Rail Delivery Group

National Rail

RDG Guidance Note: Contingency Planning for Regional Power Outages (RPOs)

RDG-OPS-GN-037
Issue 2 – July 2022

Photo courtesy of Peter Lovegrove

About this document

Explanatory Note

The Rail Delivery Group is not a regulatory body and compliance with Guidance Notes or Approved Codes of Practice is not mandatory; they reflect good practice and are advisory only. Users are recommended to evaluate the guidance against their own arrangements in a structured and systematic way, noting that parts of the guidance may not be appropriate to their operations. It is recommended that this process of evaluation and any subsequent decision to adopt (or not adopt) elements of the guidance should be documented. Compliance with any or all of the contents herein, is entirely at an organisation's own discretion.

Other Guidance Notes or Approved Codes of Practice are available on the Rail Delivery Group (RDG) website.

Executive Summary:

This document provides guidance for railway undertakings on planning for and implementing contingency arrangements in the event of power outages.

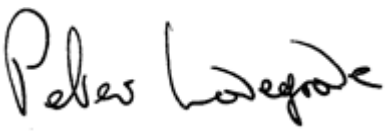
Issue Record

Issue 1 of this document was published as: RDG-GN037 – Contingency Planning for Power Outages.

Issue	Date	Comments
1	January 2017	Original document
2	July 2022	Following periodic review (delayed because of COVID). Document reordered to make it less repetitive and easier to navigate, and contents updated to reflect current national situation and more recent events and learning. Re-titled to emphasise it applies to regional, rather than national, power outages. Reformatted to comply with latest RDG template.

This document is reviewed on a regular 3 year cycle.

Written by / Prepared by:



Peter Lovegrove
Operational Resilience Manager,
Rail Delivery Group

Authorised by:

James Burt
Chair of RDG Emergency Planning Group

Contents

1 Introduction, purpose and scope

1.1 Introduction

The UK National Security Risk Assessment recognises two risks associated with power outages. These are risks R76 (National Power Outage) and R76A (Regional Power Outage). This Guidance Note addresses the second of these.

1.2 Purpose

The purpose of this document is to provide guidance to enable railway undertakings to better understand, plan for and implement individual and joint business contingency arrangements in the event of a regional power outage. It is not intended to be an emergency plan in itself, but rather to assist railway undertakings to put in place their own strategic level and local plans for such an event.

1.3 Scope

This Guidance Note applies to all RDG Train Operator members.

It considers the impact of and possible mitigating actions that could be undertaken by a railway undertaking during a widespread power outage, whether planned or unplanned. In terms of scale, it is intended to encompass everything from a localised outage lasting no more than a couple of hours through to a Regional Power Outage (RPO) extending up to 5 days.

The focus is on widespread power failures across large parts of the network, with other parts remaining unaffected, as it is here that maintenance of a service, potentially involving modified depot, train operations or station working, is possible and where most benefit can be derived from pre-planning.

2 Definitions and glossary

Term	Description	Definition
BCP	Business Continuity Plan	Document outlining how a business will continue operating during an unplanned disruption in service and containing contingencies for business processes, assets, human resources and business partners.
BEIS	Department for Business, Energy and Industrial Strategy	The Government department with lead responsibility for electricity in the UK.
DNO	Distribution Network Operator	Owners and operators of the system that takes power from the National Grid and distributes it to homes and (most) businesses on behalf of the energy suppliers.
GSM-R	Global System for Mobile Communications – Railway	International wireless communications standard for railway communication and applications as used across Europe.
LRF	Local Resilience Forum	Group/process for bringing together all the category 1 and 2 responders within a police force area for the purpose of facilitating co-operation in fulfilment of their duties under the Civil Contingencies Act
MTPD	Maximum Tolerable Periods of Disruption	Maximum allowable time that the organization's key products or services is made unavailable or cannot be delivered before its impact is deemed as unacceptable
NPO	National power outage	Complete loss of the National Grid which would then take 5 to 7 days to re-establish and to stabilise the grid. This is covered in the national risk R76.

PABX	Private Automatic Branch Exchange	An automatic telephone switching system within a private enterprise. For railway undertakings, it is an internal comms system between the signallers, the station and the control room.
RPO	Regional power outage	A wide area power outage affecting one or more UK regions but not the power supply at a national level.
RSN	Resilience Satellite Network	Communications network used to pass information to/from central government to the LRF SCGs (formerly referred to as HITS - High Integrity Telecommunications System).
SCG	Strategic Co-ordinating Group	Multi-agency body responsible for co-ordinating the joint response to an emergency at the local strategic level
VoIP	Voice over internet protocol	A VoIP phone or IP phone uses Voice over IP technologies for placing and transmitting telephone calls over an IP network, such as the Internet, instead of the traditional Public Switched Telephone Network (PSTN).

3 UK power network and outages

3.1 UK electricity supply infrastructure

There are four high voltage transmission networks in the UK. National Grid owns/operates the transmission network in England and Wales, as well as operating the network transmission in Scotland (see figure 1 below). The transmission networks operate like a motorway system, enabling the bulk transfer of high voltage electricity direct from power stations around the country.

Electricity in the UK is provided by National Grid and Distribution Network Operators (DNOs). DNO networks are regional grids that branch from the National Grid to deliver power to industrial, commercial and domestic users in the local area. Independent DNOs operate within DNO boundaries.

DNOs are commercial companies and Category 2 Responders under the Civil Contingencies Act. They transmit and distribute energy to customers over their electricity networks for the energy suppliers such as EDF Energy, British Gas, E.ON, Scottish Power, etc.

The electricity industry is regulated by the Office of Gas and Electricity markets (Ofgem). The lead government department for electricity is the Department for Business, Energy and Industrial Strategy (BEIS).

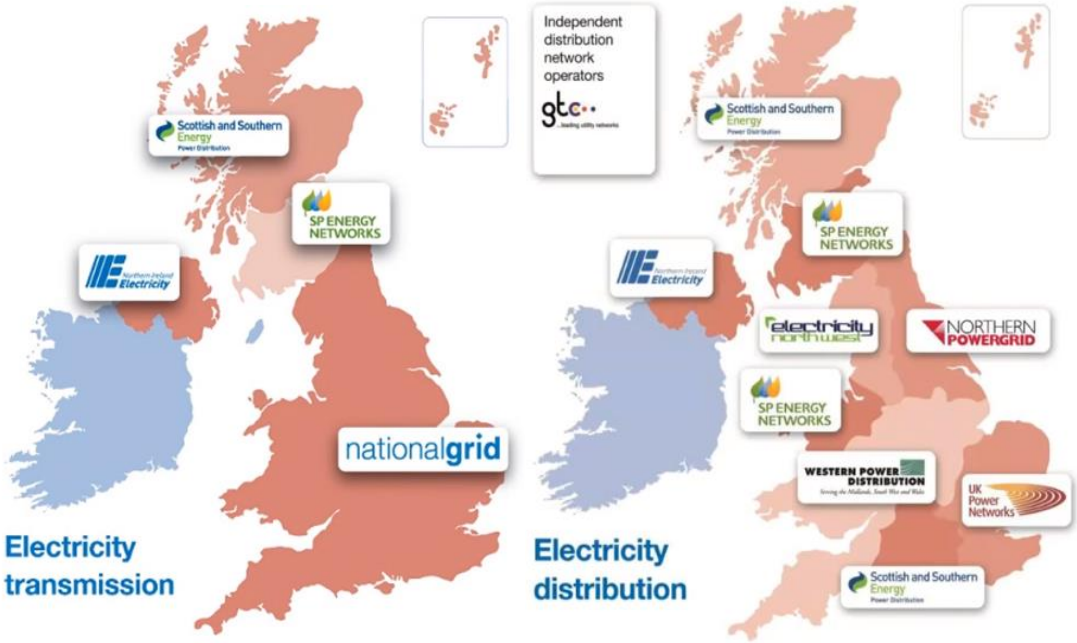


Figure 1: Maps of UK electricity transmission and distribution networks

3.2 Power outages

The UK is used to a generally very consistent electricity supply, as our energy infrastructure is mature and generally very stable. Localised short disruptions to power supplies are experienced, with minor impacts on the rail network, across the country. However, disruptions rarely extend for significant periods of time (e.g. beyond 24-hours) or across wide areas. The causes of such interruptions are usually relatively obvious to ascertain and to remedy and hence supplies are often re-connected within hours or a day at most.

Having said this, more significant disruptions can occur - storms in late 2021 and early 2022 demonstrated network vulnerabilities, with such severe weather events are expected to become more frequent due to climate change.

Two types of power failures are considered under the Local Resilience Forum (LRF) risk assessment process - NPOs and RPOs. A third kind of power disruption (very localised) is not included because such disruptions are so small and frequent as to not require any special response arrangements. Levels of disruption caused by each differ significantly.

National Power Outage (NPO) (R76)

An NPO (known in the risk assessment process as: *R76 Failure of the national electricity transmission system*) caused by an infrastructure failure would result in the wholesale loss of the UK's power generating capacity and the shutdown of all power generating stations. An NPO would impact massively on the functioning of the UK as a whole. The resumption of rail services is unlikely to be an immediate priority. An NPO is out of scope for this guidance because it would be almost impossible to run any kind of service, but it is explained here briefly for context.

Restarting all power stations itself requires a huge amount of electricity and the plan for this is known as Electricity System Restoration (previously operation Black Start). Around 15 power stations have generators able to produce enough power locally to restart them, with them, in turn, generating enough power to restart the rest of the network. There is a move towards doing this in smaller clusters using 'Distributed Energy Resources' (DERs) based on renewable generation to restore power stations, using hydro power, biomass or intermittent generators like wind and solar[1]. This new approach is not yet operational.

If there were an NPO this would be without warning, but it would be immediately obvious almost everywhere by an almost total loss of comms. Full restoration would take up to or even possibly longer than 7 days. During this time, there would be rota disconnections, meaning that areas would be disconnected from power for specific periods of time (usually 3 hours a day at specific times). Areas adjacent to the 15+ black start power stations would be likely to be connected sooner than those further away. There are concerns about how realistic such plans are, however they are not the focus of this Guidance Note.

Regional Power Outage (RPO) (R76A)

The cause of disruption to the regional power network (*known in the risk assessment process as R76A Regional failure of the electricity network*) is likely to be identified and resolved within a relatively short period - normally hours - but the outage could still potentially last days. The cause would almost certainly be a localised infrastructure issue affecting part of the power distribution network, not normally the power generation itself. Examples include severe weather bringing down overhead cables, storm water affecting a sub-station or a fire near the distribution board. Although the outage may affect a large geographic area, key functions would still be able to continue at a national level. The time it would take to restore the power to that area would be heavily dependent on the damage to the infrastructure, access to the damaged infrastructure to effect repairs and from where spare parts could be sourced.

Regional outages covering larger areas, can and have occurred in the UK, most recently in the 2021-22 winter and were the result of severe storms. Relevant overview information provided by BEIS includes the following:

[1] https://www.nationalgrideso.com/news/black-start-bottom-rethinking-our-most-important-back-plan.

"*A significant failure of the electricity network across one or more regions of Great Britain would result in a large number of customers (approximately 1 million) being without power supply for up to 24 hours; for a small number of customers this may extend to 72 hours.*

Specific impacts will vary depending on the region(s) affected (i.e. the effects on large urban areas will be very different to those in more rural areas due to higher population densities and infrastructure dependence) and will cause cascading failures across utilities causing disruption to public services as well as domestic household and businesses. Regional telecommunications systems (mobile, internet, radio and TV broadcasting) are expected to be disrupted due to the loss of supply to mobile phone mast booster / transmitter stations and domestic routers. Transport services (rail, road and airports) may see significant disruption due to the failure of traffic light systems and the ability to pay for fuel at filling stations / sites. Domestic customers and businesses can expect the loss of lights and electrical appliances. Properties which are reliant on electricity for their central heating and cooking appliances will not have access to hot water, heating and be unable to heat food. Water supplies may be disrupted due to the failure of pumps across the network, especially to high rise buildings. For health and safety reasons, many buildings and sites can expect to close due to loss of power for lighting, heating, lifts as well as safety and security systems." [Taken from R76a-BEIS, Regional Failure of the Electricity Network, Reasonable worse case scenario, accessed via ResilienceDirect]

3.3 Plans for responding to power outages

There is no multi-agency national plan for dealing with a power outage in the UK (whether this is a national response to a regional incident or a nation-wide outage), although this is an emerging piece of work in 2021-22.

Planning for such incidents sits within generic emergency management structures and mechanisms as described by the Civil Contingencies Act 2004, with responsibility sitting with each organisation to maintain its own contingency arrangements.

LRFs are being asked by government to develop their own plans. Local level planning for power outages is likely to be by LRF area and plans are at different levels of maturity, though the extent of RPOs would be very unlikely to align with LRF areas. As there is no national plan bringing this all together, it is likely that different LRFs will take different approaches. Any response to a very large-scale power outage may also result in the National Emergency Plan for Fuel (NEP-F) being enacted, because of the impacts on fuel management.

There is no single rail industry plan for managing the response to a power outage (whether national or regional). Operators and Network Rail may have local plans in place. Railway undertakings are encouraged to join in with LRF discussions around power outages and to influence LRF plans as needed. This includes the local application of related plans - e.g. for fuel.

Critical National Infrastructure, telecoms and locally significant sites are expected, under a range of legislation and good practice, to have mitigation strategies in place to withstand reasonably foreseeable scenarios, such as the consequences of a power outage, although the duration being planned for may be exceeded within this RPO scenario.

3.4 Phases of a power outage

The following diagram (figure 2) illustrates the phases of a power outage and will be discussed in the context of a regional but not national (full) power outage:

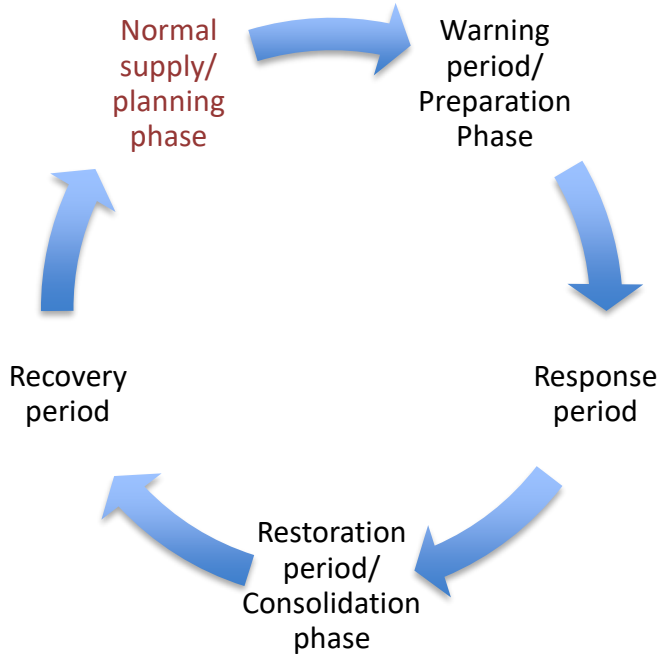


Figure 1: Phases of a power outage

Normal supply/planning phase: This is the business-as-usual period of electricity supply, which includes minor disruptions in very localised areas. During this time, contingency plans can be drawn up and minor interruptions can be used to test new resilient equipment.

Warning period: Before a power cut, there may be indications of potential interruptions to electricity supplies. A supplier carrying out work on the network may provide notice to customers of possible power disruption at specific times. During this time, it may be possible for a railway undertaking to start taking steps to implement new arrangements for staffing and position standby power generators. If emergency repairs are needed, a section of the grid may be taken offline without warning. Unfortunately, the larger the incident, the less likely it is that there will be any warning or notice provided by the power companies.

Response period: This is the period during which there is no or disrupted power, the issue is being identified and a solution developed. During this time, organisations should consider the full business continuity arrangements needed to manage the incident, as it may result in a loss of staff, denial of access or loss of access to a building, etc. This period will be the most difficult to manage, as it is impossible to determine the exact nature of the power loss or its likely duration. It could last anywhere between 5 minutes and a prolonged period. Even in regional outages, depending on the cause (e.g. storm damage), customers may be without power for days.

Restoration period: This is the period during which power is being restored, but it may not be back to its fullest extent or may drop out again intermittently.

Recovery period: This is the period after power has been fully restored, but whilst businesses, organisations and individuals are all finding their feet again and dealing with the aftermath of a significant loss of power. This period could last months, depending on the scale of the impact and the damage to the organisation's infrastructure.

3.5 Generic impacts

A prolonged and or widespread power outage would have far-reaching impacts, directly and indirectly, on society's and the rail industry's ability to function. The image below (figure 3) shows, the potential impacts of a power outage on various sectors, both in an immediate sense and in respect of secondary impacts which result from other services not working. The more widespread and prolonged the power outage, the more exacerbated the effects.

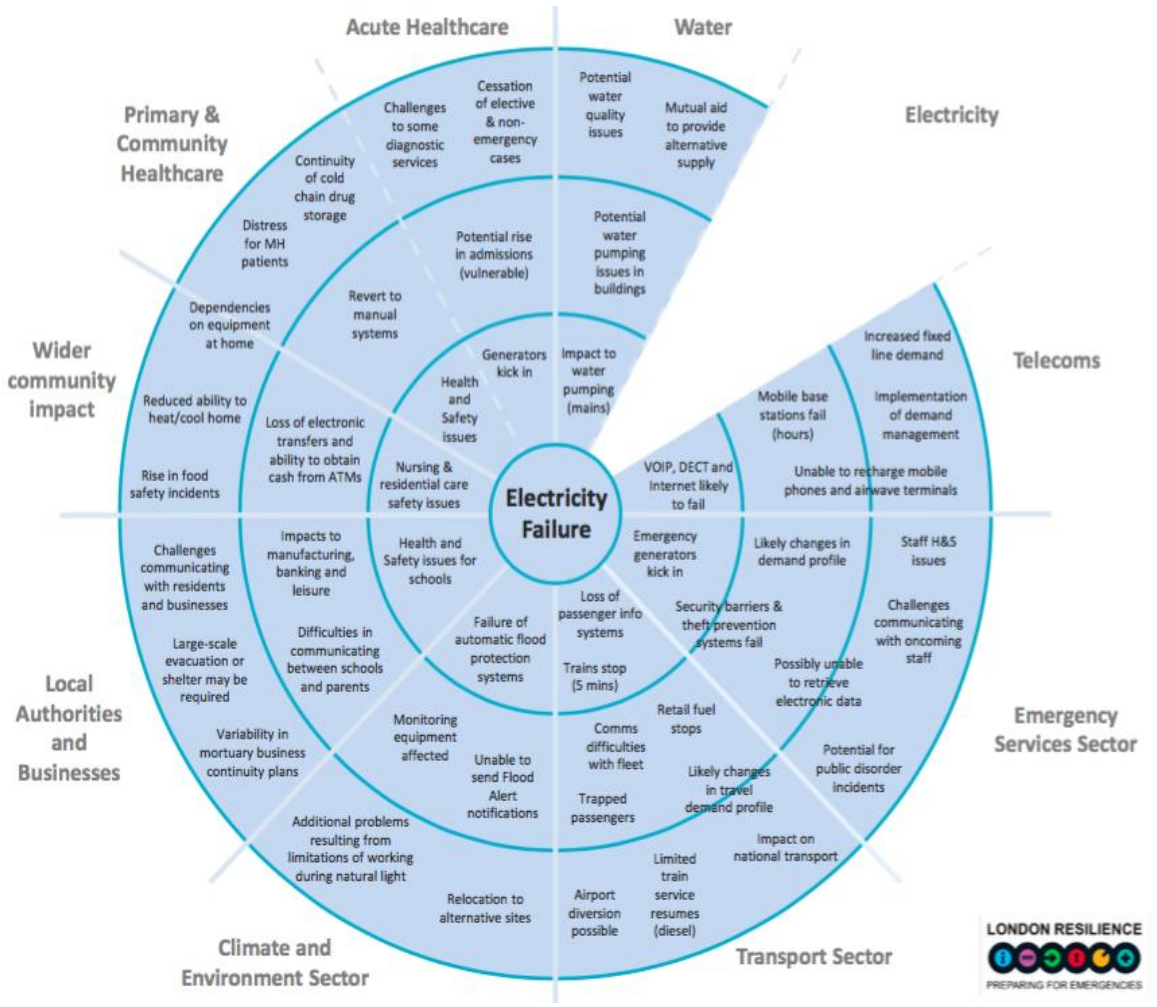


Figure 3: The wider impacts of a power cut (Source: Anytown Project, 2013)

A power outage may not happen in isolation and may overlay additional disruption. The cause of the power outage (e.g. severe weather damaging infrastructure) may in fact still be ongoing and be impacting on service provision in other aspects (staff unable to attend work as there is ongoing flooding, etc.).

The following table describes generic impacts on different functions.

Area	Detail
Fire and security alarm systems:	Increased property fires due to fire alarm systems failing and an increase in alternative and less safe heating and lighting sources (e.g. open fires / candles). Intruder alarms will cease working, potentially drawing on resources or increasing likelihood of opportunist theft (particularly if security or other lighting has failed).

	Security doors will revert to their failsafe mode. This could mean a 'default to open' position, which could cause a security breach, or a 'default to locked' position, which could cause a safety issue for any persons trapped inside (though this is highly unlikely).
Fuel:	Fuel pumps may not be able to dispense fuel. Re-supply may also be an issue as refineries will be without power. The National Emergency Plan for Fuel may need to be enacted. There should be a strong link between any power outage planning and any local arrangements for fuel plans.
Transport (other than rail):	Traffic lights and street lighting will stop working, causing traffic chaos and additional hazards. There is likely to be widespread disruption to all forms of motorised transport. It may not be possible to run transport services through tunnels and across bridges. Fuel supplies may be unavailable or the ability to fuel vehicles severely restricted.
Water and food:	Water supplies may be affected depending on the length of time the power is out (anything extending beyond 3 days would start to impact on a clean water supply). People may also stockpile water, diminishing the length of time that water might be available. Water may need to be boiled before consumption for a significant period even after the power supply has been reconnected if water treatment has not functioned properly during the outage. Some locations would lose their water supply within a shorter timescale if they rely upon pumped water (e.g. some areas of high ground or high rise buildings). Loss of ports could impact on national supplies of goods including food. Many supermarkets work on 'just in time' delivery and therefore will start to run out of food (at normal rates of consumption) within around 3 days. People may stockpile foodstuffs, resulting in low food stocks and queues for basic goods in shops. Freezers and fridges losing power will lead to food spoiling quickly and there will need to be a subsequent food waste management strategy to reduce the likelihood of food quality, hygiene and public health issues.
Cash machines and cash flow:	Cash machines and electronic payment systems (including tills and credit card authorisation systems) will not work, so any transactions will have to be with cash already in circulation. Businesses may experience cash flow problems as automatic payments leave accounts and other incoming cash is not able to move around as per normal.
Power generation:	Generators will be a relatively temporary fix, as refuelling of the generators will be necessary after a number of hours (depending on the fuel tank capacity) and is likely to be an issue. In addition, many organisations fail to maintain their generators, thus anticipating a greater level of resilience than they actually have.
Business activity:	Many business issues will be familiar from the impact of a loss of staff on business activities as a result of COVID. Members of staff will find it difficult to move around because of traffic and rail disruption and therefore may not be able or willing to come in to their normal place of work. Additionally, school closures will have a knock-on effect on staffing, noting that some job roles are more likely than others to be performed by people with school aged children. Businesses will experience economic impacts through loss of trade, loss of ability to take payments, delays in payments affecting cash flow of the organisation, loss of staff in key roles and positions causing business continuity issues. Multiple businesses could be affected and would need to consider whether they work together to manage any scarce resources or whether they work as individual organisations. The wider the area affected, the less opportunity there would be for mutual aid provision, as more and more businesses would be involved and would therefore be vying for those scarce resources.

Communications:	Communications mechanisms (e.g. internet, mobiles and even hard-wired phones, Airwave, etc) would be significantly hampered if not rendered entirely useless. In the event of a major incident, communications would be very challenging – those in strategic command roles would have poor situational awareness while it would be difficult to disseminate any decisions they are able to make. There is a strong link between any power outage planning and communications plans . The Resilience Satellite Network (RSN) is a standalone network for sharing information and communicating between central government and Strategic Command Group (SCG) centres – often referred to as 'Gold'. These tend to be located in Home Office police HQ locations. How this information is disseminated further is a matter for each SCG to determine. Some mobile phone masts have generators, others run off locally generated solar power and the rest have none. Therefore, there will be a deteriorating service across the mobile networks until eventually none work. After around 8 hours, networks will be lost, irrespective of any individual's battery life on their mobile phone.
Staff	It is likely that staff may experience difficulties getting into work or may need to stay at home due to childcare issues if schools are closed. They may also be reluctant or unable to leave their homes if there is no power.

4 Overview of power network serving the rail industry

The following schematic (figure 4) depicts the UK power distribution network, from power station to consumer. Voltage varies along the network from generation to transmission to distribution - domestic customers receive lower voltage and commercial, industrial and traction customers higher voltage.

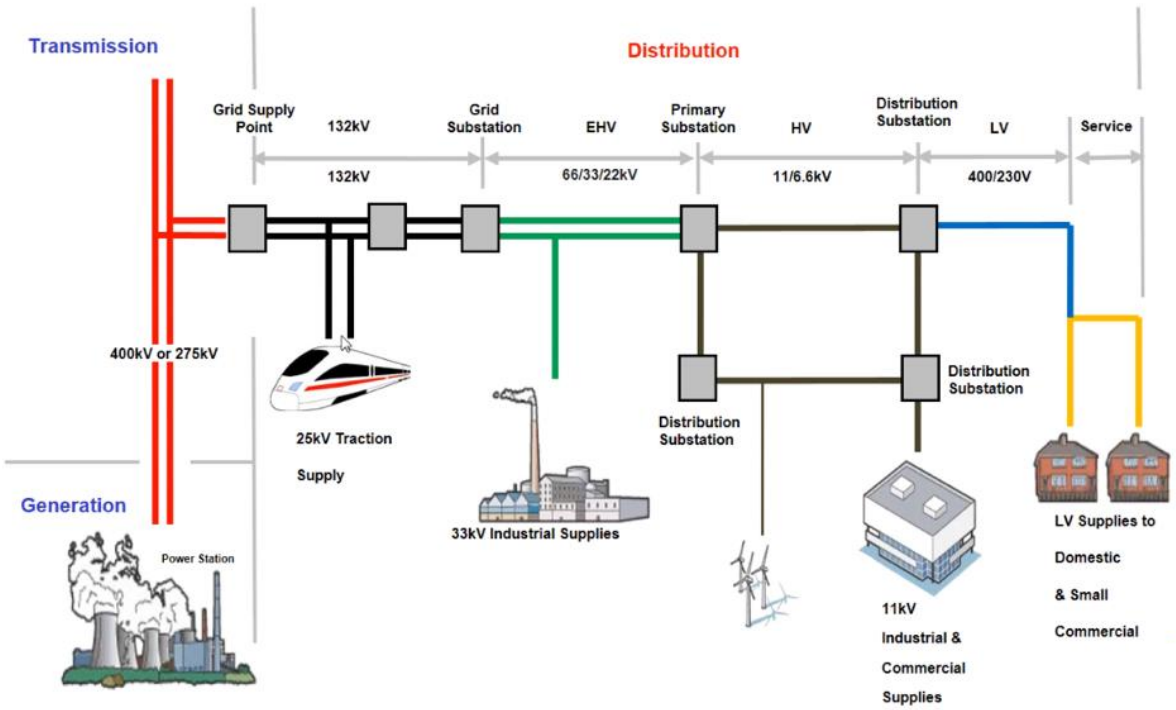


Figure 4: Schematic of distribution network system voltage

There are two types of power supplied to the rail industry:

- **Traction current and signalling:** Electricity used for traction purposes and signalling on the main line network comes direct from the grid, independent of the domestic supply.

- **Stations, offices, CCTV, level crossings, depots, and control rooms, etc.**[2]: Powered through local power supplies.

The rail industry is the largest user of electricity nationally and is designated as a priority user in respect of power for signalling and traction current, which comes from the network at transmission level. Traction current is separate to signalling power and therefore it is possible to lose one without the other. In theory, rota disconnections would not affect the traction current or signalling as they run off a different part of the power network, but they would affect local power (e.g. stations and other domestic buildings, CCTV, level crossings, depots, domestic supplies to local (e.g. depot) signalling where these are not supplied from the main line signalling or traction current, etc.).

To date within the UK, there has never been a disruption caused by external issues at the power-generating end of this power supply. Disruptions have tended to be due to severe weather or rail equipment bringing the overhead wires down.

In the majority of power outages, alongside obvious issues relating to moving trains around the network, the main issue will relate to the ability to provide a safe environment for passengers to board or alight from trains and negotiate stations.

Traction power

Traction power is provided to railway undertakings via Network Rail (see next section). It would be prioritised in the event of both a reduction in electricity availability and reconnection should the power have gone down completely. Traction current is through the traction transmission network, via the 3rd rail (750v DC system) or overhead catenary (25,000v AC system).

Most electrical sections have alternative feeds available which can be activated by Electrical Control Room Operators, though the wider the area affected by the loss of power, the less likely this is to provide a solution. Beyond this, no mitigation measures are available as generators do not have the capacity to provide sufficient power for traction.

Signal power[3]

The power supply to the signalling system can fail for a variety of reasons, for example due to a power outage or a blown fuse in the circuit. The signalling system is designed to fail-safe: when the power fails, signals revert to either a red aspect or no aspect (i.e. blank or 'black'), in either case requiring a driver to stop the train. Although 'degraded operation' without normal signalling is theoretically possible, by means of Temporary Block Working or Emergency Special Working, there are a number of reasons why this might not be possible or practical to implement.

The likely failure of communications networks in this scenario would also mean that options such as Emergency Special Working, which requires staff on the ground, would be unable to be organised or resourced[4]. Also, it cannot realistically be applied over a very large area and provides very limited capacity.

Thus, if signals are lost over a wide-area, trains are to all intents and purposes not going to run, as there is no real sustainable alternative to the provided signalling system. Some, mainly business critical, Network Rail signal boxes, ROCs and other key locations have generators, but there remains a risk that there will not function as planned due to issues with refuelling, poor maintenance or related technical faults. Uninterruptible power supplies[5] (UPSs) are also often provided.

[2] It is believed that in some cases these supplies are also drawn from the traction current supply – railway undertakings are advised to investigate locally if the supply source is not obvious.
[3] National Rail Enquiries, *Signal Power Failure.* http://www.nationalrail.co.uk/service_disruptions/80833.aspx
[4] MOMs need to go to set and clamp designated points etc before any ESW can be operated and they would be required to support the evacuation of passengers from the network, etc.
[5] A UPS differs from an auxiliary or emergency power system or standby generator in that it will provide near-instantaneous protection from input power interruptions, by supplying energy stored in batteries, super-capacitors or flywheels. The on-battery runtime of most

5 Rail specific impacts and mitigations

Railway undertakings are reliant on power, not only to do obvious things like lighting in stations, depots and offices, keeping signals working and providing the traction current for trains, but also to manage ticketing systems, to get messages to staff and passengers, manage their payroll, operate equipment and machinery in depots and maintain security and alerting (such as fire detection) systems.

In some cases, going back to paper-based systems during disruptions may no longer be physically possible; some of the more indirect and therefore less obvious effects of a power outage could be the more difficult to manage or have the widest impact.

5.1 Stations

Loss of power to stations would be the most immediate impact for railway undertakings. During a power outage, any or all of the following could be affected:

- Lighting (platform, passenger movement areas (subways, stairs and overpasses, ticket offices and staff only areas, waiting rooms and public areas)).
- Ticket machines (both in ticket offices and self-service).
- Communications (mobiles, radios, Voice over internet protocol (VoIP) phones, internet and landlines, also Public Address (PA) systems).
- Lifts and escalators (both lighting and functionality).
- Customer Information Screens (CIS).
- Ticket gates and therefore revenue protection.
- Automatic doors and exits (including emergency exits - may default to open or to closed).
- Staff welfare facilities (toilets, water pumping, hot water provision, heating/air conditioning).
- Any concessions and or stall-holder areas or stores within the station.
- On-train catering providers' facilities, particularly refrigeration of food products.
- Fire alarm and detection systems may not be operating or may be unable to sound alarms, etc.
- CCTV, including that provided to support Driver controlled operation (DCO).

Contingency arrangements in stations

Each station's emergency plan should detail the actions required in the event of a power outage. Many stations in the UK have been subjected to various upgrades and reconfigurations over the years. In some cases, the network diagrams for the power distribution in the stations may not match up with what is physically in place, even where the wiring is up to date. This can mean that it is difficult to anticipate how a power outage may manifest itself. It is understood that Network Rail (as the landlord of almost all stations) is in the process of checking that the wiring and distribution diagrams are updated, but there are many stations for which this information is still outstanding and which may have out of date distribution network diagrams. It is quite possible, depending on the wiring at the station, that power could remain unaffected in some areas but not be available in others.

uninterruptible power sources is relatively short (only a few minutes) but sufficient to start a standby power source or properly shut down the protected equipment.

Railway undertakings should assess which of their stations require back-up power generators, taking into account such factors as the number of trains calling, train dispatch arrangements, number of passengers, characteristics of the station (such as stairs, subways, etc.) and the availability of other sources of lighting.

Where such generators are provided, adequate fuel supplies, suitable maintenance and testing regimes should be defined and compliance with these periodically checked. Such backup generators must be in place, it is unlikely they will be available ad hoc in the event of a widespread power outage.

There is a high reliance by station staff on mobile phone technology, digital customer information screens and other Information Technology (IT) systems for information on real time train running. If these go down, staff may have to work 'blind', looking at the front of incoming services and speaking to train staff to determine the calling pattern and destination of each train. This takes time and also means that passengers will have to move to platforms as and when trains are announced, with very little time to transfer from one place to another.

Minimum requirements to keep open a station:

- With regard to maintaining safe operations, during daylight hours on a day with mild weather, a loss of power would not present a significant problem at many, particularly smaller, stations if platforms, walkways and other areas used by passengers receive sufficient natural lighting. In other cases, it may be necessary to close parts of the station – for example a platform only accessible by means of a subway in which the lighting has failed.

- If passengers are obliged to use subways or other areas without natural light, then clearly there is a need to provide artificial lighting in those areas at all times that the station is open if they are to be able to do so safely. If, as at Clapham Junction, there is a subway and a footbridge option, then the former could be closed off and appropriate crowd control measures introduced on the latter. Where new footbridges are installed in stations, their designs should consider the provision of natural light to reduce the need for lighting in a power outage situation.

- The position is clearly more challenging during the hours of darkness, though it should be remembered that modern trains tend to have good interior lighting which may be capable of sufficiently lighting platforms while passengers are joining or alighting from the train. It may therefore be an option to instruct train crew not to dispatch the train until all alighting passengers are clear of the platform, though this has the potential to significantly extend dwell times and hence may not always be practical.

- As a minimum for a station to be open, it must be possible for passengers to safely board and alight from trains and exit the station. It should be the Station Manager's role to make a judgment call on when it becomes unsafe to have people in the area and therefore when the station should be wholly or partly closed. The operation of the station may also depend on having a working fire safety system or other appropriate mitigations if the fire alarm system isn't working.

- There needs to be a safe method of train dispatch. Where Closed Circuit Television (CCTV) systems used in conjunction with Driver Controlled Operation (DCO) / Driver Only Operation (DOO) have failed alternative dispatch arrangements will need to be identified and competent staff deployed to support these.

- Non-safety related impacts of a power outage include an inability to issue tickets – where passengers can be asked to pay on the train or at their destination (clearly without penalty) - and the loss of customer information, both visual and audio. This may be addressed to at least some extent by asking train crew to make additional or more comprehensive announcements when calling at any station so affected.

Where stations are wholly or partly closed due to power supply problems, relevant train crew should be alerted accordingly, as they may have to enact special procedures in order to disembark passengers from a train via a station with limited or no power.

Maintaining welfare facilities for staff working at the station is important. Contingency arrangements should be put in place to ensure they continue to have access to these (or alternative) facilities in the event of an extended power outage – it should be the responsibility of the Station Manager to ensure that provision for this is included in the individual station incident response plan. The basic requirements according to Health and Safety Executive (HSE) Welfare at work guidance for workplaces include:

- Toilet & washing facilities with warm / cold running water.
- Access to drinking water.
- Facilities to make hot drinks and heat food.

Railway undertakings should consider the following contingency arrangements to maintain continued staffing of key stations, taking into account the special requirements for subsurface stations. It is likely that there will be fewer staff than normal with which to operate the station due to staff difficulties getting in and childcare/caring demands on station staff at home. There should be a specific focus on those stations which have been identified as key hubs.

- Operating staffed stations as unstaffed stations.
- Paring back operations to serve only core / hub stations - prioritising those stations that require staff presence and identifying at which times.
- Redeploying available staff from other grades with the appropriate competencies to provide a staff presence at key stations to undertake core activities (including train dispatch and shunting) during peak times.
- Subject to them having the right competencies, it may be possible to move staff from one area/function which is not able to function without power (e.g. ticket sales) to another that supports a reduced power service (e.g. safe management of the platform train interface). However, it should be recognised that staffing a station during a power outage could require more staff than during normal operations.

Railway undertakings may be approached by their local LRF in terms of using stations or station car parks to become central hubs for public welfare and information provision, or for the parking of vehicles there. This is only likely to be major stations, due to their size, locations and facilities. Railway stations tend to be easily accessible and are designed to have parking spaces, waiting space and information display capabilities, which may be of use.

Similarly, railway undertakings may wish to designate certain hub stations from which to channel their resources. In this case, staff could be asked in the event of communications going down, to report to their nearest station or their nearest hub station in order to be provided with work instructions. In the event of prolonged or pre-announced power outages, railway undertakings could provide briefings to staff to report to pre-defined locations to be issued with their work or given other instructions.

In the event of a loss of power at multiple stations, an option would be to focus attention and resources (in particular staff and resilience equipment) at key hub stations and to close smaller stations.

It may be possible to hire in or have a standing contract with a hire company to provide lighting, catering services, etc. in the event of a very localised disruption. It is unlikely that this will be successful or even possible in a widespread outage as many other businesses will be thinking along the same lines and hire companies may be hiring out their equipment on a first come first served basis or to more vulnerable / better paying customers.

In addition to torches, lamps and other forms of emergency lighting, loud hailers are generally useful and a relatively cheap option for managing immediate communications with members of the public and for guiding them around a darkened station. One option that may be possible, if platform capacity allows, is to berth a suitable train at the station for use as a mobile or stationary office hub. Potentially this could provide a power supply for recharging any mobile electrical items and also providing lighting, heating and air conditioning, Wi-Fi, hot water and toilet facilities. Clearly if the traction current has also been affected this will need to be a diesel-powered train with one engine left running.

The space on such a train could also be offered to other organisations, for example to use for triage or as a welfare centre.

5.2 Train operations

During a power outage, trains, along with their passengers, will become stranded. Diesel powered trains may also be blocked by disabled electrically powered train on the line ahead of them or if signalling systems have been affected. A reasonably wide scale power outage affecting routes/areas predominantly served by electrically powered trains is likely to result in multiple stranded trains. It may take a considerable time before all of them can be 'rescued' by diesel locomotives (exacerbated by potential concurrent signalling failures). If diesel trains are being used, their drivers may need to be accompanied by a suitable person with the appropriate route knowledge if the line concerned is not one for which they have this knowledge themselves.

Once any stranded trains have been removed, and if the power outage is continuing, there may be an option of substituting electric by diesel-powered trains. However, there are many reasons why this may not be feasible: signalling systems may not be functioning, spare diesel units may be unavailable, drivers with the necessary combination of route and traction knowledge may not be available, diesel fuel may not be available and fuelling may not be possible.

Once traction current is lost, electrically powered trains are reliant on batteries to maintain on-train systems. Such battery power is limited and subject to intended load shedding to extend the functioning of communications systems for as long as possible. On train air conditioning normally cuts out as soon as traction power is lost. Other systems, such as heating, lighting and operation of toilets, will be lost progressively within the first hour or two, as the available battery power is exhausted.

Even with load shedding, internal communications systems on the train and external communications systems with signallers or control offices (GSM-R) will similarly fail within 1-2 hours of power being lost.

There will be issues with onboard catering - ability to heat or cool food.

A key priority will be maintaining passenger welfare until the train can resume its journey or passengers can be evacuated from it - see *RDG and Network Rail Guidance Note RDG-OPS-GN-049 - Meeting the Needs of Passengers Stranded on Trains* and *RDG Guidance Note RDG-OPS-GN-015 - Extreme Weather Arrangements, including Failure or Non-Availability of On-Train Environment Control Systems*[6].

Contingency train service plans:

Railway undertakings should work together and with Network Rail to identify service levels that can be delivered in relation to:

- Potential levels of absenteeism, in concert with increased workload in parts of the operation (such as passenger safety) and decreased workload in other work areas (e.g. ticket sales and revenue protection).
- Likely reduction in passenger demand.
- Communicating any amended timetables to both passengers and staff.

[6] As at the date of publication of this Guidance Note, the current version is numbered as RDG GN-015. This is being reviewed and will be numbered as shown here when next re-issued.

5.3 Depots (rolling stock and fleet maintenance)

During a power outage, depot operations/functions likely to be affected include access to depots, lighting, refuelling and train maintenance in general (as power to operate machinery, measuring/ diagnostic devices, etc. may be unavailable).

Local loss of electricity could affect train access to and from depots. Although it is theoretically possible to operate points manually and use hand signalling, the number of competent persons available to do so may be limited.

Maintenance and safety checks will also become limited. Security of the line and of depot areas may require additional staffing as electronic security systems are designed to 'fail safe', i.e. unlock, in the event of power loss. Most train maintenance procedures also require use of powered equipment, (e.g. carriage washing, emptying toilet tanks or changing vehicle components).

Consideration should be given to providing depots with back-up generators for essential work – or requesting contractors to do so where train maintenance is outsourced. It is unlikely that it will be possible to maintain full depot functionality for prolonged periods even by means of generators. Where such generators are provided, adequate fuel supplies, suitable maintenance and testing regimes should be defined and compliance with these periodically checked.

Maintaining adequate supplies of diesel fuel to trains will be difficult – deliveries of supplies may be affected and hand fuelling of individual trains may be required.

Access for staff may also be an issue, with manual checks needing to be put in place if electronic access systems are non-operational.

Contingency options:

Railway undertakings should consider contingency arrangements for rolling stock maintenance and fleet management activities:

- Modification of fleet maintenance / servicing schedules.
- Operating train services "short formed" to minimise accumulated miles and release stock for day time maintenance.
- Derogation / extension in duration between time-based examinations being agreed in principle between railway undertakings and Rolling Stock Leasing Companies (ROSCOs).
- Availability and authority of professionally competent persons to make risk assessed decisions on the above.
- Mutual support between depots with staff available for train maintenance, those normally used for the servicing of the company's stock and those not.
- Ordering and stockpiling of key components, the supply of which might be compromised or delayed (for example brake pads and blocks).
- Management of diesel fuel stocks and/or arranging for trains to be fuelled at alternative locations.
- Coverage of train operating activities at depots (e.g. shunters and depot drivers).

5.4 Communications, control networks and systems

If control rooms are within the area of power disruption or outage, this will bring with it a range of issues which could exacerbate any already being experienced on trains or in stations.

In addition to the generic heating, lighting and communications problems already described, during a power outage, mapping systems used within the industry to monitor the position of trains and provide decision support could be affected, thus rendering control and other staff blind to train locations and movements on the network.

There is a great deal of reliance in the railway undertaking community on digital information systems, either to display information in stations or for communications between train, signaller, station and control staff.

Communications means with staff in general will be stretched:

- Wi-Fi on board trains is based on the local network and is likely to be affected.
- Standard means of communicating between office-based staff is most likely going to be via email, VoIP phone or mobiles. Most train guards/conductors now work with a smart phone. With no Wi-Fi or mobile phone signals locally, this will cause limited issues, as there are other mitigation strategies on board trains such as GSM-R and Driver Guard communication systems. Station staff are more vulnerable as they need to be able to provide information in real time to passengers arriving at the station.
- GSM-R radios are provided in the cabs of all trains and can be used to dial other GSM-R units, internal railway numbers and in some cases also selected external numbers. Some handheld GSM-R radios are available at key locations within some railway undertakings, such as depots and control offices. However, it should be remembered that in the absence of power, on-train GSM-R will fail within 1-2 hours.
- There are two types of signal post telephones, type 1 dials the signaller directly only (these are the type provided on signal posts but may also be found at stations) while type 2 can be found on station platforms, these can dial any internal number.
- Some railway undertakings have limited landline capacity and those with internet based VoIP phones will be even more vulnerable. By 2025 it is planned that all phones will move away from copper lines.
- PABX: An internal Communications system between signallers, the station and the control room. Where it still exists, functionality may be very localised.
- Power banks are now available for tablets and mobile phones, there are limited back up batteries for laptops. However, without a longer-term solution for powering the chargers, and if there is no internet or mobile phone signal available, they are of limited value.

The rail industry, through Network Rail, has a relatively standalone communications system which functions independently of BT networks using cables running alongside railway lines. This is quite resilient, however it is being removed as alternative more modern systems replace it.

Control rooms should therefore have business continuity or contingency plans that allow their key functions to be maintained in the event of a loss of power which might affect the building and or utilities.

Unusual or emergency situations can only be managed effectively if there is an efficient and robust communications process. Without this, those in strategic command roles will have poor situational awareness while dissemination of any decisions they are able to make will be difficult. This will undoubtedly be a major challenge in the event of a power outage where many modern methods of communication are unlikely to be working effectively. Existing communication plans should be updated, or new ones put in place to identify key contacts - with alternatives in case they are absent - and set up chains of communication so that information can be disseminated quickly to everyone.

Communication mechanisms need to be reviewed and consideration should be given in any existing communications plans to providing a default physical location for employees to respond to. That way, even if phone and internet communications go down, employees can still attend a physical location for an update, where this is possible and pragmatic. In addition, anyone coordinating those messages centrally can concentrate on ensuring communications routes are maintained to a small but more resilient number of locations.

To report a power cut or receive information about an outage, the free national power cut number 105 should be called - the relevant DNO will respond.

5.5 Remaining business functions

Aside from the operations of train services, there is also a need for the rest of the business to continue to function. Some parts of the business could be slimmed down but will be otherwise unaffected by a power outage, whereas other parts are likely to see their workload increase because of one. For many of those parts of the organisation that are non-essential in the immediate term, there will be a time limit beyond which it will not easily be possible to operate in the absence of that function.

Business continuity planning is part of any organisation's responsibilities, and it is expected that railway undertakings will have business continuity arrangements for offices and office staff as well as for stations (see next section for more on business continuity planning). Railway undertakings should have an understanding of what the MTPD is for each of their key business functions from Business Impact Analyses undertaken as part of the business continuity planning that should have taken place. The MTPD will be different for different parts of the business.

Broadly speaking, the business activities of a railway undertaking can be broken down into the following functional areas. Points that have already been made elsewhere are not repeated below.

Business function	Impact and considerations
Commercial:	Overall cash flow is important and will be affected by the loss of ticket sales in stations and potentially also online ticket sales as well as difficulties in maintaining revenue protection. Railway undertakings have many costs which are fixed, irrespective of whether they are able to operate trains; staff and rolling stock leasing costs are likely to be the biggest two. Commercial teams may also need to manage suppliers who are either unable to deliver their goods in the circumstances or who can deliver them but to a location which is not able to receive them.
Customer service:	This is likely to be severely impacted by a loss of power, both in the immediate area and through knock-on effects from one elsewhere on the network, with the number of contacts (in particular complaints) made by the public likely to increase. More customers are likely to contact customer services by phone if their Wi-Fi has gone down and they need train times (especially if a revised service is implemented). This could be the case even for those at a station, as both the CIS and PA systems are unlikely to be working. Customer service as provided by Twitter, online chat and phone will be challenged. Should the customer service office itself be affected by the power outage at the same time or because of a separate incident, this will mean that response times will go up and increased numbers of complaints can be expected, as queries remain unanswered and frustration mounts.
Human Resources - Absenteeism and other issues:	Power outages are likely to cause a number of HR issues, notably those around staff absences or changes to working patterns. Core activities which are particularly vulnerable to absenteeism amongst specialist employees could include: • Safety critical work. • Essential business or administrative tasks (such as financial, information technology and payroll activities).

	• Work activities that may have a significant impact on operational performance (such as control, train planning, rostering and maintenance of rolling stock). These changes may already be covered under existing HR policies and contracts, but if not, contingency arrangements should include how to manage and compensate staff in the event of: • Redeployment to different roles or different locations (including WFH), • Flexible / alternative working hours (amended timings or extended hours). • Alternative accommodation if it is not possible for them to return home. • Increased demands upon staff who are at work during a power outage - may lead later on to increased staff welfare / care / support needs. • Sickness/absence management processes where workload will be increased or where attendance management procedures may need to be suspended. Much of this information should have been assessed as part of planning for other disruptive events (most recently COVID, but also pandemic flu, extreme weather or industrial disputes). Absenteeism levels during a power outage will depend on the scale and location of the incident. Generally, absenteeism below 20% will not significantly affect business operations and normal working may continue (albeit with minor alterations), however: • Even low absenteeism overall can disproportionately affect particular locations or business activities whilst not affecting other areas at all. Certain roles may be performed by members of staff who travel greater distances to their workplace and therefore are likely to experience greater difficulties travelling to work. Certain grades of staff may include a higher percentage of employees with children of school age. • Absenteeism will reflect those needing to care for relatives or dependants who may be vulnerable due to ill heath, age, etc. Certain grades of staff may include a higher percentage of employees with children of school age and hence be disproportionately affected by school closures. • Some may be unwilling / unable to attend work because of travel difficulties.
	Loss of the payroll system, or access to it, is likely to be a significant issue for HR. In addition, it should be assumed that all staff records are now electronically held rather than paper based so access to these would be lost. This is probably not too important in the short term, but if it is a prolonged outage, a back-log will build up over time. Another issue would be determining what to do with staff who are unable or unwilling to attend work; are they required to take absence time from their leave allocation, take unpaid leave, be granted additional leave or will some other form of special arrangement apply? Will there be penalties for those not able to attend or symbolic gestures of thanks for those who have gone the extra mile in challenging circumstances? Each railway undertaking should have a policy for such a situation.

Signalling and electric traction control contingency:	Railway undertakings should ask Network Rail for details of how it has assessed the impact of absenteeism amongst signallers and electrical control room operators in addition to the impact that a lack of power may have on safety checks for sections of the line. Mitigation measures could include prioritisation of resources to key routes and restricted hours of operation. Such measures should be co-ordinated with relevant railway undertakings with mutual agreement on levels of service to be operated.
Business administration:	Railway undertakings should also review contingency arrangements to ensure the continuity of essential business or administrative activities. These include the maintenance of bill and salary payments, supplier management, and the provision of critical IT support to those working in different environments and with different IT, as well as to address issues with IT equipment caused by extended periods of power outages. Railway undertakings should consider the effect of a power outage on the capability of approved suppliers to ensure continuity of supply of critical goods and services and the risk associated with shortages or over-supply if goods are not being used and therefore have to be stored. Again, these arrangements are likely to have been tested during COVID.
Information Technology (IT):	As a power outage is likely to affect IT systems and access to them, it follows that hard copies of any power outage response plans should be kept in suitably accessible locations – having a power outage plan that cannot be accessed when it is needed due to it being saved on an inaccessible server would hardly be helpful. Redeployed staff may have additional / different IT needs than they would do normally and will need to be supported.
Financial impact:	Railway undertakings should consider the effect of a power outage on financial aspects of the business, including cash flow, payment of staff, impact of lower takings (due to reduced passenger numbers) and higher costs in the long run. Depending on the cause of the incident and associated secondary impacts (e.g. fuel shortages or severe weather hampering the response), government and or specific railway undertakings may advise passengers against unnecessary travel. Footfall and passenger numbers are likely to increase once services are up and running again and the power restored.
Regulatory issues, compliance and insurance:	Legal departments are likely to be impacted by any cases made against the organisation for, for example, any slips, trips and falls as a result of dark stations or in respect of passengers stranded on and potentially evacuated from trains. The effects of a power outage (particularly prolonged and/or widespread outages) may compromise compliance with requirements such as: • Regulatory and commercial contract requirements. • Performance regimes. • Safety Certificates / authorisations. • Railway Group Standards and Rail Industry Standards. • Scheduled and periodic competence and medical assessments. • Security checks required by the DfT Land Transport Security Division. • The assessment of risk and subsequent contingency arrangements must take into account the mandatory requirements of the above, with appropriate representation made to the regulatory body concerned where specific derogation or relaxation may be required on a temporary basis.

	Additionally, because of the power outage the organisation may wish to make a claim on insurance. However, risk transfer via insurance has usually required physical damage to either the insured's assets or the assets of specific service providers to trigger a business interruption claim. Only 20% to 25% of business interruptions, such as supply chain disruptions, are related to a physical loss. Therefore, depending on the type of insurance a railway undertaking holds, it should be aware that it may face very significant uninsured losses. This might trigger an increasing demand for new risk transfer solutions related to power outages risks in the future.
Managing Director and Crisis Team:	The senior management crisis management team is likely to need to be activated to deal with any power outage of significance and its consequences. Getting it to meet may be a challenge if its members are in disparate locations and unable to communicate with each other or unable to travel to meet in person. Some decision-making may have to fall to those local managers in place at key locations and what decision-making is acceptable at a local level will have to be communicated in advance. Alternatively, decision-making may have to be carried out by a smaller group of the crisis management team than would usually be the case. Additionally, as with most other office-based members of staff, senior management could be subject to loss of mobile communications and or their office equipment.
Media and communications:	Whilst not business critical in terms of day-to-day activities, if it is perceived as mismanagement by the railway undertaking that the power outage has occurred or that it has handled the situation poorly, then this could cause reputational damage to the company. There will need to be a significant effort on the part of the media and communications teams to mitigate this, with positive messages around what steps the railway undertaking is taking or took to manage the situation and how it is continuing to look after its passengers.

6. Business continuity planning

6.1 Introduction

It is expected that all railway undertakings, as large organisations, will have in place Business Continuity Plans (BCPs) to manage their core business for an amount of time in the event of a power outage, although this scale of outage may be of a longer duration than anticipated within local BCPs. A lot of mitigation strategies will be business specific.

Many of the mitigation measures should be identified in BCPs already - as this is effectively a 'loss of staff' combined with a 'loss of utility' and also 'denial of access' situation. Possible mitigation measures will typically comprise a combination of staged train service contingency plans, redeployment of staff to key existing or additional activities (such as passenger safety on stairs or in dark areas) and locations and derogations from certain requirements (particularly those based on a periodicity).

Suggestions are provided in the relevant section in Section 5 of this guidance note, where the contingency arrangements relate to a specific business area.

Existing BCPs may, however, only reflect a single (i.e. one railway undertaking) agency's view of responding to a localised power outage and may focus on specific locations, such as individual stations or depots, rather than adopting a wider area/company-wide approach to the issue. Any plans for power outages must address how the organisational plan(s) links in with those of other agencies and to an incident affecting multiple sites within a wider affected area.

Power outages will not necessarily align to DNO, LRF or operator route boundaries - therefore plans should be flexible to accommodate different partner working arrangements.

6.2 Plan structure

It is suggested that railway undertakings have in place:

A strategic power outage plan that describes the approach to the key company-wide issues around power outages, in particular those affecting a wider area where multiple facilities could be affected.

This should cover the general company / owning group approach to:

- Leadership.
- Managing staff absences and absenteeism.
- Redeploying staff to key areas.
- Managing routes with fewer staff and additional safety roles - key routes and hub stations identified (if these are being used).
- Managing ticket sales and revenue protection.
- Managing suppliers who may not be able to supply.
- Managing finite resources (staff, generators, etc.).
- How communications will be maintained with staff, with external agencies and with customers.
- How the plan links in with those of any other responding agencies, including the LRF.
- Any specific critical systems that have been lost, including any safety or security related systems.

Local level plans for each location (station, depot, office, etc. - termed facility for the rest of the section), developed and generated around the key principles outlined in the strategic document. This information may also be incorporated into BCPs covering a wider range of disruption.

Such plans will be more operationally focused and should include:

- Identification of the key electricity infrastructure.
- Plans and maps of the facility (if a station, this should include hazard areas such as stairs, dark areas, underpasses, etc. and an indication of whether to provide additional staff there or whether to close the area).
- Whether the facility is safe to keep open without staff or the minimum number of staff needed and in which positions to run the facility safely.
- The circumstances relating to lack of power under which the facility must close.
- Any electricity sensitive machinery / systems and how these must be managed.
- Whether any other agencies have expressed a wish to use the facility as a hub and how this is going to be accommodated.
- Any other facilities dependent on the facility and the maximum period for which they can be unavailable.
- Mitigation measures – generators, redeployment of staff, equipment available, etc.
- Restoration factors – if power can only be restored partially, how this will be managed.

6.3 Engaging with multi-agency partners

Railway undertakings should consider the multi-agency aspect of any plans, particularly alignment with those of Network Rail. There is little evidence currently that there is a widespread multi-agency approach to power-outages within the railway undertaking community, but there is a strong push centrally for the rail industry to improve planning for all kinds of power outage.

Any lack of multi-agency planning could result in a misunderstanding of how a power outage would or could play out in practical terms if the incident extended beyond the railway undertaking's own site boundaries. Many responding agencies will be concentrating on maintaining care of the vulnerable and prioritising the safety of those individuals. In recovery, railway undertakings must be linked into LRF discussions so they are kept up to date with issues and prioritisation. Electricity providers and central Government will look to the LRF to provide updates and situation reports, which can be passed on to rail industry partners.

A power outage may not only affect a station in isolation. If a wider area is affected, the problem is likely to be disproportionately worse, as the impacts will be greater and the mitigating resources available within all affected organisations more thinly spread.

Railway undertaking BCPs and associated procedures for dealing with a loss of power in the short, medium and long-term should consider the likely local impacts of a power outage, beyond the immediate facility concerned.

Railway undertakings should consider how coordination will take place in an environment where there is a finite number of response or resilient resources and equipment but competing priorities. This should include how they will work with others and through which mechanism decisions about resource allocation are both made and communicated. This should include Network Rail, other railway undertakings and other responding agencies. The key route to successful coordination is to engage with LRFs early on during planning and to establish strong relationships before any incident arises.

6.4 Generators

Where a generator is provided, in order to be useful:

- It must be installed appropriately to match the power generation output required to meet the needs of the location during a power outage. This could be a greater or lesser load than under normal circumstances.

- It must be maintained regularly to ensure that it has not broken down in the intervening months or years since it was last used or tested.

- It must be tested on a regular basis, at full load (not just switched on) and run for a meaningful period, powering a meaningful amount of the power infrastructure in that location. So, for example, if lifts are still required to function, the generator's ability to provide for this should be tested during a period of maximum power consumption.

- An appropriate fuel supply plan should be put in place, including details about where spare fuel would come from and the delivery time. Railway undertakings should also seek to be on the priority access scheme within the local part of the National Emergency Plan for Fuel (NEP-F) and/or maintain sufficient supplies elsewhere. There may be an option to work with other railway undertakings to establish a common fuel stockpile and document how this would be managed and accessed.

- Railway undertakings should also recognise that enterprising locals may seek to gate crash their contingency power supply once its existence is made known. This happened in a hospital in Lancaster in 2015 which had 200% capacity from its generators, but university students set up in its waiting rooms with 6-gang extension cables when it became known that it was one of the few locations with power.

6.5 Maintenance of BCPs and exercising

Railway undertakings should consider how to maintain any plans and / or procedures developed to manage a power outage.

Power outages should be included in exercise scenarios and railway undertakings should identify lessons from historical power outages on the rail network.

Peer reviewing by other rail industry partners and local responders is also recommended to ensure that learning is shared and that the plans and procedures reflect best practice, as well as the actual rather than assumed response practices of other agencies with whom the plan will have to integrate.

7. Experiences and case studies

The following examples provide real cases of loss of power affecting the rail industry and some of the impacts on services. Unfortunately, there are not many significant incidents of widespread power outage and so many of the examples provided only paint a picture of the isolated loss of power to a station or to traction power.

Storms Arwen and Eunice, November 2021 and February 2022[7]

Several winter storms battered Scotland and northern England in late November 2021, leading to widespread power outages affecting over 870,000 homes, some of which did not have their power fully restored for over a week. Part of the complication was the extent of the storm damage, which meant that extensive repairs were needed, sometimes in remote and after the storm, inaccessible areas. Energy officials said the damage had been so bad that some overhead lines will need to be rebuilt - while the impact of the storm had been "one of the worst" in the last 20 years. The damage was so extensive that in some cases, large sections of overhead lines will need to be rebuilt in order to restore supplies. See https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1055504/arwen-review-interim-report.pdf for the interim report.

Storm Eunice was a more widespread storm causing extensive travel disruption affecting much of the country on 18 February 2022. Most operators issued ‘do not travel’ notices, as they were unable to provide alternative means of transport for those unable to travel by rail, given the hazardous conditions affecting all modes of transport including on the highways and in the air. Many rail lines were closed and teams of engineers were on standby to manage the impact of fallen trees and debris on the lines. Only minor power outages were experienced however.

Aberdeen, May 2016[8]

Aberdeen railway station was left without power in May 2016 after a rat chewed through a cable, causing a power cut. Electricity engineers found the dead rat beside a gnawed cable shortly after the power went out at 09.30 and power was not restored until later in the afternoon with the help of an outsourced generator.

It was just the railway station that was affected, not any of the surrounding buildings. Although train services were not affected by the incident, lighting and electronic timetables were down. Station workers put up posters displaying timetable information around the premises and staff were on hand to assist passengers.

Birmingham, April 2016

In the early hours of 11 April 2016, the power supply to signals in the Proof House Junction area, close to Birmingham New Street station, failed, this eventually being identified as due to malicious damage to a cable. Around an hour later, it was reported that the backup diesel generator had not cut in owing to a failure of the alternator. Attempts were made to source a second generator but this was not immediately available. Power was eventually restored by means of diverting other supplies and normal working resumed at 09.59. Overall, the incident resulted in 131 cancellations, 137 part cancellations and total delays of 6026 minutes.

[7] https://www.bbc.co.uk/news/uk-scotland-59451287
[8] https://www.pressandjournal.co.uk/fp/news/aberdeen/932619/passengers-left-dark/

It was reported on the BBC and Birmingham Mail thus[9]:

A major signalling power failure caused hours of delays to trains through Birmingham New Street in April this year when there was damage caused to cables. Network Rail asked people to avoid the station after signal problems at Proof House Junction. Trains struggled to get in and out of the south end of the station, with problems affecting Arriva Trains Wales, CrossCountry Trains, London Midland and Virgin Trains. CrossCountry said the problem caused up to an hour-long delay between Manchester Piccadilly and Bournemouth. Virgin Trains West Coast reported waits of up to 30 minutes between Wolverhampton and London Euston. Passengers went on social media to vent their frustration at the service, which had also suffered delays only two days before.

London Midland said it was expecting services to be affected until about 16:00 BST that day. The incident was expected to cost the rail industry hundreds of thousands of pounds. Network Rail said it believed the cause of the problems was vandalism. This outage was relatively contained as it only affected the signalling power and therefore the problems on the line were limited to being a rail issue, rather than a power outage affecting the wider area.

Lancaster, December 2015 – widespread loss of power and severe weather

In December 2015 Lancaster was affected by a significant power outage. This coincided with and was caused by a period of severe weather which caused river levels to rise resulting in a main substation being flooded, thus causing the power cut. The wider area in and around the city was affected not only by the power cuts, but also by the storm damage, flooding and severe winds. The power was out for 5 days. During this time, Lancaster station lost all power.

The main impacts on Lancaster station were:

- Although there was no power to the station itself, trains were still able to pass through the area. Because the weather had brought down overhead power lines, diesel trains were being run north of Preston.
- Generators were in short supply in the local area as the power cut affected much of the city of Lancaster and Virgin Trains had to react quickly to get a generator from a local company.
- Customer Information Systems (CIS) were down – staff had to wait for trains to come into the station before they could identify where they were going and advise passengers accordingly.
- The fire alarms and intruder alarms went down. Both caused the system to make loud audible beeps and resulted in staff having the additional burden of having to carry out regular manual checks to ensure the station remained fire free.
- As there was no lighting, many of the passenger waiting room areas had to be shut, even during the day, as the small windows meant that there was insufficient lighting for them to be a safe area in which to wait.
- The footbridges and stairs required additional staff to ensure that passengers could move through those areas safely. Additional lighting was able to be provided for some of the areas.
- There were no mess or catering facilities for staff; outside caterers had to be brought in to feed staff working at the station.
- There was only one small retail outlet in the station. Its operator decided to close for the duration, based on decreased footfall and the difficulties in proceeding without power.

[9] http://www.bbc.co.uk/news/uk-england-birmingham-36012618 and http://www.birminghammail.co.uk/news/midlands-news/new-street-station-major-rail-11166462

- Many of the station staff working would normally have used their mobiles to communicate. At points these went down because of a lack of power to the local mobile mast. However, even where the network was working, it was still a challenge to keep phones and tablets charged without functioning power sockets.

- Landlines were still working (as they were powered by the exchange and this was still operating) and so contact with Control was maintained.

- Passenger numbers using the station were down significantly. Customers were advised not to travel where possible, not only because of the power cut, but also because of the weather.

- Power to the booking office was lost and staff relocated to other functions. Some were safety critical trained and therefore could be re-positioned to get passengers on and off trains.

- Another challenge was that buses were being run between Penrith, Oxenholme and Carlisle because of the damage to the infrastructure as a result of the storm. Running buses requires a greater number of staff per passenger than running a normal train service.

- A greater number of staff were needed because of the loss of electricity. This was because many of them were performing safety functions that would otherwise not have been necessary with light or would normally have been performed by automated systems. Additional members of staff were needed to provide information, whilst at the same time having very little information to give out.

Clapham Junction, 30 April 2015

A displaced conductor rail shortly before 08.00 resulted in the closure of three of the four tracks serving Victoria and 5 trains becoming stranded. More than 1000 passengers were evacuated to trackside. Normal working was not resumed until some eight and a half hours later and overall the incident resulted in 587 cancellations, 253 part cancellations and total delays of 14,522 minutes.

This incident attracted the attention of the London Evening Standard, Guardian and Daily Mail, the latter reporting it under the headline “Rail hell: Power failure traps thousands for five hours, fights break out as temperatures soar and passengers are helped onto the track on ladders” and including numerous pictures and Tweets from passengers involved.

“A POWER outage has left trains filled with THOUSANDS of frustrated commuters stranded outside a station for more than FIVE HOURS.

Police and firefighters were forced to evacuate around 2,000 stricken passengers, some of whom were still waiting to reach London more than five hours after boarding their train.

Passengers overcome by sweltering temperatures were also handed water.

The scenes of chaos, due to a major power supply problem, unravelled at Clapham Junction in south London - the UK's busiest interchange station - during rush hour this morning.

One passenger had to be treated by ambulance staff on one of the stationary trains, while firefighters used a short-extension ladder to evacuate travellers from one held-up service.

British Transport Police (BTP) reported evacuating 904 passengers from one train, while travellers on another stricken service were waiting for a tow.

Passengers spoke of "nightmare" conditions at Clapham Junction.”
[https://www.express.co.uk/news/uk/574035/Clapham-Junction-delays-power-supply-outage-trains-passengers-stranded]

Leeds station, April 2013 – loss of power

Leeds station was without power for a prolonged period in April 2013. This was related to a local power network failure which also affected the back-up generator at the station which failed to kick in. A Class 185 diesel unit was eventually brought in as a mobile office (as it has its own generator) and to provide power for meeting rooms, kettle, power sockets etc.

Train movements were unaffected by the outage but arrival and departure boards, lighting and loudspeakers were down, as were lifts, escalators and ticket machines. Passengers took to Twitter to comment on the "pitch black" conditions, which meant that station staff had to guide passengers around using torches. Shops and food outlets lost trade after most were forced to shut because of the outage. One passenger described the situation: "Leeds train station without power is like a zombie apocalypse."

London, August 2003[10]

In August 2003 a severe loss of power supply, resulting from poor infrastructure maintenance of the grid, affected parts of south-east London, with up to 500,000 people impacted. Despite the power only being off fully for around 34 minutes, around 1800 main line rail services were brought to a standstill in south London and the south-east. Mainline and underground stations were shut and evacuated as they were plunged into darkness at around 18.20. Sixty percent of the London Underground was affected (London Underground had shut down the last of their independent generators in favour of using National Grid supplies in 2002, with only limited back-up capability) and people were stuck underground. 270 sets of traffic lights were affected. To relieve the transport problems, buses accepted train and Tube tickets, but were subject to significant queues. Thousands of people took to the rain-soaked streets. Pubs filled up with people sitting out the delays.

[10] http://news.bbc.co.uk/1/hi/england/london/3199594.stm, and http://news.bbc.co.uk/1/hi/england/london/3189755.stm

Rail Delivery Group

National Rail

Rail Delivery Group Limited Registered Office, 2nd Floor, 200 Aldersgate Street, London EC1A 4HD
www.raildeliverygroup.com 020 7841 8000 Registered in England and Wales No. 08176197