recommendation 13). Should measures such as component redundancy or other defence barriers be necessary to achieve the required integrity, the reliability of each redundant element and defence barrier should itself be assessed using the above process.	ORR has reported that Network Rail has reported that it has taken actions in response to this recommendation. ORR proposes to take no further action unless they become aware that the information provided becomes inaccurate.

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	F. Modify the current installation, inspection and maintenance regimes against the requirements determined in E so that they are appropriately risk based for the new design (refer also to recommendation 13). G. Introduce processes to implement the modified design and modified inspection and maintenance regimes and any associated mitigation measures where justified.	
2 23/02/2007 20/2008 Derailment at Grayrigg Status: Implemented	The intention of this recommendation is that Network Rail should implement processes to gather and analyse data, both in the short term and thereafter, that will enable it to identify and monitor accident precursor events in its S&C. This information can then be used to identify potential problems before they can lead to catastrophic failure, and also to inform the development of process safety indicators (see Recommendation 14). Network Rail should implement processes to: a. capture, and record on a single national database, data about component failures, and interventions made during maintenance and inspection activities, for each set of S&C; b. use the data from a) above to monitor failure and intervention rates locally and nationally in the behaviour of S&C components; c. identify precursor faults that might lead to more serious failures; and d. identify those precursor faults where the failure and intervention rates indicate a need to reduce the risk of catastrophic failure.	ORR reports that it considers this recommendation to be implemented. RAIB notes that Network Rail is implementing a detailed strategy to address the need to gather and analyse data to enable it to identify and monitor accident precurser events in its S&C. However, it is recognised that full implementation of part a will take some time to achieve. ORR proposes to take no further action unless they become aware that the information provided becomes inaccurate.
3 23/02/2007 20/2008 Derailment at Grayrigg Status: Implemented	The intention of this recommendation is that Network Rail should implement the measures it identifies from Recommendations 2. Network Rail should introduce processes to implement any design modifications arising from Recommendation 2 using the principles outlined in Recommendation 1.	ORR reports that Network Rail has collected and analysed precurser data, this has been used to inform the re-design of the strecher bar and the development of a roll-out strategy. RAIB notes Network Rail's intention to revisit its FEMECA analysis. ORR proposes to take no further action unless they become aware that the information provided becomes information.
4 23/02/2007 20/2008 Derailment at Grayrigg Status: Implemented	The intention of this recommendation is that Network Rail should move to a riskbased regime for the maintenance and inspection of S&C. Network Rail should introduce processes that require the adoption of a structured risk based approach when reviewing and enhancing its standards for the inspection and maintenance of all existing types of S&C.	ORR reports that Network Rail has completed implementation of this recommendation.

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5 Derailment at Grayrigg Status: Implemented	23/02/2007	20/2008	The intention of this recommendation is that Network Rail should, as soon as possible, provide its front line staff with clear guidance on when a defect, fault or failure requires investigating, and the scope of investigation required. Network Rail should include in maintenance standards and instructions: • the circumstances under which an investigation of a defect, fault or failure to S&C systems as a whole or its sub-components is required; and • definition of the scope of the investigation and other immediate actions to be taken (eg temporary speed restrictions, special monitoring) for each situation.	ORR reports that Network Rail has completed implementation of this recommendation.
6 Derailment at Grayrigg Status: Implemented	23/02/2007	20/2008	The intention of this recommendation is that Network Rail should be able to systematically identify, and rectify, any potential or actual incidence of flange-back contact. Network Rail should review its processes for S&C examination so that the following are included: a. examination for, and reporting of, signs of flange-back contact; and b. measuring, recording and reporting gauge, free wheel clearance and residual switch opening dimensions,at frequencies commensurate with adequate risk control.	ORR reports that Network Rail has completed implementation of this recommendation.
7 Derailment at Grayrigg Status: Implemented	23/02/2007	20/2008	The intention of this recommendation is that Network Rail should provide its front line staff with adequate information on the correct installation, inspection and maintenance of fasteners associated with non-adjustable stretcher bars. Network Rail should modify its maintenance instructions to define: • how staff should initially fit and tighten non-adjustable stretcher bar fasteners; • how staff should inspect and maintain the fasteners if necessary during subsequent visits, including practical instructions to achieve any required torque; • when a fastener is considered to be loose taking into account the nut rotation required to achieve the required preload; • how staff should act in the event of a fastener being identified as loose; • how staff should record actions taken; and	ORR reports that Network Rail has completed implementation of this recommendation.

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			• how staff should carry out any other actions identified from Recommendation 4.	
8 Derailment at Grayrigg Status: Implemented	23/02/2007	20/2008	The intention of this recommendation is that Network Rail should provide its front line staff with clear information on permitted residual switch opening dimensions. Network Rail should revise its maintenance instructions to clearly specify the value (or range of values) required for residual switch openings, particularly with reference to the maximum permissible value (or range of values) and the frequency at which it must be checked.	ORR reports that Network Rail has completed implementation of this recommendation.
9 Derailment at Grayrigg Status: Implemented	23/02/2007	20/2008	The intention of this recommendation is that Network Rail should provide its front line signalling maintenance staff with all the information that they need to carry out their work, including secondary documents referred from principal documents, and that its systems provide for checking and recording the actions taken. The information from this system should be readily accessible and usable on or off site. Network Rail should review management systems and associated documentation covering the maintenance of S&C systems so that signalling maintenance staff: a. have ready access to all relevant documentation on and off site; b. are reminded on site of all the required maintenance actions; c. positively record that each required maintenance action has been carried out; and d. are subject to regular supervisory checks to verify that actions that are required to be taken have been carried out to the required quality.	ORR reports that Network Rail has completed implementation of this recommendation.
10 Derailment at Grayrigg Status: Implemented	23/02/2007	20/2008	The intention of this recommendation is that Network Rail should improve the quality of the existing basic visual inspections. Longer term issues concerning track inspection are dealt with under Recommendation 19. Network Rail should review and amend its processes for basic visual track inspection so that the issues identified in this report are addressed. To achieve this Network Rail should consider issuing modified instructions to define: a. the contents of task instructions issued to staff undertaking basic visual inspections;	ORR has reported that Network Rail has taken appropriate action to develop and implement their basic visual inspection regime, informed by our inspection findings, and continue to target their assurance regime to improve compliance. They have time bound action plans to make further improvements by introducing technological solutions to support the process and reduce reliance on paperwork, and have in place plans to manage deficiencies identified from their own assurance regime. ORR has concluded that although Network Rail has not yet been able to demonstrate consistent implementation of (c). job cards to advise the start and finish locations and the

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	b. the nature of defects that can occur and how to detect those that are difficult to readily observe; c. job cards to advise the start and finish locations and the direction of the inspection for every occasion; d. the information supplied to a patroller before an inspection in terms of clearly-presented intelligence on previously-reported defects; e. the scope of information that is to be recorded during an inspection (including definition of the need to record or comment on previouslyreported defects); Recommendations: Matters observed in the investigation: f. the requirement to make positive statements about areas of the inspection where no defects have been found; g. the checks for completeness that should be made within the track section manager's office, including verification that every inspection has been carried out; h. the analysis and supervision that should be undertaken to confirm that inspections are being conscientiously completed; and i. a suitable level of continuity that can be achieved by identifying individual patrollers with individual sections.	direction of the inspection for every occasion; (d). the information supplied to a patroller before an inspection in terms of clearly-presented intelligence on previously-reported defects; (h). the analysis and supervision that should be undertaken to confirm that inspections are being conscientiously completed; and (i). a suitable level of continuity that can be achieved by identifying individual patrollers with individual sections. They have developed an assurance regime that is capable of identifying and correcting deficiencies and are monitoring its application to achieve continued improvement. Office of Rail Regulation (ORR) proposes to take no further action unless they become aware that the information provided becomes inaccurate. However, ORR continues to monitor Network Rail performance and local non-compliances at route level.
11 23/02/2007 20/2008 Derailment at Grayrigg Status: Implemented	The intention of this recommendation is to ensure that when a supervisory and a basic visual inspection are combined, both are fully and correctly delivered, and recorded. Network Rail should modify its processes to specify the following safeguards when a supervisor's visual track inspection is combined with a basic visual inspection: a. all the paperwork relevant to the basic visual inspection (see Recommendation 10) is supplied to the supervisor; and b. an assurance check is carried out by a person other than the relevant supervisor to confirm that both inspections have been completed and recorded appropriately.	ORR reports that Network Rail has completed implementation of this recommendation.

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12 Derailment at Grayrigg Status: Implemented	23/02/2007	20/2008	The intention of this recommendation is that Network Rail should address the competence and management issues relating to the inspection and maintenance of S&C that have been demonstrated in this report. Network Rail should review its processes for practical training, assessment competence assurance for those undertaking S&C inspection and maintenance against current UK rail industry best practice (eg ORR's publication 'Developing and Maintaining Staff Competence'), and make relevant changes so that the requirements arising from Recommendations 6, 7, 8, 9, 10 and 11, as appropriate, and those from the more general observation about competence in this report, can be delivered.	ORR reports that Network Rail has completed implementation of this recommendation.
13 Derailment at Grayrigg Status: Implemented	23/02/2007	20/2008	The intention of this recommendation is that Network Rail should establish whether it is practicable, in human factors terms, for the inspection and maintenance processes to identify and rectify all defects to an adequate and consistent standard, and revise the design of S&C to allow for any identified impracticability or variability in those activities. Network Rail should conduct a review, focused on human factors, to develop an accurate understanding of the practicability of, and variability in, the performance and outcome of inspection and maintenance so that any issues identified can be taken into account in the design of S&C systems and the associated inspection and maintenance specification. This activity is integral to Recommendations 1 and 10, and a precursor to Recommendation 19.	ORR reports that Network Rail has completed implementation of this recommendation.
14 Derailment at Grayrigg Status: Implemented	23/02/2007	20/2008	The intention of this recommendation is that Network Rail should have adequate monitoring of S&C failure precursors. Network Rail should review and improve its management arrangements for monitoring performance in relation to the inspection and maintenance of S&C assets, taking account of the guidance contained in HS(G) 254, 'Developing process safety indicators' by introducing an suitable 'leading' and 'lagging' performance indicators. The indicators should encompass measures of the reliability of both maintenance and inspection activities and the performance and condition of key components.	ORR reports that Network Rail has completed implementation of this recommendation.
15 Derailment at Grayrigg Status: Implemented	23/02/2007	20/2008	The intention of this recommendation is that Network Rail's compliance and assurance systems should mandate site checks of its S&C asset so that it is independently aware of the actual state of its assets on the ground, any developing trends in its asset performance (see Recommendation 2), and their	ORR reports that Network Rail has completed implementation of this recommendation.

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			relationship to its records from inspections. Network Rail should extend its compliance and assurance processes to include independent end product checks on a sample of its S&C asset to: • confirm that its inspections and work database reflect the physical state of its assets; • confirm that the asset is compliant with appropriate standards; • confirm that the actions identified in Recommendations 1 to 3 are, in fact, delivering an improvement in the performance of S&C assets; • observe for defects or problems that, although the asset and systems may comply with the appropriate standards, may effect the safety of the line.	
16 Derailment at Grayrigg Status: Implemented	23/02/2007	20/2008	The intention of this recommendation is that Network Rail should specify adequate opportunities for inspection (and also for maintenance, although recognising that lack of maintenance opportunities was not an issue in the Grayrigg derailment) activities when developing infrastructure enhancement projects. Network Rail should include within its infrastructure enhancement project processes an assessment of the impact of any project on the inspection and maintenance of the assets at a stage of the project which allows identification and implementation of suitable measures before commissioning.	ORR reports that Network Rail has completed implementation of this recommendation.
17 Derailment at Grayrigg Status: Implemented	23/02/2007	20/2008	The intention of this recommendation is that Network Rail should review whether there is currently adequate access for inspection on its main-line routes. Network Rail should review and, if necessary, revise its access arrangements and plans (including Rules of the Route) for its main-line routes. This should be done to provide for the needs of maintenance and inspection of existing infrastructure, given current and planned traffic levels.	ORR reports that Network Rail has completed implementation of this recommendation.
18 Derailment at Grayrigg Status: Implemented	23/02/2007	20/2008	The intention of this recommendation is that Network Rail should review the interfaces in its headquarters' engineering department concerning S&C, with particular reference to track and signalling engineering. Network Rail should review and, if necessary, revise its management organisation to provide effective stewardship of S&C assets. The review should include consideration of the	ORR reports that Network Rail has completed implementation of this recommendation.

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			creation of a single professional department (design authority) responsible to the chief engineer for all aspects of S&C, including specifying design, procurement, installation, set-up, commissioning, inspection, maintenance and performance.	
19 Derailment at Grayrigg Status: Implemented	23/02/2007	20/2008	The intention of this recommendation is that Network Rail should review its track inspection requirements so that best use is made of new technology for plain line and S&C inspections43. Network Rail should re-assess the differing requirements of plain line and S&C track inspections with regard to: • the amount that is appropriate to be done by human intervention, and the amount by automated data capture, for both types of track; • the different relative frequencies that may be appropriate for both types of track; and • what protection arrangements should be provided. Consideration should be given to separate processes for plain line and S&C inspections to recognise the different requirements of each.	ORR reports that Network Rail has completed implementation of this recommendation.
20 Derailment at Grayrigg Status: Implemented	23/02/2007	20/2008	The intention of this recommendation is that Network Rail should carry out its S&C engineering safety management in line with UK railway industry documented best practice. Network Rail should review its S&C engineering safety management arrangements with reference to current UK rail industry best practice (eg the 'Yellow Book') and address any deficiencies identified.	ORR has informed the RAIB that it accepts that Network Rail is adopting best practice principles in its current S&C engineering safety management and is continuing monitor the actions taken in response to the Grayrigg recommendations RAIB is happy to note that the ORR has committed to review the actions taken by Network Rail in response to recommendations 1-19 to confirm that they are aligned with engineering safety management principles.
21 Derailment at Grayrigg Status: Implemented	23/02/2007	20/2008	The intention of this recommendation is to ensure that, in the short term, ORR explicitly includes S&C in its delivery plan assignments for as long as it remains an identified high risk in the ORR's assessment. In the longer term the intention is to ensure that the ORR includes assignments for all the higher risk items within its delivery plan, irrespective of the topic in which it is grouped. The ORR should amend its process for planning and briefing the annual delivery plan to make explicit when an area of high risk is to be included within an individual assignment.	ORR reports that it has taken action in response to this recommendation.

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22 23/02/2007 20/2008 Derailment at Grayrigg Status: Implemented	The intention of this recommendation is to minimise the risk of injury from detachment of seats in the event of an accident, by enhancing the requirement in the current design standard, for seats to deform in a ductile manner when overloaded, particularly in the lateral direction. RSSB should make a proposal in accordance with the Railway Group Standards code to introduce a specific requirement in the relevant interiors design standard, that future seats designs, including those that may be fitted at refurbishment, should demonstrate a ductile deformation characteristic, when overloaded in the vertical, lateral or longitudinal directions, in order to minimise the risk of complete detachment in accidents.	ORR reports that RSSB has taken action in response to this recommendation.
23 23/02/2007 20/2008 Derailment at Grayrigg Status: Implemented	The intention of this recommendation is to minimise the risk of injury arising from the detachment of heavy internal panels in the event of an accident. RSSB should consider, and where appropriate, make a proposal in accordance with the Railway Group Standards code to implement a requirement in the relevant design standard to provide sufficient means of retention for internal panels assessed as capable of causing serious injury in the event of complete detachment.	ORR reports that RSSB has taken action in response to this recommendation.
24 23/02/2007 20/2008 Derailment at Grayrigg Status: Implementation ongoing ▲	The intention of this recommendation is to minimise the risk of the reading light panels in a Pendolino train becoming detached in the event of an accident. Virgin Trains and Angel Trains should review the mounting of the reading light panels on the Class 390 Pendolinos and take steps to minimise occupant injury from failure of the panel retention system.	This recommendation asked for a review of the mounting of the reading light panels on Class 390 Pendolinos and to take steps to minimise occupant injury. Whilst actions have been reported that should result in improved new locks, retrofitting the fleet with improved locks or other means of panel retention was not considered to be reasonably practicable by the dutyholders and ORR, on the basis they deemed that the locks' retention failed when the design load had been exceeded and the risk associated with the current locks is therefore acceptable. The RAIB notes that following the inquest in November 2011, HM Coroner South & East Cumbria reported his concerns about the quality of the evaluation carried out by Virgin and Angel Trains and the adequacy of the actions taken to date. ORR has informed the RAIB that Virgin Trains and Angel Trains have commissioned an independent review of the cost-benefit analysis that was carried out in relation to this issue. ORR advises that it will consider the outcome of this review and inform the RAIB of its position in due course. $

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25 23/02/2007 20/2008 Derailment at Grayrigg Status: Implemented	The intention of this recommendation is that general safety lessons regarding rail vehicle crashworthiness emerging from the Grayrigg accident are considered and, where appropriate, research is undertaken to assess the practicability of making improvements. If suitable improvements are found, proposals should be made for changes to crashworthiness standards. RSSB should: a. Identify any gaps in industry knowledge about vehicle dynamic behaviour in derailments (for example the forces acting on inter-vehicle couplers and bogie retention systems) and where appropriate, undertake research to investigate improvements in vehicle performance. Where appropriate, RSSB should make a proposal in accordance with Railway Group Standards code to change relevant design standards. b. Investigate and, where practicable, make a proposal in accordance with Railway Group Standards code to introduce specifications for roll-over strength and penetration resistance of rail vehicle bodyshells in design standards to ensure consistency of performance in accidents across all future fleets; c. Undertake research into the injury mechanisms at Grayrigg to identify means of improving occupant survivability in future rail vehicle designs. Where appropriate, RSSB should make a proposal in accordance with Railway Group Standards code to change relevant design standards; d. Review and revise, if necessary, its past research into seat belts in rail vehicles in the light of the findings from the Grayrigg derailment, taking into account foreseeable changes to vehicle behaviour in future accidents, in order to check whether the conclusions reached therein remain valid; and e. Confirm and publish the results of its cost benefit analysis as to the reasonable practicability of fitting seat belts to passenger trains. If the analysis shows that fitting seat belts is other than grossly disproportionate to the risks involved, further investigate how to take the issue forward.	This recommendation intended that the industry should capture learning related to vehicle crashworthiness arising from Grayrigg, and where appropriate, make changes to standards. ORR has reported that the Rail Safety and Standards Board (RSSB) has considered and assessed the reasonable practicability of the recommendation and concluded that no changes to current standards are justified. ORR has concluded that RSSB has given due consideration to this recommendation. However, the RAIB remains concerned that potential lessons regarding vehicle roll over strength, and vehicle penetration resistance may not have been captured. The RAIB is proposing to inform the industry (by means of the Vehicle/Vehicle System Interface Committee) of its residual concerns regarding the status of this recommendation.

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26 Derailment at Grayrigg Status: Implemented	23/02/2007	20/2008	The intention of this recommendation is to assist the emergency services to optimise their response to an accident. Cumbria Police should carry out a review of, and change as appropriate, its management, procedures and training relating to the rapid and accurate location of an accident from information received in emergency calls in the control room so that received information is filtered effectively and without loss of significant data.	Cumbria Police reports that it has completed implementation of this recommendation.
27 Derailment at Grayrigg Status: Implemented	23/02/2007	20/2008	The intention of this recommendation is to promote the safety of Ambulance Service personnel who are called upon to carry out rescue work after a railway accident. The Department of Health's eleven mainland Ambulance Service NHS Trusts, the Welsh Ambulance Services NHS Trust and the Scottish Ambulance Service should: • agree and implement suitable processes so that their staff are suitably trained for work on the railway; and • agree a protocol with Network Rail to cover the necessary steps for the ambulance services to enter Network Rail property safely in an emergency.	The Ambulance Services have reported that they have completed implementation of this recommendation.
28 Derailment at Grayrigg Status: Implemented	23/02/2007	20/2008	The intention of this recommendation is to improve communications between rescue organisations after an accident. The Ministry of Defence should equip the Royal Air Force and Royal Navy search and rescue fleet of helicopters with radio communication equipment that allows direct contact with civil emergency services.	The Ministry of Defence reports that it has completed implementation of this recommendation.
29 Derailment at Grayrigg Status: Implemented	23/02/2007	20/2008	The intention of this recommendation is to identify possible links between working hours and performance, and to implement steps that can be taken to reduce any resultant risk. a. Network Rail should carry out research to establish if there is a link between working long hours over extended periods, including the number and distribution of rest days, and the propensity for human errors during safety critical tasks. The study should include, but not be limited to, those staff who have ordinary office-based duties interspersed with safety critical tasks, such as inspections. The output of the research should be a set of threshold levels of hours for differing roles.	This recommendation was intended to improve the controls of working hours of safety critical staff. In the RAIB's opinion, it is outstanding and contributes to a concern regarding the management of worker fatigue. Whilst the ORR has reported to the RAIB that alternative measures have been taken by Network Rail to implement this particular recommendation, the ORR has also reported to the RAIB that it remains concerned about the way the industry is managing fatigue and has recognised the need for improvement in this area. ORR has written to Network Rail asking it to review its approach and awaits its response.

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	b. Using the output of the research, Network Rail should establish procedures to deliver compliance with the thresholds identified.	