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GE/GN8628
Guidance on Preparation for and Operation during Winter
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Documents

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Guidance on Preparation for and Operation during Winter

Issue record

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Superseded documents

This Rail Industry Guidance Note does not supersede any other Railway Group documents.

Supply

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Part 1 Introduction

G 1.1 Purpose of this document

- G 1.1.1 This document gives guidance on the preparation of infrastructure and rolling stock for winter and their subsequent operation during frost, ice and snow conditions on the Great Britain (GB) mainline railway. This guidance is intended to assist infrastructure managers and railway undertakings in understanding their responsibilities. It does not constitute a recommended method of meeting any set of mandatory requirements.
- G 1.1.2 This document has been structured into separate sections covering infrastructure, rolling stock and operations. When planning for winter, consideration should be given to all of the guidance in GE/GN8628 as there could be information in one section of the document that is pertinent to other areas of the railway.
- G 1.1.3 This document sets out guidance on the actions that can be implemented by the infrastructure manager and railway undertaking working in isolation. However, for the effectiveness of some elements, there is a need for co-operation and co-ordinated actions between the infrastructure manager and railway undertakings. This also applies between different railway undertakings operating on the same route.
- G 1.1.4 The general guidance is supplemented in the document by previous experience, examples of which have been supplied by the rail industry.
- G 1.1.5 The content of this document concerns:
- a) Guidance on weather forecasts (Part 2).
 - b) Planning for winter (Part 3).
 - c) Guidance on winterisation of infrastructure (Part 4).
 - d) Guidance on winterisation of rolling stock (Part 5).
 - e) Guidance on operational arrangements in winter (Part 6).
- G 1.1.6 This document is supported by more detailed appendices:
- a) Recommended timeline for winter preparation (Appendix A).
 - b) Guidance on air systems (Appendix B).
 - c) Guidance on brakes (Appendix C).
 - d) Guidance on coupler reliability (Appendix D).
- G 1.1.7 Whilst not specifically covered by the document, elements of the winter guidance are also potentially relevant to organisations outside the GB mainline railway, for example, metro operations and suppliers of mobile plant used for maintenance of the infrastructure.

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G 1.3 Approval and authorisation of this document

G 1.3.1 The content of this document was approved by Rolling Stock Standards Committee on 15 March 2013.

G 1.3.2 This document was authorised by RSSB on 23 April 2013.

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Part 2 Guidance on Weather Forecasts

G 2.1 Introduction

- G 2.1.1 Winter weather conditions generally occur in GB between 01 November and 31 March, although this varies depending on the geographical region. However, contingency plans should be capable of being implemented at any time. This was demonstrated in November 2010 when winter weather conditions overlapped with the autumn period.

G 2.2 Forecasting during the winter period

- G 2.2.1 The effectiveness of any measures to improve the operation of the mainline railway during winter weather conditions depends on the timeliness and accuracy of any weather forecast. Infrastructure managers and railway undertakings should have arrangements in place for weather forecasts to be received and disseminated within their organisations.
- G 2.2.2 Using a common single weather forecasting source allows infrastructure managers and railway undertakings to have consistent information that facilitates taking co-ordinated actions. On behalf of the rail industry, the Seasons Management Team (SMT) was created in order to undertake this role.
- G 2.2.3 SMT provides a forecasting service available at <http://www.smtweather.co.uk>.
- G 2.2.4 The SMT website provides meteorological data daily before 04:00 for the 24-hour period commencing at 06:00 that day along with a five day rolling summary to facilitate advanced planning. The five day summary also includes levels of confidence with respect to the predicted weather conditions.
- G 2.2.5 SMT provides an additional notification service when winter weather is forecast. This facilitates the triggering of any contingency plans including implementing alternative timetables by railway undertakings as required.
- G 2.2.6 In interpreting the meteorological forecast, consideration should be given to the whole area of operation and adjacent routes. Implementation of appropriate measures relevant to specific parts of the operational area should be undertaken and agreed between the infrastructure manager and railway undertakings.
- G 2.2.7 The SMT issue revised forecasts in the event that the weather is different from that originally forecast. Regular checks of the SMT website should be undertaken during winter weather situations to check for any updates.

Example 1 A number of railway undertakings reported that the extreme winter weather experienced between 16 December 2010 and 27 December 2010 impacted their routes at constantly changing locations with low temperatures and snowfall affecting operations throughout the day. It was also noted that during this time the weather forecasts were seldom accurate to more than a few hours in advance.

G 2.3 Frost and snow alerts

G 2.3.1 Forecast alert levels

- G 2.3.1.1 Frost and snow alert levels together with associated confidence levels are included in the forecasts received from SMT weather. Table 1 to Table 4 set out the criteria that should be used to determine the frost and snow alert levels. Typical consequences of and their impacts on operations are provided for information, however this should not be considered as an exhaustive list.
- G 2.3.1.2 Frost and snow alert levels are used to anticipate the effects that frost and snow have on the area of operation. This provides information to enable the implementation of detailed contingency plans to minimise the effects of any forecast winter weather.

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G 2.3.2 Frost alert levels

G 2.3.2.1 Frost alert levels are set out using the following criteria:

Term	Wind < 12 mile/h	Wind > 12 mile/h	Alert Level
Slight to moderate frost	0 °C to – 3 °C	0 °C	Frost Level 1
Severe frost	– 4 °C to – 6 °C	– 1 °C to – 2 °C	Frost Level 2
Very severe frost	– 7 °C or below	– 3 °C or below	Frost Level 3

Table 1 Determination of frost alert levels

Frost alert level	Typical impact on operations
Frost level 1	a) All switches and crossings (S&C) fitted with heaters continue to operate. b) Low and isolated risk of S&C not fitted with heaters failing to operate.
Frost level 2	a) All S&C fitted with heaters continue to operate. b) Medium / high risk of S&C not fitted with heaters failing to operate. c) Low risk of mechanical signalling freezing. d) Medium risk of icicles forming in tunnels. e) Low risk of delays to trains.
Frost level 3	a) Medium risk of S&C fitted with heaters failing to operate. b) High risk of S&C not fitted with heaters failing to operate. c) Medium risk of mechanical signalling freezing or incorrect movement. d) High risk of icicles forming in tunnels. e) High risk of conductor rail icing and icicles forming on overhead line equipment (OLE). f) Possible implementation of the Key Route Strategy (KRS) (see G 3.3.1). g) Medium risk of delays to trains.

Table 2 Frost alert levels - typical impact on operation of trains

G 2.3.2.2 The temperature ranges set out in Table 1 are the ambient air temperatures measured 1.25 m above rail level.

G 2.3.2.3 Frost alert levels issued with the SMT forecast apply at any time during the forecast period, for example, during the morning or over the following night, or both. The SMT forecast also gives predicted minimum temperatures and when the specific alert level is expected.

G 2.3.2.4 The SMT forecast facilitates the determination of the impact on the area of operation. The forecasts could be used to predict the following:

- a) Wind in conjunction with ice accumulation on overhead wires and the consequential abnormal sideways displacement of the contact wire and arcing at the pantograph.
- b) Wind and high seas leading to sea water freezing on the infrastructure.
- c) Rapid changes in temperature or humidity causing snow and ice to melt on equipment or rolling stock.
- d) Freezing fog and rain, and how these cause the accumulation of ice.
- e) Flooding following the thawing of snow and ice.

G 2.3.2.5 Historically, freezing rain causes significant problems as a result of ice forming on the conductor rail. Freezing rain is when rain falls onto frozen ground and freezes immediately on contact forming sheets of ice. This is usually a localised phenomenon. Consequently, monitoring the forecast for freezing rain conditions should be undertaken throughout the winter period.

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G 2.3.3 Snow alert levels

G 2.3.3.1 Snow alert levels are set out using the following criteria:

Snow depth (mm)	Wind < 20 mile/h	Wind ≥ 20 mile/h	
	Wet or dry snow	Dry snow	Wet snow
Light (< 50 mm)	Snow level 1	Snow level 1	Snow level 2
Moderate (50 – 150 mm)	Snow level 2	Snow level 2	Snow level 3
High (> 150 mm)	Snow level 3	Snow level 3	Snow level 3

Table 3 Determination of snow alert levels

Note 1: The SMT weather forecast provides information about the depth of snow on level ground, type of snow, expected adhesion characteristics of the snow and the likelihood of snow drifting.

Note 2: Snow depths in Table 3 are for lying snow. The depth of snow above rail level is the depth of lying snow with height of the rail (200 mm) subtracted. For operational guidance with increasing snow depth see G 6.3.

Snow alert level	Typical impact on operations
Snow level 1	a) All S&C fitted with heaters continue to operate. b) Low / medium risk of S&C not fitted with heaters failing to operate through build-up of snow or ice. c) Low risk of routes being blocked through drifting snow. d) Low risk of mechanical signals freezing. e) Low risk of delays to trains. f) Low risk of build-up of snow and ice on rolling stock. (Only in combination with low temperatures, such as frost level 2 and frost level 3).
Snow level 2	a) Medium risk of S&C fitted with heaters (particularly gas, pad or cartridge types) becoming overwhelmed by the volume of snow falling. b) High risk of S&C not fitted with heaters failing to operate. c) Low risk of localised route blockage through drifting snow in high winds. d) Low risk of full barrier level crossings being prevented from fully lowering due to the build-up of snow on the highway. e) High risk of build-up of snow obscuring signal aspects. f) High risk of build-up of snow and ice on rolling stock. g) High risk of delays and disruption to train services in areas where S&C heating is not provided. h) High probability of implementation of the KRS.
Snow level 3	a) High risk of S&C, whether fitted with heating or not, failing to operate. b) High risk that full barrier level crossings are prevented from fully lowering due to build-up of snow on the highway. c) Medium risk of automatic half barrier crossings failing to operate correctly. d) Medium to high risk of routes being blocked. e) High risk of build-up of snow obscuring signal aspects. f) High risk of significant snow and ice build-up on rolling stock. g) High risk of severe delays and disruption to train services. h) KRS should be implemented in affected areas.

Table 4 Snow alert levels - typical impact on operation of trains

G 2.3.3.2 Dry snow occurs when air temperatures are - 2 °C or below. This form of snow is very fine, similar to sugar crystals and drifts very easily.

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Part 3 Planning for Winter

G 3.1 Introduction

- G 3.1.1 The key to minimising winter disruption is planning and timely implementation of actions in advance of the winter period.
- G 3.1.2 The Railway Operational Code (ROC) is a licence condition between the infrastructure manager and railway undertakings to sustain the operation of train services on the network and restore operation of the network following disruption.
- G 3.1.3 The ROC requires a winter contingency plan to be developed by the infrastructure manager and railway undertaking.
- G 3.1.4 The winter contingency plan sets out the general policy including:
- a) Details of how all relevant personnel are to be informed of the plans and procedures for the winter period, including any updates that have been made before the winter period starts.
 - b) A review and update of all winter preparation procedures and contingency planning.
 - c) Details for informing relevant personnel when the contingency plan is invoked.

G 3.2 Generating the contingency plan

- G 3.2.1 The effectiveness of the contingency plan relies on shared and reviewed information supplied by the infrastructure manager and railway undertaking. Operations and engineering teams should work together to produce a robust and effective plan for the winter period.
- G 3.2.2 The preparation for winter should:
- a) Be reviewed at monthly performance meetings and / or executive meetings, where progress against the plan is monitored.
 - b) Maximise the level and consistency of the railway undertaking's fleet performance during winter.
 - c) Include a preparation timeline for activities before, during and after the winter period. Further guidance on a timeline is provided in Appendix A.
 - d) Include information relating to any relevant modification programme that is in progress, for example the installation of coupler heaters to rolling stock for the winter period. Consideration should also be given to accelerating such programmes if they will not be completed in time for the start of the winter period.

G 3.3 Contingency plan elements

G 3.3.1 Key route strategy (KRS)

- G 3.3.1.1 For individual routes of operation a KRS sets out the policy for managing the reduced availability of infrastructure when normal operations cannot be maintained.
- G 3.3.1.2 The KRS should be developed and agreed prior to winter. When developing the KRS consideration should be given to:
- a) Operating shuttle services that remove the need to operate points and crossings whilst endeavouring to keep the railway open.
 - b) Reducing services on branch lines.
 - c) Suspending train services.
 - d) Recovery back to normal service operation.

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- G 3.3.1.3 The development of a KRS is based on a range of structured scenarios that anticipate short-term reductions in infrastructure availability, the provision of rolling stock, the availability of critical staff such as signallers, train crew and maintenance staff and consideration of how they reach their place of work.
- G 3.3.1.4 Where two or more railway undertakings operate over the same route, and to avoid any adverse impacts, consultation of any contingency plans that an individual railway undertaking proposes is necessary with all the other affected railway undertaking(s) prior to implementation. The contingency plan should be presented to those affected other railway undertaking(s) to allow them to assess how the plan impacts on their own operations.

Example 2 During winter 2010 / 2011, one railway undertaking reported that decisions made between the infrastructure manager and another railway undertaking, seemingly without consultation, had adversely affected their services.

G 3.3.2 Winter contingency timetables

- G 3.3.2.1 The level of service and routes to be maintained during a winter contingency timetable should be agreed between the infrastructure manager and all affected railway undertakings. The contingency timetable permits regular services to be maintained when only part of the network is adversely affected by winter conditions.
- G 3.3.2.2 Winter contingency timetables should be published and disseminated through all appropriate channels so that passengers can understand the conditions under which they are implemented. This gives passengers the information to plan or modify their journeys to minimise disruption and inconvenience to themselves.

Note: It is recommended that if a winter contingency timetable has been implemented, it should be in force for a complete day (24 hours). This should not be changed within this period because by changing this midstream it may cause confusion to staff and passengers.

- G 3.3.2.3 The winter contingency timetable should be developed with the intention of providing a reliable service when implemented. When developing the timetable the following factors should be considered:
- a) The impact of the KRS, for example junction control, depot and siding access S&C.
 - b) Nodal operations, for example simplifying or splitting of train paths and alternative destinations.
 - c) Coupling strategy:
 - i) Suspension or reduction of coupling activities.
 - ii) Allowance of additional time where coupling of rolling stock is necessary.
 - d) Reduced availability of resources including rolling stock, train crew, operations staff and maintenance staff. Consideration should also be given to keeping the driver, guard and train together for the duration of their duty.
 - e) Increased journey times and impact on line capacity as a consequence of:
 - i) Reduced operational speeds.
 - ii) The need to undertake additional running brake tests.

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- f) Operating a reduced or slower service minimises damage to rolling stock during extreme winter weather. This facilitates the train service being restored as efficiently as possible back to normal service once the weather has improved.

Example 3 During 2010, the TGV network in France implemented a blanket 160 km/h emergency speed restriction as a result of the winter weather conditions being experienced. Speed reductions are also implemented on the Shinkansen services in Japan and have been effective at reducing the damage caused from icy ballast balls being thrown up from the track at speed. These balls of ice and ballast can weigh up to 15 kg and therefore are potentially damaging to rolling stock.

Example 4 Following the winter of 2010 / 2011, a significant proportion of rolling stock in GB was in service in a degraded condition as a result of snow and ice damage. Railway undertakings were also forced to defer maintenance tasks. This backlog of defects and overdue maintenance took a number of months to rectify.

Example 5 During winter 2010, one railway undertaking took the decision to attempt to run a full timetable. As a result all routes remained open for the majority of the time albeit at reduced speed with some cancellations and a large number of delays. The reduced speed service minimised damage to rolling stock but punctuality dropped 15 percentage points against the full timetable.

- g) Earlier start-up times for services in order to provide some flexibility to operate route clearance activities:
- i) Running the first train of the day as an additional ghost train provides route information, clears snow from the route and mitigates against ice forming on the conductor rail or icicles on the OLE. It is recommended that the train used for this purpose is diagrammed back to a depot to check that no damage has occurred during the journey. Consideration should be given to using the same formation of rolling stock on consecutive days to clear snow to limit the potential damage to a fleet of trains.
 - ii) To clear snow, it is recommended that the longest train formation possible is used. As an alternative to running a passenger ghost train, consideration should be given to the routing of a freight train or treatment train prior to service using rail vehicles that are unlikely to become stranded by the conditions causing the line to be blocked.

Example 6 Experience from one railway undertaking running 'light loco' Class 73 locomotives showed it was ineffective at clearing snow. This was because as much snow was drawn back onto the infrastructure at the rear of the locomotive as existed in front prior to the passage of the locomotive.

- h) On 3rd rail routes consideration should be given to running services at 20 minute intervals to remove the build-up of snow from the conductor rail. Intervals in excess of 30 minutes can result in the complete loss of electrical contact with the risk of stranded trains.
- i) On some routes the traction supplies have been designed assuming that the train's regenerative dynamic braking supplements the supply. Where winter operation of trains reduces the output or isolates the regenerative brake, there will be a corresponding reduction in the traction energy supply available to operate the service. The impact of this on the timetable should be considered.

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G 3.3.3 Other contingency plan considerations

- G 3.3.3.1 Contingency plans should contain arrangements for the care of passengers on stranded trains. This includes provision of information, access to toilets and a means of sending and receiving messages on a train or at a station. If the train is stranded, refreshments should be considered and arrangements made for safe passenger detrainment.
- G 3.3.3.2 Further guidance on passenger information during disruption and passenger needs when trains are stranded is provided in:
- a) Approved Code of Practice – Passenger Information During Disruption (ATOC/ACOP015).
 - b) Good Practice Guide - Meeting the Needs of Passengers when Trains are Stranded (ATOC/NR GPG SP01).
- G 3.3.3.3 The contingency plan should include arrangements for holding trains at, or allowing more than one train to occupy, a station platform when the line ahead becomes blocked.
- G 3.3.3.4 The contingency plan should identify alternative access points at which trains should be held when the line becomes blocked. This, for example, could be adjacent to level crossings (providing the train is clear of the level crossing) or depots. On 3rd rail routes the train should be drawn past the crossing to avoid subsequently restarting on a 3rd rail gap through the crossing.
- G 3.3.3.5 Rolling stock is designed to operate in specific temperature ranges. Railway undertakings should consider the forecast temperature range and any degradation to train services that temperatures at or below the design limits would cause.
- G 3.3.3.6 The contingency plan should consider the consequences of extreme winter weather conditions occurring during the Christmas shutdown period.

Example 7 One railway undertaking has a plan for drivers to report for duty at stabling locations where, if required, they run up engines at set times to minimise any possibility of the engine freezing. Additionally, booking on times on the day after Boxing Day are brought forward to address any issues relating to the weather conditions.

G 3.4 Severe winter weather processes

- G 3.4.1 National co-ordination of severe winter weather is managed through the Severe Weather Event National Industry Conference. This is chaired by Network Rail and joined by railway undertakings, the Department for Transport and the Association of Train Operating Companies (ATOC).
- G 3.4.2 At a local level, the Extreme Weather Action Teams (EWAT) conference is an agreed process to review weather conditions at specific decision points. The EWAT process should be incorporated into any winter contingency plan.
- G 3.4.3 The EWAT conference should be implemented in the event of the forecasted weather conditions deteriorating to an extent where the infrastructure manager's maintenance and operations teams declare that their resources are unable to maintain any particular part of the GB mainline railway. Decisions with regard to the implementation of the applicable KRS should also be made at this time.

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G 3.4.4 The times for the decision points to implement a KRS for the following day should be nominally at 10:00 hrs (pre-planning) and 17:00 hrs (go / no go).

Example 8 One railway undertaking has enhanced the EWAT process by using a work sheet of critical activities that underpin delivery 'on the day' by counting down from three days in. Representatives at the EWAT conference report on progress and importantly flag the areas at risk of non-delivery.

Example 9 One railway undertaking uses the SMT weather forecast in conjunction with a 'Winter Trigger Matrix' to highlight what actions should be considered on a day by day basis before the forecast winter weather event.

G 3.5 Contingency plan implementation

G 3.5.1 After the EWAT conference, detailed local planning should be undertaken at route and operation level for the proposed next day's train service, planning Day B on Day A, in the light of prevailing and emerging weather conditions.

Example 10 During winter 2010, one railway undertaking temporarily reorganised their control whilst encountering extreme winter weather conditions such that two teams were created. One team was responsible for the day-to-day running of the railway that day. The second team had the responsibility as a 'shadow control' to look at the planning required for tomorrow and the day after.

G 3.5.2 The contingency plan should set out how the contingency plan links to the EWAT decision points at preplanning (nominally 10:00 hrs) and go / no go (nominally 17:00 hrs). An earlier decision (on Day A) gives more time for detailed planning and communication but may be less accurate locally as the forecast may change during the course of the day. Contingency plans therefore need to adapt in response to changing weather situations.

Note: It is not uncommon for the forecast for precise locations and severity of snowfall to change during the 24 hours up to the winter weather event.

G 3.5.3 Prior to implementing the contingency plan, a review should consider:

- a) Which route(s) as part of the KRS should take priority in the event of extreme winter weather.
- b) Assessment of how much of the infrastructure is likely to be available based upon the weather forecast at the time.
- c) The capabilities of keeping the infrastructure open, including dealing with ice formation in tunnels.
- d) When to implement the KRS and associated winter contingency timetable.
- e) The availability of staff to keep the infrastructure open to plan and operate services and the provision of additional resources at stations and elsewhere.
- f) Provision of additional personnel at key locations, for example to help with coupling activities to provide assistance to train crew.
- g) Provision of additional personnel at key locations to obtain information from, and provide assistance to, drivers with respect to rolling stock performance.
- h) Provision of additional personnel at key locations to manage passengers in the event of train services becoming stranded between stations.
- i) Arrangements for station staff to assist in the clearance of snow and ice from platforms and rolling stock passenger doorways.
- j) Distribution of equipment, for example snow shovels and brooms or extra grit boxes at remote / difficult to access locations.

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- k) The use and co-ordination of rolling stock and specialist equipment to mitigate the impact of snow and ice on the infrastructure, this includes:
 - i) Snow ploughs.
 - ii) Treatment trains and multi-purpose vehicles (MPVs).
 - iii) Operation of additional ghost trains.

Note: For 3rd rail areas, access to depots and sidings should be covered by the anti-icing treatment train.

Example 11 During winter 2010 / 2011 there were instances where the snowploughs in sidings were frozen in. Maintaining appropriate access to these assets when required is essential to prevent subsequent problems.

- l) The ability to maintain fuel deliveries to relevant sites and alternative arrangements.
- m) Hiring of four-wheel drive vehicles suitably prepared for winter conditions, such as provision of snow chains, to facilitate access to key remote locations.
- n) Reacting to changing weather conditions during the winter period.
- o) Recovery of the service after carrying out a KRS extreme winter weather operation.

G 3.6 Actions required following the end of the winter period

- G 3.6.1 The contingency plan should include actions to remove any additional equipment that has been installed to enhance winter resilience, for example, coupler bags and traction motor snow filters. Any control equipment that is solely present to mitigate the effects of winter, such as coupler trace heating or 3rd rail trace heating should be isolated.
- G 3.6.2 The contingency plan should include actions to undertake maintenance tasks that have been deferred as a result of the need to free up resources to facilitate continued operation during the winter period.
- G 3.6.3 The contingency plan should consider the repairs to rolling stock or infrastructure to allow for the rectification of damage sustained by rolling stock or infrastructure during the winter period for which rectification was deferred.
- G 3.6.4 The contingency plan should include a process to review the service delivered during winter to determine if any lessons need to be learnt and adopted. Where two or more railway undertakings operate on the same route then a joint review should be undertaken with the infrastructure manager.

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Part 4 Guidance on Winterisation of Infrastructure

G 4.1 Preparations prior to the start of the winter period

G 4.1.1 Infrastructure winter preparedness plan

- G 4.1.1.1 Winter weather conditions can impact the reliability of equipment vital to the effective operation of the infrastructure. The type of failure varies depending on the type of asset, its location and the weather conditions.
- G 4.1.1.2 The infrastructure manager should have an infrastructure winter preparedness plan that identifies locations and assets through a risk assessment to reduce the effects of winter weather. This should also consider the impact of the failure of neighbours equipment for example supplies due to the extreme winter weather.
- G 4.1.1.3 Railway undertakings should have an infrastructure winter preparedness plan when they are responsible for depots and other infrastructure locations.
- G 4.1.1.4 The infrastructure winter preparedness plan should consider the variation of ambient temperatures and conditions. The effects of altitude and the local environment for sections of route (due to orientation of the track, for example East – West or North - South) on air temperatures should also be considered.
- G 4.1.1.5 The infrastructure winter preparedness plan should document preventative actions required in the range of frost and snow conditions set out in Part 2. The infrastructure winter preparedness plan should also consider:
 - a) Temperatures at or below – 17 °C when waxing of winter grade diesel can occur.
 - b) Actions required at the end of the winter period.
- G 4.1.1.6 The infrastructure winter preparedness plan should identify those locations and assets which present a hazard when subjected to heavy snow fall. This should consider the effect of snow on trees and the likelihood of an avalanche of snow from both adjacent higher ground and adjacent buildings and structures. The infrastructure manager should develop strategies for additional inspection and remedial action of those areas identified as a hazard. Consideration should be given to implementing actions to reduce the identified hazard prior to the onset of the winter period.
- G 4.1.1.7 The infrastructure winter preparedness plan should include identification of areas that are at risk of flooding when snow thaws. Areas that should also be considered are properties adjoining the railway where thawing of snow could cause issues.
- G 4.1.1.8 The infrastructure winter preparedness plan should identify those locations and assets which present a hazard when subjected to freeze / thaw action on structures. This should consider the effects of ice expanding within the fabric of buildings and structures. The infrastructure manager should develop strategies for additional inspection and remedial action of those areas identified as a hazard. Consideration should be given to implementing actions to reduce the identified hazard prior to the onset of the winter period.

G 4.1.2 Plain line

- G 4.1.2.1 The infrastructure winter preparedness plan should consider the following preventative actions for plain line:
 - a) Potential reduction in the height of ballast below sleeper level in areas where there is a known risk of ice or snow build-up to reduce the risk of ballast being disturbed by ice falling off rolling stock.

Example 12 Following winter 2010 / 2011, one railway undertaking commented that 'Network Rail's efforts to maintain ballast levels in the four foot below sleeper level on high speed sections roughly halved the number of broken outer skins and cracked windscreens compared to last winter'.

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- b) Inspection of cuttings or exposed areas where lines may become blocked due to drifting snow.
- c) Suspension of activities for the rail head treatment train (RHTT) water-jetting activities if they are still scheduled.

G 4.1.3 Line side features and structures

G 4.1.3.1 The infrastructure winter preparedness plan should consider the need for the following preventative actions for line side features and structures:

- a) Additional inspections for ice build-up in tunnel ventilation shafts and tunnel portals (where temperatures above zero may be experienced during periods of freezing ambient temperature).

Example 13 See Rail Accident Investigation Branch (RAIB) report (R16/2011) into derailment in Summit Tunnel, December 2010.

- b) Additional inspections where the effects of local climatic conditions could generate ground heave in water logged conditions. This includes areas along a line where altitude and shelter generate temperatures lower than the general ambient temperature.
- c) Additional inspections following a line closure.
- d) The installation or repair of snow fences and sheds or the construction of snow voids at known problem locations.
- e) Removal of trees that are at risk of falling due to the weight of snow or snow on branches causing OLE encroachment.
- f) The impact on the track of any line side building or structures with a pitched roof from which an avalanche of snow could become a danger.
- g) All flood sites fitted with permanent or temporary pump equipment should be checked to confirm correct working order of this equipment.

G 4.1.4 Level crossings

G 4.1.4.1 The infrastructure winter preparedness plan should identify level crossings that could be affected by snow or ice build-up. This includes:

- a) Where there is a risk of level crossing gates not opening due to deep drift conditions or because of snow ploughed against them.
- b) Where barriers that are at risk of not raising or lowering.
- c) User worked crossings where road users and vehicles take longer than normal to traverse over the crossings.
- d) Crossings on roads which may have been ploughed and where snow drifts have been left across the track adjacent to the road.
- e) Level crossings where the road surface are regularly gritted / salted.

Example 14 During winter 2010 / 2011, routes suffered a number of track circuit failures due to road salt build-up on crossings serving major roads.

G 4.1.4.2 Arrangements should be in place with highway authorities and / or users of private level crossings to clear crossing surfaces of snow or ice and advise them not to use chemicals which may have an adverse effect on railway equipment (see also G 4.1.11).

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G 4.1.5 Switches and crossings

G 4.1.5.1 The infrastructure winter preparedness plan should consider:

- a) Identification of critical S&C for the KRS.
- b) Identification of S&C from previous winters that are at risk of failure.
- c) Reduction of ballast height by 100 mm from the top of the bearer at S&C operating equipment. This prevents freezing of stretcher bars to ballast and allows snow to melt and drain away.
- d) Inspection and testing of S&C heating.
- e) Identification of S&C heaters that are unable to cope with extreme winter weather conditions leading them to becoming frozen or blocked by snow.
- f) Identification of where S&C heaters are fitted that do not turn on automatically.

G 4.1.6 Power and traction supplies

G 4.1.6.1 The infrastructure winter preparedness plan should consider the inspection and operation of trace heating fitted to the conductor rail.

Example 15 Network Rail have installed conductor rail trace heating strips at selected locations in Kent, Sussex and Wessex. These are primarily where trains have historically experienced poor traction current collection from the conductor rail as a result of icing and would regularly come to a stand during day-to-day running, for example at stations and inclines at certain signals.

G 4.1.7 Overhead line equipment

G 4.1.7.1 The infrastructure winter preparedness plan should consider the following preventative actions for overhead line equipment:

- a) Ice build-up (icicles) between structures and OLE that cannot be mitigated by running a ghost train. Plans and response teams should be developed for high risk sites.
- b) Line side equipment for the application of treatments for the prevention of ice build-up.
- c) Wire tension checks.

Example 16 During winter 2010, one railway undertaking commented that 'Network Rail's at height examination of the OLE, proactive fault repairs and contact wire monitoring and neutral section replacement led to a step change in OLE performance in severe weather'.

G 4.1.8 Signalling equipment

G 4.1.8.1 The infrastructure winter preparedness plan should consider the following preventative measures for signalling equipment:

- a) Additional inspections when snow is falling to arrange for signals to be cleared of snow when they become obstructed.

Note: Light emitting diodes (LEDs) do not generate sufficient heat to melt snow compared with filament lamps.

- b) Risk identification and mitigation associated with mechanical signalling where the weight of snow on the semaphore signalling wire and / or arms could affect the operation of the signals.
- c) Inspection and testing of back-up generators.
- d) Operation of train staff or token equipment (where appropriate).