# Climate Change Adaptation Report

# Round 2 Update

June 2015


SP ENERGY NETWORKS

## 1. SCOPE

This report has been produced for the purpose of providing SP Energy Networks' update on Adaptation to Climate Change, in response to the UK Government's second call to report under the Adaptation Reporting Power.

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## 6. CONTENTS

## 8. EXECUTIVE SUMMARY

### Purpose of this report

This report has been produced for the purpose of providing SP Energy Networks' update on Adaptation to climate change, in response to the UK Government's second call to report under the Adaptation Reporting Power.

### Information on organisation

SP Energy Networks constructs, maintains and repairs the electrical equipment and network assets that transport electricity to around 3.5 million homes and business in the south of Scotland, Cheshire, Merseyside and North Wales. The assets, transmission and distribution licenses are owned by the three wholly owned subsidiaries SP Transmission plc (SPT), SP Distribution plc (SPD) and SP Manweb plc (SPM).

SP Energy Networks is responsible for replacing and upgrading existing assets, restoring supply as quickly as possible should a fault occur on the network, providing new connections to the network and maintaining the performance and safe condition of the network. Climate change has the potential to impact on the business and hence climate risks are recognised as being relevant to the design, construction, operation and maintenance of networks.

SP Energy Networks operates in a regulated environment where their regulator, Ofgem, sets targets covering an eight year period that apply to all network operators. As a consequence of these common drivers, the UK electricity network operators have worked together for many years on a range of activities. This basis of a common industry background, asset standards and regulatory processes means that UK electricity network operators have similar requirements when approaching the assessment of climate change impacts on their networks and work is coordinated through the Energy Networks Association (ENA). The ENA is the industry body for 'wires and pipes'.

### Background to the report and obligation to report

The UK Climate Change Act 2008 set the UK target to reduce greenhouse gas emission by 80% by 2050, from a 1990 baseline. It also gave the Secretary of State power to require companies to report on their preparedness for climate change, under the Adaptation Reporting Power.

The Adaptation Reporting Power was first exercised in 2010, when a number of different sectors of industry responsible for infrastructure and essential services were required to report on their adaptation to climate change. The three businesses which make up SP Energy Networks, together with the other transmission and distribution companies, were required to report. As a result of this, the first SP Energy Networks Adaptation report was published in 2011[1].

The Electricity Networks Association (ENA) coordinated an industry-wide response to the call to report. SP Energy Networks was a contributor to this industry wide response, and considered that the ENA assessment was a robust and appropriate baseline for its own assessment.

In 2014 the Secretary of State invited companies which had reported in the first Adaptation Reporting Power round to submit an update on their preparedness to adapt to climate change. The three businesses comprising SP Energy Networks were again invited to report. The ENA again coordinated an industry-wide response in which SP Energy Networks participated, and this industry wide report again provides a good baseline for the SP Energy Networks response.

[1] http://archive.defra.gov.uk/environment/climate/documents/adapt-reports/04distribute-trans/sp-energy-networks.pdf

This report is the SP Energy Networks response to the invitation to report, providing an update on the risks identified for SP Energy Networks in the first report, as well as an update on the uncertainties and information available relating to risks from climate change since the first reports were published in 2011.

**Key risks identified in the first SP Energy Networks adaptation report**

The first SP Energy Networks adaptation report drew from the ENA's Adaptation report. It used the list of risks identified by the ENA as a starting point, adding risks identified in the National Grid Electricity Transmission report, and further identifying three additional risks particular to SP Energy Networks.

In line with overall climate projections for hotter drier summers, warmer wetter winters and more frequent and intense storm events, the resultant aggregated list of risks focussed mainly on the impacts of:

- Increased temperatures including an extension of the growing season;
- Drought and reduced soil moisture contents;
- Rising sea levels and coastal erosion;
- Rainfall and flooding, including river erosion; and
- Storms, including lightning, and other extreme events.

The full list of risks was then assessed using the ENA risk assessment framework, which involved assessing the Relative Impact and Relative Likelihood of each risk. The result of the risk assessment is included in Figure 9.2

The three most highly-ranked risks all related to flooding of substation sites and were as follows:

- **AR10: Substations affected by river flooding due to increased winter rainfall**, with loss or inability to function leading to reduced security of supply;
- **AR11: Substations affected by flash flooding due to severe rainfall**, with loss or inability to function leading to reduced security of supply;
- **AR12: There is a risk that due to extreme sea flooding a substation may be lost** or unable to function leading to reduced system security of supply. A number of sites may be at risk from sea level rise/coastal erosion.

These risks all had high Relative Impact and high Relative Likelihood, making them the most pressing of the identified risks.

**Update on uncertainties and assumptions identified in Round 1 report**

Since the publication of the first Adaptation report, the UK Climate Change Risk Assessment (CCRA) has been published by Defra. The CCRA included a chapter on the Energy sector, to which the ENA contributed. This chapter confirmed the key risks which had been identified by the first Adaptation report.

New information on **flooding** has become available since the publication of the first SP Energy Networks adaptation report. Updated data on coastal and river flooding has become available from the Scottish Environment Protection Agency (SEPA) and Environment Agency (EA), which SP Energy Networks has already used to identify at-risk infrastructure and carry out flood protection works accordingly. New data on surface water flooding has also become available, from the EA and SEPA. This data is currently being analysed in conjunction with both parties to ensure that the best use is made of it.

With regards to climate projections, the UK Climate Projections UKCP09 have not been updated since 2011, and remain the most up-to-date and appropriate projections for use in the UK.

At an industry-wide level, the ENA and its members are currently supporting a number of research projects to improve understanding of certain climate impacts. For example, the Resilience Electricity Networks project (RESNET), led by Newcastle and Manchester Universities, aims to develop an assessment of the potential changes to wind speeds as a result of climate impacts. An industry-wide review of tree cutting is also underway. This is being led by the ENA.

**Update on risks from Round 1 report**

A workshop held in March 2015 by SP Energy Networks with staff from across a number of business areas confirmed that the risks identified for SP Energy Networks in 2011 are all still applicable, and the risk assessment remains valid.

**Progress on managing key risks**

Since the publication of the first SP Energy Networks Adaptation report, SP Energy Networks has carried out a number of adaptive actions across a number of areas, with a **key focus on improving resilience to flooding**, since this was highlighted as a source of several key risks in the first Adaptation report.

SP Energy Networks has its own policy document, **Substation Flood Resilience Policy**, which links to industry Engineering Technical Report 138 – Resilience to Flooding of Grid and Primary Substations.

Since the first Adaptation report, SP Energy Networks has obtained updated information on coastal and river flooding from SEPA and the EA, and following analysis of this information has requested and agreed funding from Ofgem for additional flood resilience measures. Between 2010 and 2015, SP Energy Networks is on course to have completed flood defence measures at 52 major grid and primary substation sites.

Whilst current climate change models provide no further evidence that the intensity of wind storms is likely to increase it is anticipated that we should expect increasing frequency of severe weather events. This is of particular interest to SP Energy Networks as significant proportions of our networks operate in rural areas that are exposed to severe weather events on a regular basis.

Following a major 1 in 30 year storm event in 1998, SP Energy Networks reviewed its overhead line resilience strategy and began to improve the storm resilience of its networks from 2000 onwards. SP Energy Networks has carried out significant investment in this area since 2000 and has defined a long term strategy to ensure 40% of the HV and EHV interconnected overhead line network is storm resilient by 2034.

SPEN's investments in this area demonstrated their value by delivering a 32% reduction in HV network faults in an equivalent 1 in 30 year storm experienced in 2012.

In addition SPMW performance must be highlighted during the storms of December 2013 which affected the whole of the United Kingdom with over 900,000 customers off supply. SPMW experienced the highest recorded wind speed of all DNO's at 109mph[2] . The network proved resilient with only 48,000 customers affected. Further, despite 18 hours of persistent high winds preventing many repairs on safety grounds, **96.7%** of customers were restored within **24 hours** and **99.8%** restored within **48 hours**.

[2] https://www.ofgem.gov.uk/sites/default/files/docs/2014/03/final_december_2013_storms_review_1.pdf

It is important to recognise that each of the networks in the UK do not currently experience the same frequency, type and severity of storm events, and it is unclear whether anticipated climate changes will pose different challenges for different network operators dependent upon their geographical location. Whilst we have delivered significant improvements in storm resilience since 2000, SP Energy Networks will continually review its network standards and storm resilience measures to ensure that it remains appropriate for the future climate challenges.

Work to improve **emergency planning and post-incident recovery** time has also been progressed since the first report. This has included both planning measures e.g. developing a list of at-risk substation sites and ensuring all staff members have a role during an emergency and practical infrastructure measures, e.g. introducing an increasing number of reclosers and remotely operated switchgear, which allow electrical faults to be isolated, and the network reconfigured remotely.

Although **heat impacts** are not presently a frequently observed issue (unlike flooding issues), SP Energy Networks has carried out a number of research actions to improve resilience to heat impacts in future. This includes an ongoing research project on underground cable rating monitoring which aims to identify the actual rating of power cables, rather than the traditional calculated rating; and a trial in the Manweb area on the use of dynamic overhead line ratings based upon measured weather conditions. Both these projects lead to increased resilience of assets to future higher temperatures.

**Barriers to adaptation**

No specific barriers to adaptation have been identified, although it is noted that given the scarcity of present-day heat-related impacts, it is difficult to make the financial case for investment to protect against heat impacts at present. However, the research work being carried out by SP Energy Networks in this area will provide the starting point for any necessary future actions.

**Future adaptation actions**

This is the second Adaptation report SP Energy Networks will publish, and it highlights the good progress made in implementing adaptation actions since the first report in 2011.

Going forward, SP Energy Networks will continue to take into consideration climate impacts and concerns during high-level decisions regarding new assets, infrastructure and planning.

At a practical, on-the-ground level, SP Energy Networks will continue to implement flood resilience measures as indicated by available flooding data, which will be updated and refined as further data becomes available.

Finally, SP Energy Networks will continue to review adaptation actions in future when new information or evidence comes to light.

# 9. INTRODUCTION AND BACKGROUND TO REPORT

Scottish Power Energy Networks (SP Energy Networks) is the group within Scottish Power (SP) which incorporates the three licence holders SP Transmission plc, SP Distribution plc and SP Manweb plc. This Adaptation Report has been prepared for all of the operations within SP Energy Networks and hence jointly responds to the Directions received by the three separate licence holders regarding reporting under the Adaptation Reporting Power. Consideration has been given throughout the assessment to the differences between each part of the overall business.

The following key sources are used as the basis of this assessment:

- The Energy Networks Association (ENA) "ENA Engineering Report 3, Climate Change Adaptation Reporting Power Second Round (Issue 1, 2015)" industry wide response to the 2nd Adaptation reporting round. The **ENA** is the industry body for UK "wires and pipes" companies which carry electricity and gas to UK homes and businesses. The ENA carried out a core assessment of risk common to all companies under the first Adaptation reporting call in 2011, and has developed an industry wide response to the second Adaptation reporting round also. SP Energy Networks have been involved throughout the development of this industry-wide response and hence it has been taken as a suitable baseline for this report, with detail regarding the specific characteristics and circumstances of SPEN added and incorporated in addition to the ENA baseline;
- The SP Energy Networks first "Climate Change Adaptation report" (2011)[3].

In addition, the UKCP09 Climate Projections[4] for the UK underpinned the assessment of risks under the 1st Climate Change Adaptation report, and continue to underpin them in this 2nd report. There has been no update to the UKCP09 UK Climate Projections since the publication of the first Adaptation report in 2011; the UKCP09 projections continue to be the most up-to-date and appropriate climate projections for use in the UK, and therefore they underpin the risks described in this second Adaptation to Climate Change report.

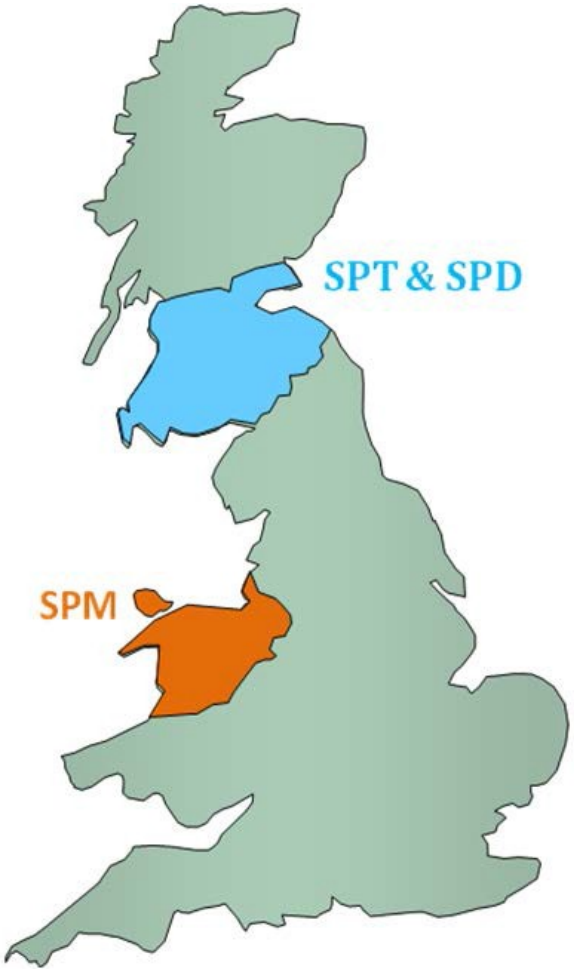
## 9.1 Information on organisation

SP Energy Networks constructs, maintains and repairs the electrical equipment and network assets that transport electricity to around 3.5 million homes and business in the south of Scotland, Cheshire, Merseyside and North Wales (see Figure 9.1). The assets, transmission and distribution licenses are owned by three wholly owned subsidiaries:

- SP Transmission plc (SPT);
- SP Distribution plc (SPD); and
- SP Manweb plc (SPM).

[3] http://archive.defra.gov.uk/environment/climate/documents/adapt-reports/04distribute-trans/sp-energy-networks.pdf
[4] http://ukclimateprojections.metoffice.gov.uk/

Figure 9.1 Regions where SP Transmission (SPT), SP Distribution (SPD) and SP Manweb (SPM) operate




SP Energy Networks operate in a regulated environment where their regulator, Ofgem, sets targets covering an eight year period. SP Energy Networks undertakes the statutory obligations and day-to-day management of the three individual license holders with the aim of outperforming regulatory targets and implementing an investment strategy to upgrade and expand the network. This Adaptation Report is for all of the network assets of Scottish Power.

SP Energy Networks is responsible for restoring supply as quickly as possible should a fault occur on the network, providing new connections to the network and maintaining the performance and safe condition of the network. Key drivers for the business are:

- The health & safety of SP Energy Network employees, contractors and the public;
- Maintaining security of supply;
- Improving customer service;
- Delivering capital investment to modernise the network and connect new customers; and
- Delivery of the Energy Policy.

Climate change therefore has the potential to impact on a number of the drivers for the business and hence climate risks are recognised as being relevant to the design, construction, operation and maintenance of networks.

SPM, SPT and SPD are regulated businesses and operate under licences issued by Ofgem. They are subject to a common regulatory framework set by Ofgem and the statutory requirements set by the Electricity Act and Electricity Safety Quality and Continuity Regulations (ESQCR) which are overseen by the Department of Energy and Climate Change (DECC) and the Health and Safety Executive (HSE). As a consequence of these common drivers, UK electricity network operators have worked together for many years across a wide range of activity including:

- Establishment of common equipment specifications and design standards, across the full spectrum of network assets, to reduce procurement costs and ensure availability of product;
- Establishing UK network owner input to the content, development and modification to national and international standards (BS, EN, IEC etc.);
- Providing a unified input to UK government, regulators (Ofgem, HSE, etc.) on development of regulations, processes, reporting, etc.; and
- Collaboration on research and development (including impacts of climate change) and work on asset designs/ ratings.

This basis of a common industry background, asset standards and regulatory processes means that UK electricity network operators have very similar requirements when approaching the assessment of climate change impacts on their networks. This has meant that the ENA has been able to produce a core assessment for all of the UK transmission and distribution companies.

The ENA's Electricity Networks Climate Change Adaptation Report Round 1 also included a description of electrical networks, levels of service, standards (both international and national) and emergency planning. Similarly, the previously published National Grid Electricity Transmission plc report contained descriptions of the transmission network and assets within it such as overhead line, cables and transformers. These descriptions are not replicated here as they are standard across the industry.

### 9.2 Background and obligation to report

The UK Climate Change Act 2008 set the UK target to reduce greenhouse gas emissions by 80% by 2050, from a 1990 baseline. The Act also gave the Secretary of State the power to require companies to report on their preparedness for climate change, under the Adaptation Reporting Power.

The Adaptation Reporting Power was first exercised in 2010, when the Secretary of State required a number of companies responsible for infrastructure and other essential services, including distribution and transmission companies and others in the power sector, to report on their preparedness to adapt to impacts of climate change.

The three businesses which make up SP Energy Networks were among those required to report. In response, SP Energy Networks submitted their 'Climate Change Adaptation report' to government in 2011[5]. The SP Energy Networks adaptation report drew significantly from the industry-wide adaptation report coordinated and published by the Electricity Networks Association (ENA), which identified key risks from climate impacts to the transmission and distribution industry. SP Energy Networks was involved throughout the development of the industry-wide ENA Adaptation report, and therefore it was appropriate to draw from the ENA report and use it as a baseline for SP Energy Networks' own report.

5 http://webarchive.nationalarchives.gov.uk/20130402151656/http://archive.defra.gov.uk/environment/climate/documents/adapt-reports/04distribute-trans/sp-energy-networks.pdf

Following on from the first Adaptation Reporting Power call, in 2014 the Secretary of State invited companies which had submitted reports under the first round to submit an update on their levels of preparedness for climate change. On this occasion reporting is voluntary. Companies which submitted adaptation reports in the 1st round are invited to submit responses. A number of potential themes are suggested for the reports to cover, including: revising risks identified in the first round and assessing whether these are still applicable to an organisation, identifying any new risks since the 2011 submissions, identifying any new information which has arisen since 2011, in particular with regards to areas of uncertainty, and describing the learning and experience gained by companies since reporting.

The ENA has again coordinated an industry-wide response on behalf of all its members, and SP Energy Networks have been involved throughout the development of this industry-wide response.

SP Energy Networks has also developed its own response to the Secretary of State's call to report, which is contained in this *Adapting to Climate Change – Round 2* report.

## 9.3 Key risks identified in the first SP Energy Networks adaptation report

### 9.3.1 Methodology

As described above, the 2011 SP Climate Change Adaptation report drew from the ENA's Electricity Networks Climate Change Adaptation Report[6], using it as a baseline from which to assess climate change risk and impacts to SP Energy Networks. The first ENA adaptation report identified a series of key risks to transmission and distribution companies arising from climate change. These risks were grouped according to the business function which they affected, as follows:

- Overhead lines, cable bridges & towers;
- Underground lines, tunnels and cable routes;
- Transformers;
- Substation sites (including switchgear, transformers and earthing);
- Overhead lines, transformers; and
- Network access.

The risks were then assessed and ranked by ENA according to the Relative Likelihood of the risk and the Relative Impact of the risk should it occur, and placed within a risk matrix accordingly (see Figure 9.2 below).

The SP Energy Networks' 2011 report used the same framework. The report was based on the ENA risk assessment, together with some additional risks identified in the National Grid Electricity Transmission plc adaptation report which SP Energy Networks found applicable to its own business, and a further three risks identified as being specific to SP Energy Networks. In order to draw from the expertise of SP Energy Networks staff from a variety of operations areas, two workshops were held in 2011, facilitated by Amec Foster Wheeler (then Entec). The workshops served to:

- Assess the risks identified by the ENA, and confirm that they applied to SP Energy Networks;
- Identify specific risks from climate change for SP Energy Networks, in addition to those identified by the ENA, and place them within the Risk matrix (i.e. assess their Likelihood and Impact).

[6] Engineering Report Issue 1, 2011, Electricity Networks Climate Change Adaptation Report

These two workshops allowed staff knowledge regarding different operational areas to be collated and fed into the risk assessment.

The results of the risk assessment as included in the first SP Energy Networks Adaptation Report are summarised in Table 9.1 and Figure 9.2 below.
In line with overall climate projections for hotter drier summers, warmer wetter winters and more frequent and intense storm events, the resultant combined list of risks focussed mainly on the impacts of:

- Increased temperatures including an extension of the growing season;
- Drought and reduced soil moisture contents;
- Rising sea levels and coastal erosion;
- Rainfall and flooding, including river erosion; and
- Storms, including lightning, and other extreme events.

In defining the scope for the first Adaptation Report, SP Energy Networks specified that the main focus of the report would be on primary or direct impacts of climate change, e.g. the potential derating of network cables due to an increase in future temperatures, rather than on secondary or indirect impacts of climate change, such as impacts on the electricity network due to increased air conditioning load associated with future higher temperatures (although these are not excluded from the analysis, as seen in Table 9.1).

The analysis during the risk assessment also took into the account the fact that SP Energy Networks is part of Iberdrola, which operates in Spain, and much of equipment and technology used by SP Energy Networks in the UK is routinely used in the Mediterranean and further afield (Middle East), and therefore is already proven to operate reliably at higher temperatures than those currently experienced in the UK.

The risk assessment carried out was underpinned by information from the UKCP09 climate projections, specifically projected changes to temperature and precipitation under the High Emissions Scenario, for the 2080s time period (covering 2070-2099), using the 90$^{th}$ percentile or 90% probability level[7]. The choice of High Emissions scenario combined with 90% probability level represents a conservative set of choices, in line with the industry's approach to risk management, and more specifically is the same as those used by the ENA in its first adaptation report.

### 9.3.2 Results

A list of all the risks identified by SP Energy Networks in their first adaptation report, and a description of each risk, is set out in Table 9.1 below. The table includes a risk identifier for each risk. The initials used in this risk identifier indicate whether the risk was originally identified by the ENA first report (AR), was identified by the National Grid Electricity Transmission plc report (NG) or was one of the risks specific to SP Energy Networks identified (SP).

Figure 9.2 below illustrates the Risk Matrix, in which each individual risk was placed after assessing its Likelihood and Impact. For example, AR3, which relates to overhead lines being affected by vegetation due to a longer growing season, was assessed as having a High Likelihood (almost certain), and a Moderate Impact, since SP Energy Networks had already observed in 2011 a greater frequency of events involving vegetation growth, and had to increase the frequency of the vegetation cutting programme and increase the breadth of the swathe managed. Given the terrain which SP Energy Network's overhead lines pass through this constituted a significant undertaking.

[7] The 90$^{th}$ percentile or 90% probability level indicates that there is a probability of 90% that the observed change will be this big or smaller.

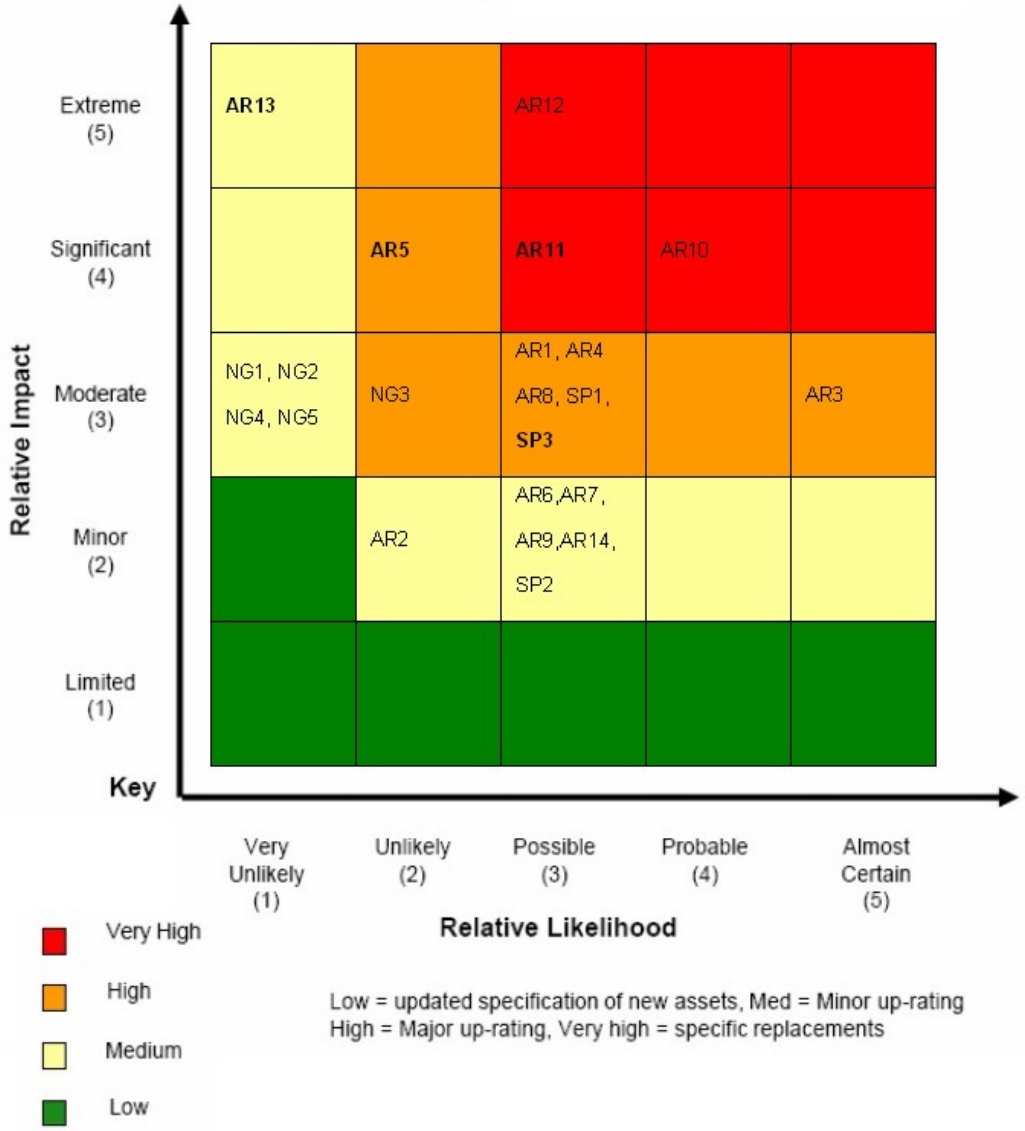
Table 9.1 Identified climate risks

| Business function | Climate (e.g. increase in temperature) | Risk identifier | Description |
|---|---|---|---|
| **Overhead Lines. cable bridges & towers** | Increased temperature | AR1 | Overhead line conductors affected by temperature rise, reducing rating and ground clearance |
| | Summer Drought | AR2 | Overhead line structures affected by summer drought and consequent ground movement |
| | Prolonged Growing Season | AR3 | Overhead lines affected by interference from vegetation due to prolonged growing season |
| | Increased sea level rise | NG1 | A number of sites may be at risk from sea level rise. Sites may become non-operational due to sea inundation potentially leading to a loss of system resilience or a loss of supply |
| | Increased coastal erosion | NG2 | A number of sites may be at risk from coastal erosion. (Due to the slow nature of erosion any site that is identified at risk will be either protected or relocated prior to any system impacts, however mitigation costs may be significant.) |
| | Increased river erosion | NG3 | If foundations are exposed, weakened or soil stability is reduced lines/bridge may fail |
| **Underground lines, tunnels and cable routes** | Increased temperature | AR4 | Underground cable systems affected by increase in ground temperature, reducing ratings |
| | Summer drought | AR5 | Underground cable systems affected by summer drought and consequent ground movement, leading to mechanical damage. |
| | Increased sea level rise | NG4 | A very small number of sites are potentially at increased risk if the level of current protection is not maintained or improved. (Due to the slow nature of sea level rise any cable identified at risk will either be protected or relocated prior to any system impacts, however mitigation costs may be significant) |
| | Increased coastal erosion | NG5 | A very small number of sites are potentially at increased |

| Business function | Climate (e.g. increase in temperature) | Risk identifier | Description |
|---|---|---|---|
| | | | risk if the level of current protection is not maintained or improved. (Due to the slow nature of sea level rise any cable identified at risk will either be protected or relocated prior to any system impacts, however mitigation costs may be significant) |
| **Transformers** | Increased temperature | AR7 | Transformers affected by temperature rise, reducing rating |
| | Increased temperature | AR8 | Transformers affected by urban heat islands and coincident air conditioning demand leading to overloading in summer months |
| **Substation sites (including switchgear, transformers and earthing** | Summer drought | AR6 | Substation and network earthing systems adversely affected by summer drought conditions reducing the effectiveness of earthing systems |
| | Increased temperature | AR9 | Switchgear affected by temperature rise, reducing rating |
| | Increased rainfall/flooding | AR10 | Substations affected by river flooding due to increased winter rainfall, with loss or inability to function leading to reduced security of supply |
| | Increased rainfall/flooding | AR11 | Substations affected by flash flooding due to severe rainfall, with loss or inability to function leading to reduced security of supply |
| | Increased sea level/tidal surge | AR12 | There is a risk that due to extreme sea flooding a substation may be lost or unable to function leading to reduced system security of supply. A number of sites may be at risk from sea level rise/coastal erosion. |
| | Increased rainfall/storminess | AR13 | Substations affected by water flood from dam burst |
| **Overhead lines, transformers** | Increased lightning activity | AR14 | Overhead lines and transformers affected by increasing lightning activity |
| **Network access** | Increased temperature | SP1 | Maintenance programme may be impacted as increased temperatures may increase loads during |

| Business function | Climate (e.g. increase in temperature) | Risk identifier | Description |
|---|---|---|---|
| | | | summer reducing opportunity for planned outages and network reinforcement to enable maintenance. Temperature increases could thus lead to a possible reduction in the flexibility of the network (because of the change in load balance through the year). |
| | Extreme events | SP2 | During extreme events teams may have limited safe access to isolate and repair faults. This could result in loss of supply to customers for a greater period of time. |
| **Control infrastructure** | Increased rainfall/ flooding/sea level rise | SP3 | Flooding impacts upon communication and control infrastructure. Whilst control centres are thought not to be at risk from flood, a site may become non-operational due to flooding potentially leading to a loss of system resilience or a loss of supply. Communications are also reliant upon third parties (Information communication technologies, ICT) who may also be impacted by an event. |

Figure 9.2 Risk matrix




Note – This refers to UKCP09 projections for the end of the century assuming a High Emissions Scenario and 90% probability level and no adaptation measures taken. Risk identifiers (see Table 9.1) in bold signify areas of particular uncertainty (AR5, AR11, AR13, SP3).

Risks which were assessed as having both a high Relative Impact (those assessed as Significant or Extreme), and a high Relative Likelihood (Possible, Probable or Almost Certain), were the highest category risks (being in effect urgent and important). Three risks fell into this category, all three relating to flooding of substation sites, due either due to increased rainfall or sea-level rise:

- **AR10: Substations affected by river flooding due to increased winter rainfall**, with loss or inability to function leading to reduced security of supply;
- **AR11: Substations affected by flash flooding due to severe rainfall**, with loss or inability to function leading to reduced security of supply; and
- **AR12: There is a risk that due to extreme sea flooding a substation may be lost** or unable to function leading to reduced system security of supply. A number of sites may be at risk from sea level rise/coastal erosion.

9.3.3 Risks specific to SP Energy Networks

The first SP Energy Networks report identified three additional operational risks specific to SP Energy Networks, as follows:

- **SP1 – impact of increased temperature on network access**. At the time of writing the first adaptation report, there was significant uncertainty regarding how demands on the electricity transmission and distribution networks would develop in future, however it was assumed that warmer winters and hotter summers might impact the seasonality of loads and potentially shift peak annual loads from the winter season into summer months; Since planning assumes that summer loading is below two thirds of that in winter, any change in this load balance within the year may limit the flexibility of the network and windows for undertaking maintenance work. This wholesale shift in annual distribution of load has not been observed in the intervening years (between 2011 and 2015), however it is still considered a distinct possibility for the future, and therefore remains a risk;
- **SP2 – extreme events limiting network access**. During events which may have led to a failure on the network, repair and maintenance teams may not be able to reach the site, for example where it and/or access roads are flooded. This could result in extended periods of interruptions for customers. Given the rural areas served by much of the networks there is a risk that access to the network will be disproportionately impacted by extreme events. This risk remains as relevant to SP Energy Networks in 2015 as it was in 2011;
- **SP3 – flooding impacts upon communication and control infrastructure**. Although SP Energy Networks believe that risks to its control systems are small, it relies as a business upon third parties for much of the communications infrastructure used. Should ICT be impacted, then the company's ability to control and operate the network would be reduced. Although it is assumed the service providers are also taking actions to identify and manage climate risks, this is an area which may be vulnerable and remains beyond the control of the business. This risk remains as relevant to SP Energy Networks in 2015 as it was in 2011.

9.3.4 Key uncertainties identified in the first SP Energy Networks Adaptation Report

The first SP Energy Networks report identified a number of risks which had substantial uncertainty associated with them, due to a lack of available data. For these the risk assessment was carried out on the basis of experience, knowledge of the industry and the potential impact of an event. These risks were:

- AR5. Underground cable systems affected by summer drought and consequent ground movement, leading to mechanical damage;
- AR11. Substations affected by flash flooding due to severe rainfall, with loss or inability to function leading to reduced security of supply;
- AR 13. Substations affected by water flood from dam burst; and
- SP3. Flooding impacts upon communication and control infrastructure.

In addition, the first SP Energy Networks report identified areas of uncertainty as follows:

- Uncertainty in the projected change in wind, storms and gust, particularly relating to the risk of conditions suitable for ice loading on lines coinciding with higher gust speeds (with the potential to impact overhead lines);
- Uncertainty around planning for new types of risks – e.g. the way risk was then (in 2011) and is still now (in 2015) managed by SP Energy Networks is based upon experience of managing past faults and understanding the vulnerability/resilience of the network to

weather events. Therefore planning for risks of which there is no previous experience is uncertain. An example of this is the impact of solar heating on distribution assets, in particular in an urban environment where there could be dramatic increases in day time load due to use of air conditioning. To date this has not been an issue but we continue to monitor and forecast load growth and further research on urban heat risk will become available before any change to design would be required (if any).

The first SP Energy Networks adaptation report identified as a key source of uncertainty whether the electricity transmission and distribution systems would remain similar to their present state for decades to come. This was considered highly uncertain, and still is, given that SP Energy Networks is already observing the impact of connecting a great volume of renewable energy into the grid, requiring new connection (typically in upland locations and across rural terrain) and impacting traditional supply and load balancing.

Although the impacts of current energy policy and a shift towards a lower carbon grid (increase in electrification of heat and transport, and of distributed generation) are excluded from this assessment (as they were from the first report), it should be noted that the projected increases in load on the network are far greater than any projected changes due to climate change. Load growth forecasts are carefully considered by both the industry and regulator as part of our 8 year regulatory cycle and agreed load forecasts are accommodated within the regulatory framework. Whilst this is not directly associated with, or considered to be part of, our focus on Climate Change it is an area that is well managed between the industry and regulator.

#### 9.3.5 Recognising opportunities

The first SP Energy Networks report recognised that not all climate impacts will be negative for the industry, and highlighted that projected warmer winters imply a reduced risk of ice accretion and ice loading, which can contribute to failure of assets. Also, reduced frequency of snowfall will make year round access to assets easier and could extend the window for construction of new or upgrading of existing network assets.

Finally, should peak loads shift towards summer months, it may be possible to move maintenance programmes into spring and autumn, taking advantage of milder weather during these months.

# 10. RESPONSE TO STATUTORY GUIDANCE

The key sources of information used in the development of this report are:

- The Energy Networks Association (ENA) "ENA Engineering Report, Climate Change Adaptation Reporting Power Second Round report" industry wide response to the second Adaptation reporting round (2015);
- The SP Energy Networks first "Climate Change Adaptation report" (2011)[8];
- The Energy Networks Association "ENA Engineering Report, Electricity Networks Climate Change Adaptation Report" (2011); and
- The UKCP09 Climate Projections[9] for the UK.

The aim of this report is to respond to the UK Secretary of State's call for updates to the 2011 Adaptation reports submitted under the Adaptation Report Power. The aim of SP Energy Networks in submitting this report is to:

- Provide an update on the risks identified in the first Adaptation report in 2011, and assess their relevance to SP Energy Networks today;
- Provide an update on any actions taken by SP Energy Networks to improve resilience to climate change since the first report; and
- To describe any new information which may have arisen since the first report on the risks and the uncertainties identified for SP Energy Networks in the first report.

In order to draw from the organisational knowledge on risks, uncertainties, and the range of adaptation actions carried out within SP Energy Networks since the first Adaptation report in 2011, a workshop with key staff was held in SP Energy Networks' Glasgow offices in March 2015. The workshop was attended by staff from the main areas of the business (asset management, sustainability, risk).

## 10.1 Update on uncertainties and assumptions identified in round 1 report

### 10.1.1 Climate projections

There has been no update to the UK Climate Projections since the first Adaptation report in 2011 – the UKCP09 climate projections are still the most up-to-date and appropriate projections for use in the UK.

After the publication of the latest IPCC assessment (IPCC AR5, 2014), the Met Office conducted a study which showed that UKCP09 continues to provide a valid assessment of the UK climate and can still be used for adaptation planning[10]. The Met Office further intends to publish a technical note providing more information on the Met Office assessment of UKCP09 compared to the CMIP5 findings later in 2015.

In addition, options to update UKCP09 are currently being explored by government.

[8] http://archive.defra.gov.uk/environment/climate/documents/adapt-reports/04distribute-trans/sp-energy-networks.pdf
[9] http://ukclimateprojections.metoffice.gov.uk/
[10] http://ukclimateprojections.metoffice.gov.uk/24123

### 10.1.2 UK Policy

Since the submission of the ENA and SP Energy Networks Round 1 Adaptation reports, UK Government has published the UK Climate Change Risk Assessment[11], published by Defra in 2012.

The Climate Change Risk Assessment took a sector based approach to assessing risks arising from climate change in the UK, and included a chapter on the Energy sector, which covered transmission and distribution of electricity in addition to generation. The ENA contributed to the development of this chapter on behalf of the industry. No new risks were identified in the Energy chapter of the CCRA additional to those already identified in the ENA Adaptation Round 1 Report.

Key points in the Energy chapter of the CCRA relevant to the transmission and distribution industry include:

- Electricity substations and other infrastructure located in vulnerable areas are likely to face an increased risk of flooding;
- Increases in temperature are expected to reduce the capacity of the electricity networks since at high temperatures certain types of equipment must be "de-rated" (i.e. the amount of current carried must be reduced). De-rating is part of a wider issue since over the long term the network experiences approximately 1.5-2% load growth per year and this may increase substantially if the transport system or heating becomes dependent on electricity; and
- The CCRA Energy chapter also noted that weather sensitivities are routinely taken into account in the Energy sector in order to plan maintenance or ensure sufficient contractors are available during significant weather events (e.g. gales), and that this provides a good basis from which to start planning for adaptation to climate change.

The Energy Chapter also identified a number of emerging challenges for the industry, including:

- Changing requirements on the electricity grid (due to both climate change impacts on electricity demand and a move towards a lower carbon economy);
- The need for adaptation of existing flood defences in the UK; and
- The increasing need for decision-making in the absence of clarity (as some climate variables can be more accurately predicted than others).

Following the Fukushima nuclear reactor event in Japan in 2011 as a result of an earthquake and subsequent tsunami, the UK Office for Nuclear Regulation published a report on the implications for the UK nuclear industry[12] (known as the Weightman report after its author, Mike Weightman).

The report found no issues in the current operating procedures and safety measures of the UK nuclear industry, but nonetheless made a series of recommendations to ensure resilience in the event of a catastrophic event similar to that experienced by Fukushima.

While transmission and distribution were not the main focus of the report, they were considered in the context of ensuring no loss of external power supply to nuclear power plants. In this context, the report highlighted a number of sources of information on flooding risk, as follows:

- Flood Map for Rivers and the Sea (for England and Wales);
- National Assessment of Flood Risk (published 2010);
- Indicative River and Coastal Flood Map; and

[11] https://www.gov.uk/government/publications/uk-climate-change-risk-assessment-government-report
12 Japanese earthquake and tsunami: implications for the UK nuclear industry (2011)
http://www.onr.org.uk/fukushima/final-report.pdf

- Information on Coastal Sea-levels, held by the Environment Agency in partnership with SEPA.

10.1.3 New information available on uncertainties – from SP Energy Networks

The workshop held in March 2015 with SP Energy Networks staff highlighted that new information has become available in the following areas:

- Improved data on coastal and river flooding available from SEPA/EA. This data has already been obtained and analysed by SP Energy Networks, following which additional funding for flood protection measures was requested and obtained from Ofgem;
- New data on surface water flooding is also available from SEPA/EA. This data has been obtained, and SP Energy Networks are currently in the process of analysing this data, in consultation with the relevant bodies, to ensure the best interpretation and use is made of it.

In addition, SP Energy Networks staff at the workshop confirmed that the assumptions made during the analysis in the Round 1 report are still valid today.

Although not new, the development of an industry wide guidance document on systematic flood risk assessment and protection is still worthy of note. The whole of the electricity network sector collaborated in the development of the Energy Networks Association's **Engineering Technical Report ETR 138** - Resilience to Flooding of Grid and Primary Substations (Issue 1, October 2009). This is now a key driver of flood protection developments in the industry.

Work was coordinated by the trade association, the Energy Networks Association, and included representatives from all electricity network companies, government (DECC), the economic regulator (Ofgem) the Environment Agency, Scottish Environment Protection Agency and the Met Office. The involvement of DECC and Ofgem was particularly important as it helped to support companies' investment plans for flooding resilience.

As a consequence of this report, all network operators now have programmes to raise protection to the agreed standards and all planned flood protection is due to be completed by 2023, with higher risk sites being completed earlier in the programme. In the major floods in the winter 2013/2014, no customer supplies were interrupted as a result of flooding at major substations operated by the network companies.

10.1.4 New information available on uncertainties – from the ENA round 2 report

The ENA Round 2 Adaptation report presents an update on available knowledge and information in Section 2 (Understanding Climate Change) and Section 3 (Understanding Uncertainties). This includes description of a number of industry wide initiatives taken to improve knowledge and understanding of risk and uncertainty in regards to climate change. These include:

- Research to improve the understanding of the impacts of climate change on wind speeds. Networks companies are currently engaged in further work through the RESNET project (Resilient Electricity Networks project), led by Newcastle and Manchester Universities. This project aims to develop an assessment of the potential changes to wind speeds as result of climate impacts and the risks this could present for electricity networks. At present there is no firm climate change evidence to support increased intensity of wind or ice storms both of which can cause extensive damage to overhead electricity networks. However, these natural hazards continue to be a serious risk to overhead line networks;
- A review of the industry approach to tree cutting, in response to increased risk from the possibility of higher wind gusts of more frequent storms in future. During the winter of 2013/14 this was a particular issue because very strong wind storms were combined with

prolonged rainfall, which made trees more susceptible to uprooting. As a result, a review has been initiated of the industry approach to resilient tree cutting set out in Engineering Technical Report (ETR) 132 Improving Network Performance Under Abnormal Weather Conditions by Use Of A Risk Based Approach To Vegetation Management Near Electric Overhead Lines.

This document was developed in conjunction with DECC and Ofgem and provides guidance for Network Operators on how to improve Network performance by enhancing the Resilience of the Network to Vegetation (mainly trees) related faults under Abnormal Weather conditions, including high winds, ice, snow and prolonged high temperatures;

- Companies are taking advantage of the Met Office's latest long range winter forecast. In addition the Met Office are now invited to attend an industry emergency planning forum in the autumn each year to discuss the forecast for the following winter and the likely consequences with industry emergency planners and operational manager. The first of these meetings was held in December 2014; and
- The ENA report also refers to proposed EU work on climate change services which could prove a useful source of information in future.

### 10.2 Update on risks from round 1 report

At the SP Energy Networks internal workshop on adaptation (held March 2015), the key risks identified in the first SP Energy Networks report were reviewed, and were all confirmed as still being applicable to SP Energy Networks. The impact and likelihood ratings in the risk assessment for each identified risk were also reviewed, and found to be unchanged since 2011. Therefore it was not necessary to make any changes to the risk assessment and outputs (Table 9.1 and Figure 9.2 above).

The risk from climate change, and particularly projected increases in sea temperature was considered in relation to a new sub-sea cable currently being laid. Increasing sea temperature could potentially affect the rating of the cable. The assessment considered that the risk to the cable was low, for the following reasons:

- Sea temperatures are projected to increase at a slower rate than air temperatures; and
- Seasonal variation in sea temperature is much reduced compared with that in air temperature, and sub-sea cables are not expected to experience the same summer peaks in temperature that could affect overhead lines.

For these reasons, whilst it is important to maintain awareness of the issue, it was not felt necessary to include it in the risk assessment.

**New information on risks from the ENA Second report**

The second ENA Adaptation report (in Section 2) highlights the new, improved information available on surface water flooding risks, and work carried out by companies on analysis of substation flooding resilience.

In addition, improvements to the reporting of faults in transmission and distribution were highlighted by the second ENA report. All faults are recorded in the National Fault and Interruption Reporting Scheme (NaFIRS) database. The ENA Engineering Recommendation G43-3 (Instructions for Reporting to NaFIRS) governs the information to be submitted for each fault. Recent improvements are that since 2010 companies submit a more complete information dataset to Ofgem, so that a higher-level aggregated analysis of faults can be carried out.

## 10.3 Progress on managing key risks

As highlighted in the first SP Energy Networks report, key drivers for adaptation within the business include:

- Improving customer service;
- Increasing resilience; and
- Reducing service disruption.

Responsibility for climate change adaptation action is devolved across all areas of SP Energy Networks, rather than being solely the responsibility of the Sustainability department.

At the SP Energy Networks workshop held in March 2015, a number of adaptive actions and initiatives undertaken internally within SP Energy Networks since the publication of the first Adaptation report were identified by staff from main areas of the business (asset management, sustainability, risk).

Key adaptive actions taken since 2011 fall across a number of categories:

### 10.3.1 Improving resilience to flooding

The key driver for flood resilience management within the industry is the Engineering Technical Report **'ETR 138 –Resilience to Flooding** of Grid and Primary Substations**'**, as identified in section 10.1 above.

SP Energy Networks has its own policy document governing **Substation Flood Resilience Policy**, linking in to ETR 138. The policy document sets out how any new substations are to be constructed at a level above any potential flooding, whereas for existing sites a variety of flood protection measures will be used as appropriate. The policy document also highlights that substations are at risk of flooding from a variety of sources, and for the purposes of the policy these will include:

- Fluvial flooding from rivers and streams;
- Tidal flooding from the sea; and
- Pluvial flooding from surface water runoff.

In line with the above internal policy, any new primary substations will be flood-proofed, and a number of substations and other assets have been retrospectively flood-proofed since 2011.

Since 2011, SP Energy Networks has obtained updated information on coastal and river flooding from the Scottish Environment Protection Agency (SEPA) and Environment Agency (EA). On the basis of this information, SP Energy Networks identified the need for additional flood protection at a number of sites, and requested and obtained funding from Ofgem for the implementation of these flood protection measures.

Between 2010 and 2015, SP Energy Networks is forecast to have completed flood defences at 52 major Grid and Primary substation sites, enhancing the electricity supply resilience to over 400,000 customers in Scotland, England and Wales.

In addition to this, a further 28 distribution substations are due to be protected under the ED1 price review period (2015 to 2023) and 3 major transmission substations in Scotland are due to be protected under the T1 price review period (2012 to 2021).

SP Energy Networks has also obtained new, more detailed surface water flooding maps from the Environment Agency and Scottish Environment Protection Agency. SP Energy Networks are currently working with both parties on the interpretation of this data, to ensure best use is made of it with regards to flood-proofing.

Figure 10.1 and Figure 10.2 below are two examples of flood proofing work carried out.

Figure 10.1 Control Room at Queensferry Primary Substation - Waterproof membrane and flood proof door installed to building

Figure 10.2 Primary Transformer at Queensferry Primary Substation - Height of bund wall increased and flood proof door installed

### 10.3.2 Improving resilience to storms

As previously mentioned section 10.1.4 there is no firm evidence to support an increase intensity of wind or ice storms, both of which can cause extensive damage and disruption to overhead line electricity network. However during a resilience workshop held with the Met Office and DECC on 22 February 2010, it was confirmed such an increase in the frequency of stormy weather is possible and likely to lead to more frequent periods of high winds. This poses a threat to overhead line electricity distribution networks due to falling trees and windblown material.

SP EnergyNetworks operates over 30,000km of EHV and HV wood pole overhead lines that supply electricity to domestic, commercial and industrial customers in rural areas. Due to its geographic locations on the west coast and operating at high altitudes areas across Scotland and Wales, SP EnergyNetworks overhead line networks are regularly subject to some of the highest severity weather events in the United Kingdom. Our severe weather areas are highlighted in figure 10.3 below.

Figure 10.3 SP EnergyNetworks designated severe weather areas (SPD & SPM)


Storms across UK December 2013:

During the storms of December 2013 which affected the whole of the United Kingdom with over 900,000 customers affected, SPMW experienced the highest recorded wind speed of all DNO's at 109mph[13] with high winds persisting for **18 hours**.

- The network proved resilient with only 48,000 customers affected in the SPMW area.
- Well tested and defined response procedures ensured that **96.7%** of customers were restored within **24 hours** and **99.8%** restored within **48 hours**.
- This level of performance was achieved despite the high winds persisting for more than 18 hours and preventing many repairs on the grounds of safety.

SP Energy Networks Approach to Storm Resilience:

It is important to recognise that each of the networks in the UK do not currently experience the same frequency and severity of storm events, and it is unclear whether anticipated climate changes will pose different challenges for different network operators dependent upon their geographical location.

SP Energy Networks have already made significant improvements in our storm resilience and performance over the last 15 years and will continue to review operational practices and network designs to further enhance performance.

In the late 1990s and early 2000s several major storms had a significant impact on our networks. In response, SP Energy Networks established leading programmes for managing trees within falling distance of our lines, increased levels of network automation and approved new, resilient construction standards to withstand the most severe weather conditions.

[13] https://www.ofgem.gov.uk/sites/default/files/docs/2014/03/final_december_2013_storms_review_1.pdf

SP Energy Networks have invested heavily in this area over previous price controls and plan to ensure 25% of our main line network at EHV and HV main lines will be resilient to severe weather by the end of 2023.

Our long-term plan is to ensure that by 2034 over 40% of all interconnected 11kV and 33kV OHL networks will be rebuilt to a storm resilient standard, such that a severe weather event should not affect any connected customer for more than 36 hours.

An assessment of our storm resilience measures was undertaken by KEMA[14] which confirmed a '10' fold reduction in fault rate during storms on circuits which have been engineered to be storm resilient.

Improved resilience investments demonstrating results:

The effectiveness of our storm resilience programme was demonstrated on Tuesday 3 January 2012 when a severe wind storm struck much of the UK, with significant winds in Scotland's Central Belt

With gusts recorded at over 100 mph, the storm was very similar to the 1998 Boxing Day storm in terms of direction, magnitude and intensity and both were classified as 1 in 30 year events. Fallen trees and overturned lorries blocked many roads and structural damage to properties was widespread. This 3 January 2012 storm was followed by a further extremely windy spell from 4 to 5 January 2012.

An internal storm review undertaken by SPEN[15] demonstrated that the network performed much better in 2012 than in the 1998 Boxing Day storm:

Figure 10.3 January 2012 vs. December 1998 Storm Performance Comparisons

| | 26 Dec 1998 | 3 Jan 2012 | |
|---|---|---|---|
| **Faults** | 1,731 | 1,174 | 32% fewer faults |
| **Customers affected** | 230,000 | 135,000 | 41% fewer customers |
| **Customers at peak** | 90,000 | 70,000 | 22% fewer customers |
| **Length of impact** | 9,874 customers off for 4 nights<br>550 customers off for 7 nights | 600 customers off for 4 nights<br>No customers off longer than 4 nights | |

Looking at these comparable events SPEN reduced HV faults by 32%, reduced customers interrupted by 41% and the number of customers off supply for 4 nights by 94%.

Approximately 60% of HV faults were due to trees and windborne material. The programme to rebuild and refurbish the HV network and create a storm resilient network in severe weather areas resulted in only four faults on lines that were rebuilt or refurbished. There were no damage faults on HV lines where the enhanced tree clearance programme was carried out demonstrating the effectiveness of these policies.

Further information on our long term overhead line strategy can be found on SPEN's website[16].

[14] KEMA Report G07-1652 February 2007, Iain Wallace: An Assessment of HV Overhead Storm Resilience.
[15] http://www.spenergynetworks.co.uk/userfiles/file/201202_SPEN_EvidenceScotAffairsCttee.pdf
[16] http://www.spenergynetworks.co.uk/userfiles/file/201403_SPEN_33_11kVOHLStrategy_ID.pdf

Figure 10.4 Tree damage to overhead line (left) and example of ETR132 tree clearance works (right).

10.3.3 Improving emergency planning and post-incident recovery time

SP Energy Networks has implemented a number of actions to improve emergency planning and post-incident recovery time. These include:

- Compiling a list of substations sites identified as being at risk of flooding. This list is kept in the control room, to ensure that at-risk sites can be monitored closely during high rainfall events;
- Implementing a new emergency plan in which every member of staff within SP Energy Networks has a role in case of an emergency;
- Introducing increasing numbers of reclosers and remotely operated switchgear, which allow electrical faults to be isolated and the network reconfigured remotely; and
- Due to an increased number of high flooding levels and a history of flooding events in North Wales, the Manweb license area has historically engaged with the emergency planning committee in North Wales, and has purchased a number of mobile flood defences since the first Adaptation report in 2011.
- Routinely reviewing our response following major storm events to identify where we can improve our performance further.

Recognition of our performance in storm events:

Fergus Ewing MSP provided evidence[17] to the Department for Energy and Climate Change Committee highlighting SP EnergyNetworks operate with tried and tested resilience structures and deal with harsh conditions every winter in Scotland and as a result are well prepared for the situations that arose during the December 2013 storms. It was also recognised that SP EnergyNetworks proactively contacted vulnerable customers and worked with local responders to ensure that vulnerable members were offered advice and assistance where necessary.

Following a significant storm event on 8th January 2015 the SP Energy Networks team was commended by the Scottish Deputy First Minister, John Swinney MSP, for the efforts made to minimise disruption to customers and promptly restore supplies.

[17] http://www.parliament.uk/documents/commons-committees/energy-and-climate-change/Power-disruption-letter-from-Fergus-Ewing.pdf

### 10.3.4 Improving resilience to heat impacts

Unlike impacts from flooding, which have already been observed in the UK and by SP Energy Networks, impacts from higher temperatures have not yet been experienced by SP Energy Networks but are expected to occur in the future. This is evidenced by the more research-focussed nature of actions to improve resilience to heat undertaken by SP Energy Networks since the first adaptation report.

Actions undertaken by SP Energy Networks in this area include:

- An ongoing research & development project on underground cable rating monitoring, which aims to understand actual rating of power cables, instead of relying on the traditional calculated cable rating;
- Ongoing trials in the Manweb area on the use of dynamic overhead line (OHL) ratings based upon measured weather (solar gain and wind speed) conditions;
- A specific case study was identified where a standard-design substation building has been located to ensure that air intake is located on the cooler, shady side of the building; and
- Finally, a newly created company-level 132kV cable specification has been developed jointly with Spain, to apply to assets in both the UK and Spain, given SP Energy Networks is part of Iberdrola. The same cables are specified for both countries, with different ratings due based on different ambient conditions. As a consequence, cables used in the UK will have built-in resilience to future temperature increases, since they are currently also specified for use in Spain.

### 10.3.5 Improving resilience to other climate impacts

Vegetation management –increased vegetation growth due to longer growing seasons, leading to a higher number of faults, was already identified as an issue in the first SP Energy Networks report. SP Energy Networks is moving from a 5-yearly to a 3-yearly vegetation cutting scheme (and has already made the switch in Scotland, but not yet in the Manweb area), and increasing the reach of the swathe cut back.

Climate-proofing of standard industry equipment – it has been observed that manufacturers are increasing the resilience of their equipment to climate extremes, e.g. switchgear resilience to high temperatures. This is thought to be due to the dual effects of manufacturers operating in a global market and wishing their equipment to be suitable for use globally (which includes hotter locations than the United Kingdom); and to increasing awareness of climate change issues within the industry.

## 10.4 Barriers to adaptation

Given the present-day scarcity of heat-related impacts observed, it is difficult to make the financial case for investment to protect against heat-related impacts at present. However, should the incidence of heat-related impacts increase in future, in-line with climate projections, SP Energy Networks will already have significant in-house knowledge of the issues at hand, due to both the research being carried out at present (outlined in *Improving resilience to heat impacts* above), and due to the experience of Iberdrola colleagues operating in Spain at present.

Finally, since SP Energy Networks is a regulated business, it must obtain approval from Ofgem, through the period price control agreement, for any expenditure including works to increase flood resilience, flood proofing or other adaptive actions. This is not a barrier to implementing adaptation actions, however SP Energy Networks plans for adaptation will be dependent on obtaining Ofgem's support and approval for the associated financial investment plan proposals.

### 10.5 Summary and future

To summarise, all the climate risks identified for SP Energy Networks during the development of the first Adaptation report still stand, and the risk assessment on the likelihood and impact of these risks also remains unchanged.

The key future climate risks to SP Energy Networks arise from flooding, both due to increased rainfall, increased frequency and intensity of rainfall, and projected sea-level rise. The three highest-importance risks remain as follows:

- AR10: Substations affected by river flooding due to increased winter rainfall, with loss or inability to function leading to reduced security of supply;
- AR11: Substations affected by flash flooding due to severe rainfall, with loss or inability to function leading to reduced security of supply; and
- AR12: There is a risk that due to extreme sea flooding a substation may be lost or unable to function leading to reduced system security of supply. A number of sites may be at risk from sea level rise/ coastal erosion.

Risks arising from the heat impact of higher temperatures are classed as lower-risk, in part because they are not anticipated to occur regularly in the short-term. Instead, they are anticipated to become more significant issues in the future.

Since the publication of the first Adaptation reports by ENA and SP Energy Networks in 2011, updated information on river and coastal flooding has become available. Using this information, and in line with industry standard ETR 138, and internal SP Energy Networks policy on substation flooding, SP Energy Networks has carried out a programme of works to retrofit flood protection measures to a number of substation sites. In the period 2010-2015, SP Energy Networks will have completed flood defences at 52 substation sites, enhancing the electricity supply resilience to over 400,000 customers in Scotland, England and Wales.

Looking to the future, SP Energy Networks will take the following actions on climate impacts:

- At a high level, SP Energy Networks will continue to include climate change impacts and concerns in the high-level decisions regarding e.g. new assets, infrastructure, and planning;
- On the ground, SP Energy Networks will continue to implement flood resilience measures as indicated by available flooding data, which will be updated as further data becomes available; and
- SP Energy Networks will review adaptation actions in future when new information or evidence becomes available.

**Appendix A**
**ENA ENGINEERING REPORT 3 – CLIMATE CHANGE ADAPTATION REPORTING POWER, SECOND ROUND (ISSUE 1, 2015)**

PRODUCED BY THE OPERATIONS DIRECTORATE OF ENERGY NETWORKS ASSOCIATION

# Engineering Report 3

Issue 1 2015

# Climate Change Adaptation Reporting Power Second Round

www.energynetworks.org

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# ENA Engineering Report

# Climate Change Adaptation Reporting Power Second Round

## Contents




Version 1
28 April 2015

# 1. Introduction

## 1.1 Method of producing the report and background information

Energy Networks Association (ENA) is the industry body for UK wires and pipes companies that carry electricity and gas to UK homes and businesses. This ENA Engineering Report (ERep) has been developed in response to the requirements placed on reporting authorities by the Climate Change Act under the Second Round of reporting.

This "core" assessment has been prepared by a task group of electricity distribution and transmission network operator members of ENA. This report presents progress made since the First Round of reporting and should be read in conjunction with the First Round Report which is attached as Appendix 3 for reference.

This ERep follows the structure set out by Defra in their guidance dated December 2013 and considers those issues that are common to electricity network companies across the UK. It is intended that companies can use this ERep as the basis for their individual reports which will also include company specific information. This ERep does not address the means by which risk is managed within member companies, which will be dealt with within their individual reports.

Transmission and distribution companies in Great Britain are regulated businesses and operate under licences issued by Ofgem and are also subject to common statutory requirements which are overseen by DECC and the Health and Safety Executive (HSE). Allowed revenues for the industry are currently set by Ofgem in periodic price reviews and therefore any costs associated with adaptation to climate change need to be agreed with Ofgem.

Transmission and distribution companies are responsible for transporting electrical power from generating plants to customers over their extensive networks. These networks comprise a mixture of overhead lines and underground cables and include points on the system called substations, where voltage transformation takes place and switching and control equipment are located. These sites supply large numbers of customers, typically 5,000 to 30,000 customers at primary sites and 50,000 to 500,000 customers at grid sites.

Overall levels of supply security are agreed with Ofgem and these standards specify the requirements for the availability of alternative supplies at various levels of customer load. Although these standards allow for the loss of multiple circuits they do not provide for certain low probability events including multiple failures or the total failure of a grid or primary substation. Particular attention must therefore be given to these sites when considering network resilience.

Whilst every effort is made to ensure network security, companies have well developed business continuity and emergency plans to ensure an effective response to a range of events that can affect both transmission and distribution networks. Under the terms of the Civil Contingencies Act network operators are Category Two responders and work closely with other utilities, the emergency services and local authorities. They are also active participants in the DECC Energy Emergencies Executive Committee (E3C).

## 1.2 Summary of climate impacts

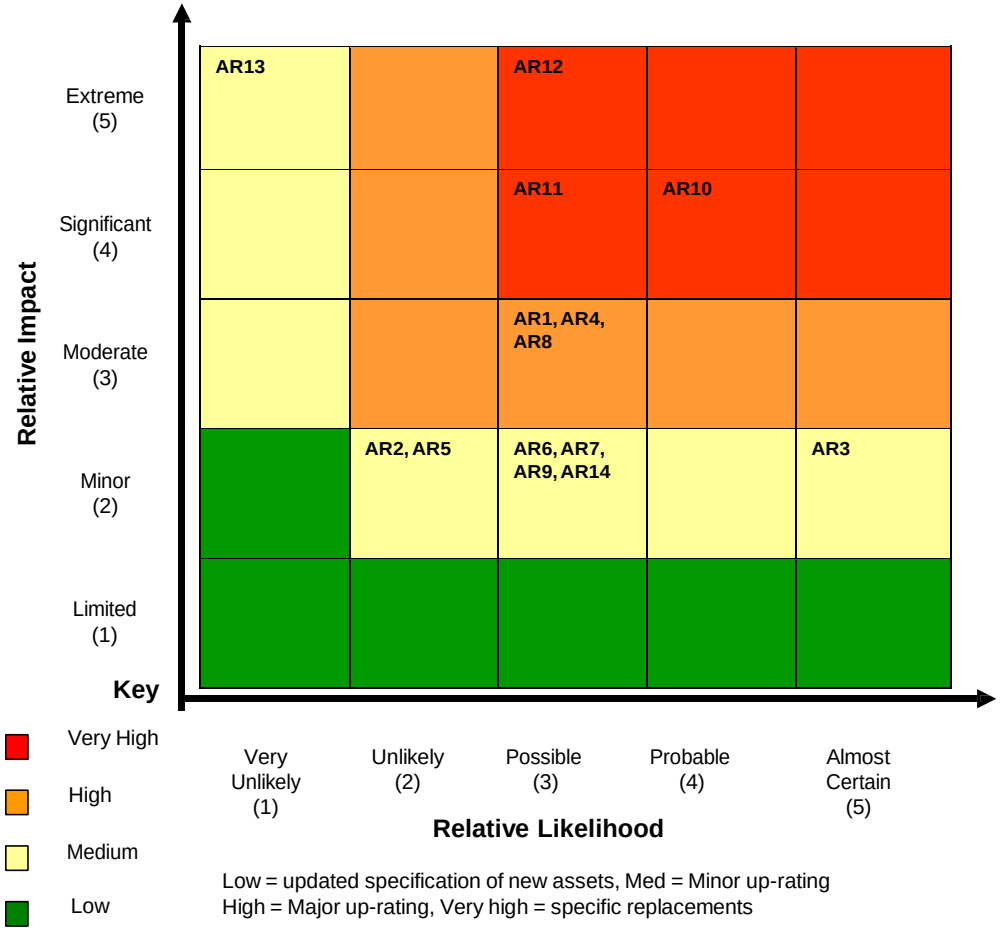
The main impacts on electricity networks from the current climate change projections are:

- Temperature—predicted increase.
- Precipitation—predicted increase in winter rainfall and summer droughts.
- Sea level rise—predicted increase.
- Storm surge—predicted increase.

In considering adaptation to climate change, electricity and gas network companies use the Met Office, UK Climate Projection (UKCP09) and take into account projections to the end of this century because the different types of network infrastructure generally have very long operational lives, typically 30 to 80 years. There are no immediate plans to review these projections

At present there is no firm climate change evidence to support increased intensity of wind or ice storms, both of which can cause extensive damage to overhead electricity networks. However, an increase in the frequency of stormy weather is possible and this is likely to lead to more frequent periods of high winds which can pose a threat to electricity distribution networks due to falling trees and windblown material.
The risk matrix below is reproduced from the ENA First Round Report

**Risk Matrix Showing Overall Impact (Refers to UKCP09 projections for the end of the century assuming a High Emissions Scenario and 90% probability level and no adaptation measures taken)**




AR1 Overhead line conductors affected by temperature rise, reducing rating and ground clearance.
AR2 Overhead line structures affected by summer drought and consequent ground movement.
AR3 Overhead lines affected by interference from vegetation due to prolonged growing season.
AR4 Underground cable systems affected by increase in ground temperature, reducing ratings.
AR5 Underground cable systems affected by summer drought and consequent ground movement, leading to mechanical damage.
AR6 Substation and network earthing systems adversely affected by summer drought conditions, reducing the effectiveness of the earthing systems.
AR7 Transformers affected by temperature rise, reducing rating.
AR8 Transformers affected by urban heat islands and coincident air conditioning demand leading to overloading in summer months.
AR9 Switchgear affected by temperature rise, reducing rating.
AR10 Substations affected by river flooding due to increased winter rainfall.
AR11 Substations affected by pluvial (flash) flooding due to increased rain storms in summer and winter.
AR12 Substations affected by sea flooding due to increased sea levels and/or tidal surges.
AR13 Substations affected by water flood wave from dam burst.
AR 14 Overhead lines and transformers affected by increasing lightning activity.

Low = updated specification of new assets, Med = Minor up-rating
High = Major up-rating, Very high = specific replacements

**Relative likelihoods**
Probability of a climate change effect having an impact under the change scenarios considered in the report.

**Definitions of relative impacts**[1]

| | |
|---|---|
| **Extreme:** | Regional area affected with people off supply for a month or more<br>OR<br>asset de-rating exceeds ability to reinforce network leading to rota disconnections on peak demand. |
| **Significant:** | County or city area affected with people off supply for a week or more OR asset de-rating requires a significant re-prioritisation of network reinforcement and deferment of new connection activities. |
| **Moderate:** | Large town or conurbation off supply for up to a week OR significant increase in cost of network strengthening. |
| **Minor:** | Small town off supply for a 24 hour period OR significant increase in cost of network maintenance requirements. |
| **Limited:** | Limited impact - can be managed within “business as usual” processes. |

[1] Areas affected can be as a result of single or multiple events.

A more detailed matrix showing the changing risk profile during the century is shown in Appendix 8 of the First Round Report. This shows clearly that the greatest weather and climate threat to electricity networks is considered to be flooding. A summary of the industry's considerable efforts to manage existing and future flood risk is described in Section 1.3 below.

The other serious risks are due to gradually increasing temperatures which reduce the amount of energy that electrical networks can transmit resulting in a requirement for network re-design/strengthening.

However, overall network investment plans also need to take account of increasing loads due to normal growth rates and the expected very substantial additional impact of "low carbon" loads/generation such as heat pumps, electric vehicles and solar PV. Current projections indicate that these are likely to have a far greater impact than potential temperature increases and "Smart Grid"[1] technology is being developed to provide minimum cost solutions that also have the potential to provide service enhancements for customers.

In view of this it is currently considered that it will be possible to build adaptation requirements into "Business as Usual".

However, it will be necessary to consider adaptation when designing the building blocks of the "Smart Grid" and information on adaptation requirements is being shared with those working on "Smart Grid" development.

*(Smart Grids use additional functionality to provide greater capacity and flexibility over their passive equivalents. Using a mixture of modelling, state estimation and active measurement systems they dynamically alter their settings and layouts to accommodate greater levels of load and generation without requiring additional conventional reinforcement.)*

**1.3 Impact from flooding**

In the event of serious flooding, electricity substations can be put out of action and the consequences can be severe. The flooding of a large substation can mean the loss of electricity supply to thousands of people, as well as to other types of infrastructure. The risk has been highlighted by severe flood incidents in the last few years, particularly those in 2007.

Such events show the need to understand and improve the resilience of substations to flooding. Action is particularly vital because, due to climate change, flooding of all kinds is likely to get worse. The Government has recognised this, and in 2007 asked for a comprehensive assessment of substations' resilience to flooding. Sir Michael Pitt's review of the 2007 floods also called for an improvement in the resilience of substations.

Network operators realised they needed a consistent sector-wide approach to flood resilience, but no industry standards existed. Regulations required 'reasonably practicable' measures to be taken to prevent loss of supply, but there was no common view about what this meant.

The electricity network sector has addressed this gap, developing a systematic approach to flood risk assessment and protection. The approach is documented in the Energy Networks Association's *Engineering Technical Report ETR 138 - Electricity Substation Resilience to Flooding (Issue 1 October 2009).* This sets out industry guidance on:

- standards of resilience
- how to take account of increasing risk due to climate change
- methods of assessing the likelihood and impact of flooding
- measures to reduce flood risk
- cost-benefit analysis of measures.

*Standards of resilience*

The ETR identifies three different levels of acceptable flood risk, depending on the importance of the substation. These standards are the default, but can be raised or lowered if an analysis of the costs and benefits suggests that is appropriate.

- Level 1: most important grid substations (typically supplying 50,000 to 500,000 customers) - likelihood of flooding should be no more than 1 in 1000 annual probability

- Level 2: other primary substations (typically supplying 5,000 to 30,000 customers) - likelihood of fluvial flooding no more than 1 in 100 annual probability (1 in 200 annual probability for Scotland) and 1 in 200 annual probability for sea flooding.
- Level 3: for sites where level 1 or 2 cannot be justified – other flood resilience measures.

*Data specification*
The ETR specifies the data that should be collected for the purposes of assessing flood risk. The specification requires companies to collect, for each substation:

- the likelihood of flooding in any one year from rivers or the sea (and surface water from 2015)
- the potential depth of flood water
- information about historic flooding
- existence and condition of flood defence scheme
- whether the site is in an area where the Environment Agency provides flood warnings
- the time required to activate flood protection measures.
- societal risk – number of customers and number of critical/vulnerable customers

*Climate change allowances*
The ETR recommends allowances to take account of the impacts of climate change on flood risk for both fluvial and sea flooding. An additional allowance is included for uncertainties in data and modelling.

*Cross-sector approach*
The whole of the electricity network sector collaborated in developing ETR 138. Work was coordinated by the trade association, the Energy Networks Association, and included representatives from all electricity network companies, government (DECC), the economic regulator (Ofgem) the Environment Agency, Scottish Environment Protection Agency and the Met Office. The involvement of DECC and Ofgem was particularly important as it helped to support companies' investment plans for flooding resilience.

***Benefits***
All network operators now have programmes to raise protection to the agreed standards and the current programme will be completed by 2023.

By setting out an industry standard and an agreed approach, companies know how to tackle flood risk. Because government and the regulator were involved from the start, business plans which follow this approach have been approved. The respective allowances are published and expenditure monitored on an annual basis by Ofgem.

Other benefits are:

- The government is clear about the standard of protection of this vital service.
- There is consistency across the country - customers in different areas enjoy the same standards of protection.
- Operators of infrastructure which rely on electricity understand the risks to their service.
- Resilience measures will take account of climate change, so will be robust in the foreseeable future.

**Lessons in the development of ETR 138**

- Developing a cross-sector approach and acceptable levels of risk.
- Allowing flexibility in the standard, depending on costs and benefits.
- Discussing resilience standards with operators of dependent infrastructure.
- Involving all relevant organisations, including government and the regulator to achieve acceptance.
- Agreeing climate change allowances to handle uncertainty about future risk.
- Keeping standards under review, and updating to take account of new information.
- These lessons can read across to other areas.

This approach is held up as an exemplar by the Infrastructure Operators Adaptation Forum (facilitated by the Environment Agency climate ready team) and details are published on the Institution of Engineering Technology web site. The work in developing the ETR is also referenced in the 2014 report on infrastructure resilience by the Adaptation Sub Committee of the Committee on Climate Change.

## 2. Understanding climate risk

**2.1 How has your understanding of climate risks, impacts and their effects on your sector/organisation and stakeholders advanced since your first round report?**

There has been no significant change in the understanding of climate change risks since the first round of Adaptation Reports were submitted in 2011. This understanding was based on the UKCP09 data published under the Climate Impacts Programme (UKCIP) that forecast the risks under various scenarios to the end of this century.

Information recently provided by Defra confirms that following the publication of the latest IPCC assessment (2014), the Met Office conducted a study which shows that, in general, UKCP09 continues to provide a valid assessment of climate change

In addition, the recently published report by the Committee on Climate Change provides a useful summary of the current knowledge regarding climate risks for infrastructure.

There have been a number of significant weather issues across the world and in the UK since 2011, notably the very extreme wet and stormy weather in the UK during the winter of 2013/14, that emphasise the importance of planning for the type of extreme event that could become more common with climate impacts, particularly flooding.

Companies are continuing their research into the potential impact of climate change, including through a range of stakeholder engagement programmes which have been encouraged by the industry regulator, Ofgem. The outcome of these company initiatives will be included in their separate reports.

Flooding presents the most serious climate risk to electricity networks and this includes current flood risk and the higher risks forecast as a result of climate change from increased rainfall and higher sea levels. To mitigate this risk companies are carrying out a programme of flooding resilience work that will continue to 2023. Resilience measures already in place at major electricity transmission and distribution installations prevented any loss of supplies due to flooding during the severe weather in 2013/14.

As noted in the introduction, information on surface water flooding has become more reliable and companies now consider it sufficient to justify additional flooding resilience measures. In view of this the ETR 138 task group has updated the document to include the management of surface water risk

**2.2 What climate change evidence or research have you used to better understand the implications for organisational functions?**

To a large extent, companies are still reliant on UKCP09 as the primary source of information. As indicated in Section 2.1, the latest update from Defra confirms that following the publication of the most recent IPCC assessment, in 2014, the Met Office conducted a study which shows that, in general, UKCP09 continues to provide a valid assessment of climate change.

As detailed in our First Round Report, UK electricity networks companies have carried out two research projects with the UK Met Office that investigated the potential impact of climate change on energy companies. The initial project was a ground breaking initiative that brought climate science closer to business applications. This was the first project sponsored by an entire sector to review the specific impacts of climate change on their industry. Supported by climate scientists, experts from the industry worked together to understand their precise requirements and developed practical applications and business strategies for a changing world.

A second project was commissioned with the Met Office to build a risk model that quantifies the relationship between climate and network faults, and also the vulnerability and exposure of the network to these faults. This model can be driven with climate projections to assess how network resilience may be affected by climate change.

Networks companies are currently engaged in further work with Newcastle University. This work includes an assessment of the potential changes to wind speeds as result of climate impacts and the risks this could present for electricity networks.

At present there is no firm climate change evidence to support increased intensity of wind or ice storms both of which can cause extensive damage to overhead electricity networks. However, these natural hazards

continue to be a serious risk to overhead line networks. In order to better understand potential changes in wind impacts, electricity companies have supported the RESNET project (Resilient Electricity Networks project), led by Newcastle and Manchester Universities. The initial reports are currently being reviewed

As noted in the introduction, the greatest climate threat to networks is currently assessed to be flooding. This applies to present risks and as a result of predicted climate change.

Following the 2007 floods in the UK an Industry Task Group was set up to produce a common approach to the assessment of flood risk and develop target mitigation levels that could be subject to cost benefit assessments. This was enabled by the great improvement in information on flood risk in recent years. The Task Group comprised representatives from Networks Companies, Government Departments and Agencies and the Industry Regulator.

Based on this report, companies are now undertaking a long term programme of work to improve substation resilience to flooding that takes into account predicted climate impacts. This programme was agreed by the industry regulator when they set the current allowances for Transmission and Distribution companies as part of the regulatory control periods. The respective allowances are published and expenditure monitored on an annual basis.

All planned flood protection is due to be complete by 2023 with higher risk sites being completed early in the programme. In the latest floods in the UK in the winter 2013/14, no customer supplies were interrupted as a result of flooding at major substations operated by the network companies.

**2.3 Has your understanding of thresholds of climate impacts advanced to better pinpoint organisational vulnerability? If so, how?**
UKCP09 provides climate information for the UK up to the end of the century. The projections show three different scenarios representing high, medium and low greenhouse gas levels. Information is provided on observed climate data, future climate projections and future marine and coastal projections. These scenarios are still being used and remain the best existing available information.

However, companies have carried out detailed analysis on substation flooding resilience and this has greatly assisted the understanding of risk at particular sites and ensured that appropriate protective measures are put in place.

In addition, flood mapping for surface water has been improved for England and Wales and the industry guidance on flood protection has been updated to take this into account. Similar information is also expected for Scotland. Companies have included resilience measures to protect key sites against surface water flooding in their latest regulatory submissions.

**2.4 How have you developed your quantified assessment and analysis of risk likelihood and impacts?**
The risks identified in the first round are still considered to be appropriate.

All electricity network operators are committed to providing a safe, reliable and affordable network to deliver energy to customers. Whilst companies will always prioritise safety, reliability is the key measure in monitoring and evaluating whether they are performing effectively.

Whenever a customer loses supply details of that interruption are recorded by Transmission and Distribution companies. Distribution networks are much more affected by climate impacts than the transmission system and all supply interruptions on distribution networks are recorded in the NaFIRS (National Fault and Interruption Reporting Scheme) database. This information is shared nationally and summaries are submitted to Ofgem. Data is available for over thirty years but the quality of the data has improved significantly over the last fifteen years since the introduction of the Ofgem Interruptions Incentive Scheme (IIS).

ENA Engineering Recommendation G43-3 (Instructions for Reporting to the National Fault and Interruption Reporting Scheme) sets out the details to be captured for each fault. For each interruption companies will capture a large amount of information and up to 100 separate fields will be populated. These include:

- location
- number of customers affected

- duration
- type of equipment
- manufacturer
- cause of the fault.

Using this information companies can identify trends in all these areas and take action where appropriate.
Prior to 2010 companies submitted an annual Medium Term Performance report to Ofgem which summarised the number of faults on overhead and underground networks, at each voltage level, in the following categories:

- Lightning
- Rain, snow, sleet, blizzard, freezing fog, frost & ice
- Wind, gale, growing trees, falling trees & windborne materials
- All other due to weather & environment causes plus birds, animals & insects
- Company & manufacturer causes
- Third party
- Any other causes (including unknown & unclassified)

Since 2010 companies have provided the full dataset to Ofgem who perform their own analysis.
Although the data was aggregated at that level, companies actually capture data to a more detailed level, attributing faults to one of 99 different direct causes specified in G43-3. Eleven of these are weather related:

- Lightning
- Rain
- Snow, Sleet, Blizzard
- Ice
- Freezing Fog and Frost
- Wind and Gale (excluding Windborne Material)
- Solar Heat
- Airborne Deposits (excluding Windborne Material)
- Condensation
- Flooding
- Windborne Materials

Therefore, using data from the NaFIRS system companies can monitor how their networks are performing, identify any trends in weather related faults and respond accordingly.

**Incentives on network reliability**
Distribution companies also have financial incentives to minimise the number and duration of interruptions, including those caused by climate impacts.

Ofgem introduced the Interruptions Incentive Scheme (IIS) in April 2002. Under this scheme distribution companies are set a target for the number of interruptions each year that last over three minutes, and the total length of those interruptions. If they beat these targets they are rewarded and conversely they are penalised if they do not achieve the targets.

The incentive rates have varied at each price review, but for the period from 2015 to 2023 they have been set so that the cost of an individual customer going off supply for over three minutes is approximately £15, with every additional minute costing a further £0.37[2].

The amount that distributors can benefit or be penalised under IIS is capped, with the amount varying with the size of the DNO. For the largest DNO this is set at just over £33m and for the smallest at £14m.
This money is not paid directly to the affected customers, but will be added or deducted from the allowed revenue that distribution companies will collect from suppliers. This will result in adjustments to tariffs for all customers.

Transmission companies have a similar incentive scheme known as Energy Not Supplied (ENS).

[2] Figures quoted in 2012/13 value before application of IQI efficiency factors.

Distribution companies are also subject to Guaranteed Standards of Performance enacted through the Electricity (Standards of Performance) Regulations which is a Statutory Instrument made under powers conferred in the Electricity Act 1989.

The Guaranteed Standards are a set of standards of service agreed with Ofgem, and backed by a financial guarantee – customers receive a payment if the distributor fails to meet these standards.
From April 2015 the guaranteed standard for supply restoration has been set so that domestic customers will receive a payment of £75 after they have been without supply for 12 hours and £35 for every subsequent 12 hour period. A non-domestic customer will receive £150 for the first 12 hours and a further £35 every 12 hours. These payments will be made directly to the customers affected.

For both IIS and Guaranteed Standards there are variations in the case of Severe Weather, recognising the additional difficulties in restoring supply under these conditions.

As mentioned in Section 2.2, new work is being focussed on identifying risk from the possibility of higher wind gusts or more frequent storms. A serious risk for Distribution Networks occurs during very strong wind storms when trees are uprooted some distance from an overhead line but are close enough to damage the conductors or break supporting poles. During the winter of 2013/14 this was a particular issue because very strong wind storms were combined with prolonged rainfall which made trees more susceptible to uprooting.

As a result, a review has been initiated of the industry approach to resilient tree cutting set out in Engineering Technical Report (ETR) 132 Improving Network Performance Under Abnormal Weather Conditions by Use Of A Risk Based Approach To Vegetation Management Near Electric Overhead Lines

This document was developed in conjunction with DECC and Ofgem and provides guidance for Network Operators on how to improve Network performance by enhancing the Resilience of the Network to Vegetation (mainly trees) related faults under Abnormal Weather conditions, including high winds, ice, snow and prolonged high temperatures. This is particularly important due to the possibility of increased rainfall combined with strong winds and extended growth periods as a result of climate impacts.

The Terms of Reference for this review are attached as Appendix 2.

## 3. Understanding uncertainties

### 3.1 What uncertainties remain in monitoring and evaluating climate risks to your sector's/organisation's functions?

There is a need for cross sector planning scenarios to ensure that sectors with interdependencies have used similar assumptions when reporting; this was not fulfilled in the first round of reporting. This is important to address the wide variety of views regarding the extent and impact of climate change on national infrastructure.

This important role is being developed by the Infrastructure Operator's Adaptation Forum which is facilitated by the Environment Agency climate ready team...

As indicated in Section 2.4, there are now increased concerns about interdependencies between weather events such as very strong winds following prolonged rainfall and initial discussions are taking place with Newcastle University regarding dependent heavy rain and wind models.

When CP09 is updated it would be helpful if there was a better understanding of probable event frequencies and relationships. Also, the EU is proposing to carry out work on Climate Change Services and this could prove a useful source of information. ENA have provided information to the EU on UK Energy Networks issues and requirements.

### 3.2 What new uncertainties have come to light?

As indicated in Section 2.4, there are now increased concerns about interdependencies between weather events such as very strong winds following prolonged rainfall.

### 3.3 What further implications do uncertainties have on action your sector/organisation has taken or plans to take?

Any emerging uncertainties will be captured within the risk management approach adopted by the companies and addressed within business work plans.

This process needs to ensure that any asset investment made is necessary, timely and appropriate. All of the companies are regulated monopoly businesses and as such expenditure is subject to economic regulation by Ofgem. This is achieved through a periodic price control process known as RIIO (Revenue = Incentives + Innovation + Outputs). The current price controls run from 2013 to 2021 for transmission and from 2015 to 2023 for distribution companies.

Unless there are very exceptional or unforeseen circumstances, then the levels of approved revenue needed to accommodate the planned asset infrastructure investment and maintenance for this period, must be agreed with Ofgem when the Price Control is set. This includes any work required to adapt to climate change. Therefore it is extremely important that the industry develops its ACC plans with the regulator to ensure that plans and supporting information meet network operators' and the regulator's requirements.

At present the current UKCP09 data does not support further asset investment beyond that already planned. Nevertheless, climate change risk will continue to be monitored as part of the companies' approach to risk management and information will be shared with the sector via ENA, who will also update DECC and Defra of any significant developments.

**3.4 What progress have you made to address information gaps?**

The following initiatives are being undertaken:-

- Working with EA and SEPA to understand the latest surface water flooding information and update national flood protection guidance.
- Current work with Newcastle University.
- Support for the EU initiative.
- Project initiated to review current guidance document on resilience tree cutting. (ETR 132)
- Information on the impact of recent severe weather has been shared between network companies and a large number of actions to improve emergency response have been co-ordinated through ENA and DECC.
- Companies are taking advantage of the Met Office's latest long range winter forecast. Also, the Met Office are now invited to attend an industry emergency planning forum in the autumn each year to discuss the forecast for the following winter and the likely consequences with industry emergency planners and operational managers. The first meeting took place in December 2014 and further discussions are planned during 2015 including a workshop run by the Met Office.

**3.5 What are the strategic business and methodological assumptions that underpin your analysis of impacts and risks?**

The strategic business and methodological assumptions have not changed substantially since the First Round. Company business strategies are driven by a number of factors including the following key issues:-

- The absolute need to keep customers/public and employees safe
- The regulatory framework
- Reliability
- Asset life cycles
- And finally, ensuring that customers receive a very high level of service.

Customer service is particularly important and this includes, minimising power cuts, restoring supplies quickly and efficiently in the event of a power cut and providing rapid and helpful information to customers.

These issues were all covered in the first round reports. However, there is no doubt that the winter storms and the subsequent DECC and Ofgem reviews have focussed companies on the critical importance of planning for severe weather events and a number of processes have been revised and strengthened as a result.

As discussed in the First Round, a particular aspect of electricity networks is that many of the assets have very long lives, typically 30 to 80 years and this means that it is very important to take account of predicted climate change impacts when planning new installations or safeguarding existing key equipment.

Flood protection currently being provided is designed to be resilient to the end of this century, based on currently available data.

## 4. Details of actions

### Table of Actions: Implemented Actions

| Summary of actions (as set out in first round report) | Timescale over which action planned | Progress on implementing actions | Assessment of extent to which actions have mitigated risk | Benefits/challenges experienced |
|---|---|---|---|---|
| It is expected that flooding adaptation work for current known threats including climate change will be completed over the next ten years.<br><br>Under the current Ofgem price controls, the following expenditure has been agreed on flooding resilience:-<br><br>In the Transmission Price Controls from 2008/2013 and 2013/21 National Grid, Scottish and Southern Energy and Scottish Power total expenditure is planned to be £227m<br><br>Distribution Price Control<br>In the price control period from 2010 to 2015 distribution companies have spent £73m with a further £100m planned to be spent in the period from 2015 to 2023. | 2013 to 2021 for the Transmission System<br><br>2015 to 2023 for the Distribution System | On target. National programme details are held by Ofgem.<br><br>Progress against the current programme was reviewed by the ASC in their July 2014 report. The ASC found that progress was being monitored and was on target. | Risks are being mitigated as the work proceeds to 2023 with sites prioritised in order of risk. | No loss of supply to customers during the severe weather in 2013/14 due to flooding at major substations operated by network companies. |
| ENA member companies propose to engage in discussion with Ofgem and DECC with a view to agreeing revised design standards for overhead lines to take effect from the next price control | The timescale is under review depending on further consideration of work carried out by EATL and other available data both in | Work has been carried out by specialist electricity network consultants, EATL to consider overhead line ratings. However, the | The risk being managed is a decrease in overhead line ratings leading to network overloading. However, this is a complex | Improving understanding of the issues involved in this complex subject. |

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| review, starting in 2015. | the UK and internationally. | initial results from the study have shown that further work is necessary. | subject and further work will be necessary before any firm recommendations can be made. | |
| It is proposed to review critical industry standards | 2015 | ETR 138 covering substation resilience to flooding has been updated to take account of the latest data on surface water flooding.<br><br>A review has started of ETR132 covering resilience tree cutting and Terms of Reference are attached as Appendix 2. | The inclusion of surface water flooding will provide additional resilience for key electricity substations and should ensure that supplies of electricity to the public are protected against failure of these assets due to the increasing risks of surface water ingress as a result of increasing rainfall. | Strengthened the relationship between electricity transmission/distribution companies and Defra, EA and SEPA. |
| The scale of the change to "Smart Networks" is likely to be very large entailing the re-design and re-building of many circuits and substations. The resultant upgrade may be far larger than required to accommodate potential adaptation requirements and it will be necessary to understand these two requirements fully before companies submit their financial plans to Ofgem.<br><br>Therefore, although it is essential to research fully the potential effects of climate change in order to understand | Some initial impacts are expected during the current price controls to 2021 and 2023 but significant impacts are not forecast until the following price controls, currently scheduled to 2029 and 2031. | The industry has worked with DECC and Ofgem through the Smart Grid Forum to assess the impacts of Carbon Targets on Transmission and Distribution Networks and how these impacts can be most effectively mitigated by the combination of network reinforcement and the deployment of "smart network" technology. | The potential risk is caused by failing to understand the impact of low carbon technologies on transmission and distribution networks. The very wide and detailed research effort should ensure a very full understanding these risks and a range of cost effective initiatives that can be employed to mitigate the risks. | The initiatives outlined have advanced the industry's understanding of the risks and potential solutions, promoted partnership working with industry and academia and taken the UK into the forefront of this type of work internationally. |

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| the possible impacts and mitigations, it is probable that the scale of any network upgrades will be dictated by the drive to low carbon networks. | | This has resulted in a number of reports, notably from Work Streams 3 and 7, which have provided guidance to both the industry and the regulator on the likely timing of impacts and the most cost effective action that the industry can take to ensure reliable supplies to customers at minimum cost.<br><br>In addition, Ofgem has introduced initiatives that encourage network companies to carry out research into innovative methods of managing the introduction of low carbon loads and generation on a very large scale.<br><br>The largest initiative to date, “The Low Carbon Network Fund” had a maximum value of £500 million between 2010 and 2015 and has produced remarkable results with network | | |

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|---|---|---|---|---|
| | | companies initiating a very wide range of projects, many carried out with partners in manufacturing or academia. | | |
| The thresholds at which climate change will start to present a risk to companies is well understood for a number of impacts, e.g. increased temperature causing a reduction in equipment ratings. In these areas it will be necessary to monitor actual climate change effects and updated projections in order to ensure that planned adaptation activity is sufficient and timely. | Ongoing monitoring of actual climate impacts, initially over the current price controls to 2021 and 2023 | This monitoring will be carried out in conjunction with the work on low carbon networks described above. | Risks will be mitigated as understanding of climate impacts and speed of change improves. | |
| In other areas of activity such as earthing systems and vegetation growth further work will be undertaken to identify the thresholds at which action needs to be taken. In addition, research into the impact of air conditioning loads, low carbon loads/generation and smart networks is already in hand and climate change impacts will be factored into this work to ensure that the thresholds are fully understood and appropriate action factored into programmes of work. | During the current price controls to 2021 and 2023. | ETR 132 Risk based approach to resilience tree cutting is under review with a target to complete by December 2015.<br><br>The other actions will be considered in the considerable R&D effort targeted at the development of smart networks for low carbon applications described above. | To be assessed and reported. | To be assessed and reported. |

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|---|---|---|---|---|
| Low carbon networks and smart grids are an international issue and network operators will be engaged in British, European and International Standards work to ensure standards are developed for the new networks and these will need to take account of the thresholds for climate change impacts on an international scale. | These standards are expected to be agreed during the period 2015-17. | ENA is working closely with BSI and international standards committees to ensure that the UK is well represented in the development of new standards. | To be assessed and reported. | To be assessed and reported. |
| **Monitoring and evaluation**<br>Some of the issues will be company specific and it is expected that companies will establish their own individual monitoring processes and these will be monitored by Ofgem in future years via established processes.<br><br>The industry approach to identification, risk assessment and development of mitigation plans for major substations at risk of flooding, provides an illustration of the way in which joint work on adaptation could be pursued. As described in Section 1.3 , a Task Group was established under Energy Networks Association, with membership from each of the member electricity network companies together with EA, SEPA, Met Office, DECC and Ofgem. A report was prepared by the group and submitted to the Energy Minister. That report has formed the basis of common standard submissions to Ofgem in the recent price control | Ongoing and for flooding resilience, monitoring will be necessary over the current price controls for the next 8 years. | The recent ASC report confirmed that companies are monitoring progress against flooding and tree cutting resilience and this is being audited by Ofgem | To be assessed and reported. | To be assessed and reported. |

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| review and will be regarded by DECC as the industry standard, if necessary by referencing it in the guidance to the ESQCR in a similar manner to other ENA documents.<br>Monitoring of progress on adaptation by Ofgem can then be facilitated via a common approach through the price control and the annual regulatory reporting processes which is companies' preferred approach. This process will continue to use latest information as it becomes available. | | | | |
| **Ensuring a flexible response**<br>Companies will continue to work with ENA to review the latest information on climate change projections, including actual recorded climate change outcomes, and update action plans as necessary. This will include maintaining and developing the relationship with holders of key information including Defra, EA and the Met Office.<br>Companies will also maintain a dialogue with DECC and Ofgem as part of annual regulatory reporting and the periodic price control process. The general position regarding companies' resilience will be continually reviewed via the DECC, E3C bi-monthly meetings and the follow up work in the companies via ENA working groups. | Ongoing monitoring via established resilience groups. | This monitoring is already in place through the following groups:-<br>ENA : ACC Task Group, Emergency Planning Managers' Forum, Industry Standards Groups<br><br>Other: Energy Emergencies Executive Committee (E3C) and associated Electricity Task Group.<br>EA Facilitated-- Infrastructure Operators Adaptation Forum<br>Cabinet Office led— Infrastructure Operators Security and Resilience Forum. | | |

| Further or new actions planned | Risks addressed by action | Timescale for new/further actions planned |
|---|---|---|
| Information on surface water flooding has become more reliable and companies now consider it sufficient to justify additional flooding resilience measures. In view of this ETR 138 has been updated to include the management of surface water risk. | Surface water flood risk to grid and primary substation sites. | Protection works implemented by the end of the latest price controls finishing in 2023. |

## 5. Addressing Barriers and Understanding Interdependencies

### 5.1 Where you've identified interdependencies, how have these assisted or hindered actions to address climate risk?

The First Round Reports highlighted key interdependencies with other sectors, some of which were not previously required to report via the mandatory process.

There are particular concerns regarding transport systems to enable access to key sites and telecommunications for control room SCADA[3] and voice communications.

As indicated in **Section 2.4**, there are now increased concerns about interdependencies between weather events such as very strong winds following prolonged rainfall which made trees more susceptible to uprooting, with consequent damage to overhead power lines.

As noted in **Section 3.1** there is a need for cross sector planning scenarios to ensure that sectors with interdependencies have used similar assumptions when reporting; this was not fulfilled in the first round of reporting. This is important to address the wide variety of views regarding the extent and impact of climate change on national infrastructure. This important role is being developed by the Infrastructure Operator's Adaptation Forum, facilitated by the Environment Agency climate ready team, and electricity network companies will play a full part in any collaboration projects that are initiated by this Forum.

As mentioned in **Section 3.3** there are interdependencies between improving climate knowledge and the current eight year regulatory process which could result in a delay between any change in climate knowledge and a corresponding change in investment. However, in view of the long term nature of climate considerations this is not considered to be a serious problem.

For electricity transmission and distribution companies there is a further interdependency due to Carbon Reduction Targets designed to limit the amount of climate change. These targets are resulting in a requirement to connect renewable generation and low carbon loads such as heat pumps and electric vehicles and are particularly affecting distribution networks. Smart networks are being designed to accommodate these loads without completely rebuilding existing systems, however, there will still be a need for conventional network reinforcement and this will need to be designed to accommodate climate impacts.

Companies will continue to engage with Local Resilience Forums where local interdependencies are discussed and plans put in place to manage potential problems.

### 5.2 What were the main barriers to implementing adaptation actions and why?

Defra have confirmed that following the publication of the latest IPCC assessment (2014), the Met Office conducted a study which shows that, in general, UKCP09 continues to provide a valid assessment of climate change However, there is also a need for stronger links between the forecasts and the actual projected impact at the local, regional and national environment level i.e. the level of rainfall, frequency of severe events, change in wind levels, the degree, extent and depth of flooding, increased rates of erosion and the exacerbation of land movement etc that will impact on all sectors.

The focus of implementation action has been on flooding resilience where climate impacts cause a relatively small increase over the base line investment and the programme has been agreed over two regulatory periods to 2023.

### 5.3 Have new barriers been identified? Are these being addressed? If so, how?

Only one potential barrier has been identified and that is the uncertainty regarding future maintenance of joint flood defence schemes. ETR 138 encourages companies to investigate this type of scheme if it will reduce the overall cost of flood protection to the community and provide reliable protection. However, it is essential for network companies to have confidence that this type of scheme will provide secure protection in the very long term and that responsibility for the construction and maintenance of the flood protection measures are clearly defined and agreed.

[3] SCADA—Supervisory Control and Data Acquisition

## 6. Monitoring and Evaluating

### 6.1 How effectively has consideration of climate change risks been embedded within your sector or organisation?

There is an increasing level of awareness within the companies and their employees regarding climate change risks and the requirements for both mitigation and adaptation response. This is aided by the sharing of information and best practice via ENA, the industry body for the sector. ENA represents both the electricity and gas network companies providing opportunities for further liaison and learning opportunities, as all energy sector companies are designated as Reporting Authorities and share some common issues.

Climate change risks are now recognised and monitored at Board level within ENA member companies.

The Committee on Climate Change, Adaptation Sub-Committee (ASC) recently produced a Progress Report—"*Managing climate risks to well-being and the economy"*. This report assesses the current state of resilience to weather and climate of infrastructure, businesses, health care system and emergency services. It is therefore particularly pertinent for electricity networks. ENA together with network companies provided evidence to the ASC.

The ASC reported that they found evidence that the electricity transmission and distribution sector are assessing climate risks, taking action in response, and reporting on progress against plans.

The ASC noted that the electricity transmission and distribution sector has developed technical standards for managing current and future risks from flooding and storms. These provide a consistent approach across the industry to identifying the most critical assets at the highest level of risk in order to prioritise action. Application of these standards is used to make a business case to the regulator for funding resilience measures that provide value for money to the consumer through the price control process.

### 6.2 How effective have organisational monitoring and evaluation processes been to ensure adaptation responses are implemented and on track? If these have not been effective, what barriers prevented this?

Companies have incorporated the key actions detailed in the First round of Reports in their company business plans.

As indicated in Section 6.1 the ASC reported that they found evidence that electricity transmission and distribution sector are assessing climate risks, taking action in response, and reporting on progress against plans.

### 6.3 How effective were monitoring and evaluation processes in determining how the organisation/sector handled recent extreme weather conditions?

Electricity networks companies manage emergency response to weather related issues on a regular basis, sometimes several times in a year, and therefore have well developed and practiced emergency planning procedures, including a mutual aid agreement (detailed in Section 3.1.5 of the First Round Report).

During the exceptional winter weather from November 2013 to February 2014 distribution companies in particular, faced an very demanding sequence of interruptions mainly as a result of wind storms causing damage to wood pole overhead lines due to falling trees and windblown material.

In particular, between 22 and 28 December 2013, as a result of two severe winter storms and consequent damage to the distribution overhead line network, almost one million properties suffered disruption to electricity supplies. Although 95.3% of customers were restored within 24 hours, 1.7% of customers experienced a disruption to supply in excess of 48 hours, and there were lessons to be learned to improve the effectiveness of the industry response to disruptive events, and minimise customer inconvenience as much as possible.

Some companies experienced particular difficulties with customer communication and resourcing the amount of repair work. However, it was noted independently that the industry's staff showed remarkable resilience, working long hours in potentially dangerous conditions, with no reportable accidents. As a result, staff were thanked for their tremendous efforts at a parliamentary reception.

Ofgem have established criteria that identify certain "exceptional events" that include particularly large interruptions that DNOs have limited ability to prevent. In order to reduce the volatility and impact of these

occurrences on their performance (and future target setting), these “exceptional events” are excluded from annual performance figures. Exceptional events are classified as being either a severe weather exceptional event or a one-off exceptional event.

Severe weather exceptional events refer to a level of interruptions occurring for a period of time that result directly from bad weather. To be considered a severe weather exceptional event, a specific and verified number of higher voltage interruptions, directly caused by bad weather, are required to have occurred within a 24 hour period. This is referred to as the severe weather exceptional event threshold and is currently eight times the average daily higher voltage fault rate.

One-off exceptional events are those where a single cause outside the DNO’s control causes a significant level of interruption. To be considered a one-off event, a specific and verified number of interruptions and/or minutes lost are required to have resulted. These numbers are referred to as the one-off exceptional event thresholds and currently stand at 25,000 customers interrupted and two million customer minutes lost.

To justify company claims against these exceptional event criteria, Ofgem undertake an investigation into the incident including the effectiveness of the company’s preparations and response.

However, due to the serious consequences of the 2013 Christmas storms, two enquiries took place led by DECC and Ofgem, with companies required to report on how performance could be further improved in a number of areas. These resulted in reports by Ofgem and DECC which have been published.

Following the initial DECC report, the industry undertook a major review of its performance to identify areas of good practice and areas for improvement. This review took place through the framework of the Energy Emergencies Executive Committee (E3C) with support from ENA. All the distribution companies and DECC were involved and specialist Task Groups were established to address particular issues,

A number of actions to improve future preparedness and response were identified, including:-

- Developing a single national number for customers to call during a power disruption. The complexity of this programme necessitates a longer time frame, and is planned for implementation in April 2016
- Identifying the levels of recognition amongst customers, and addressing any gaps using appropriate communications strategies. Ensuring that whilst a national power outage number is developed, each Network Operators’ customers are aware of the correct phone number to call in the event of disruption to power supplies.
- Developing worst case scenarios for customer calls and ensuring that telephony systems and call agents can provide a high level of service.
- Sharing with each other and key stakeholders, when weather forecast content causes them to trigger pre-emptive escalation.
- A Customer Welfare Good Practice Guide (GPG) has been produced which sets down minimum standards for welfare provision during emergency events, with particular emphasis on customers held within its Priority Services Register.
- A Social Media GPG has been produced and each DNO has developed a social media strategy, based around the recommendations from the GPG.
- Developing and implemented a common framework that clarifies standards expected around the identification and provision of a restoration time to customers and its subsequent proactive update in the manner agreed with the customer.
- Holding a workshop to share their resource and contractor management strategies.
- to ensure the rapid availability of adequate resources to deliver resilience, particularly over extended holiday periods.
- Reviewing and updating the industry Mutual Aid protocol to ensure it is adequately proactive, and criteria around strategic prioritisation are clear.

These actions are reviewed in a DECC report published in December 2014 which recognises that this work is part of an on-going responsibility to review, maintain and improve the effectiveness of the response to disruptive events. E3C has agreed that an annual review of this work, following each winter, will ensure new lessons are identified and reflected in on-going processes and procedures for preparedness and response.

It should be noted that during the winter flooding, no electricity supplies were interrupted as a result of flooding at major electricity substations operated by network companies and a number of substations were protected by new flood defences that incorporate protection against long term climate change.

In addition some sites were protected by portable flood barriers and the mutual aid agreement was implemented to provide support to the Thames valley area from the North of England. Helicopter transport and high volume pumps were also made available.

During January 2015 hurricane force winds affected parts of Scotland causing severe damage to the overhead distribution network. Performance of the Network Operators was reviewed at the January E3C meeting. The response from public, press and government appeared to be generally positive to the supply restoration efforts.

Weather forecasts and contingency plans were shared before the event and at mutual aid conferences and there was a good response to requests for assistance, with staff being sent from a number of other network operators in areas that had not suffered serious damage.

**6.4 Has the sector/organisation identified any financial benefits from implementing adaptation actions? Perhaps through cost benefit analysis, fewer working days lost, more efficient operations etc?**

Current flooding resilience projects incorporate provision for climate adaptation and this ensures that protection measures should not require rebuilding for the life of the asset. Of course, this is based on our current understanding of climate change and we cannot be sure that if climate change is worse than currently predicted that our defences will be suitable, in which case additional expenditure may be necessary.

Prevention of flooding at substations saves direct costs on repairs and customer compensation and also saves large costs that would have fallen on the community if lengthy and widespread power cuts were to occur.

**6.5 Has there been sufficient flexibility in the approach to adaptation within the sector/organisation, which allowed you to pursue alternative courses of action? If not what remedial measures could you take to ensure flexibility?**

The industry operates within a flexible approach to providing protection. For example, the industry standard on flooding resilience provides a framework for identifying those sites requiring improved resilience and a variety of methods by which that resilience can be achieved to ensure the best value for money, This includes, protecting whole sites, protecting key buildings/equipment or contributing to wide area schemes.

Examples of different approaches to flood protection are provided in Appendix 1.

## 7. Opportunities and Benefits

**7.1 What action have you taken to exploit opportunities**

ENA and network operators have taken the opportunity to strengthen their relations with key organisations including Defra, EA, SEPA and the Met Office.

A report has been commissioned with Newcastle University on wind impacts.

**7.2 How effective were your efforts?**

The work with EA and SEPA has resulted in an important strengthening of substation flooding resilience measures as described in Section 3.

The work with Newcastle University is helping the industry to understand the potential impacts of climate change on wind patterns and further work may help to indentify dependencies between climate impacts such as wind and rain.

**Appendix 1**

**Examples of Flood Protection Initiatives for Electricity Substations**

Designing Out Flood Risk

High voltage transformer and associated control equipment protected by a bund wall with step access. (Courtesy WPD)

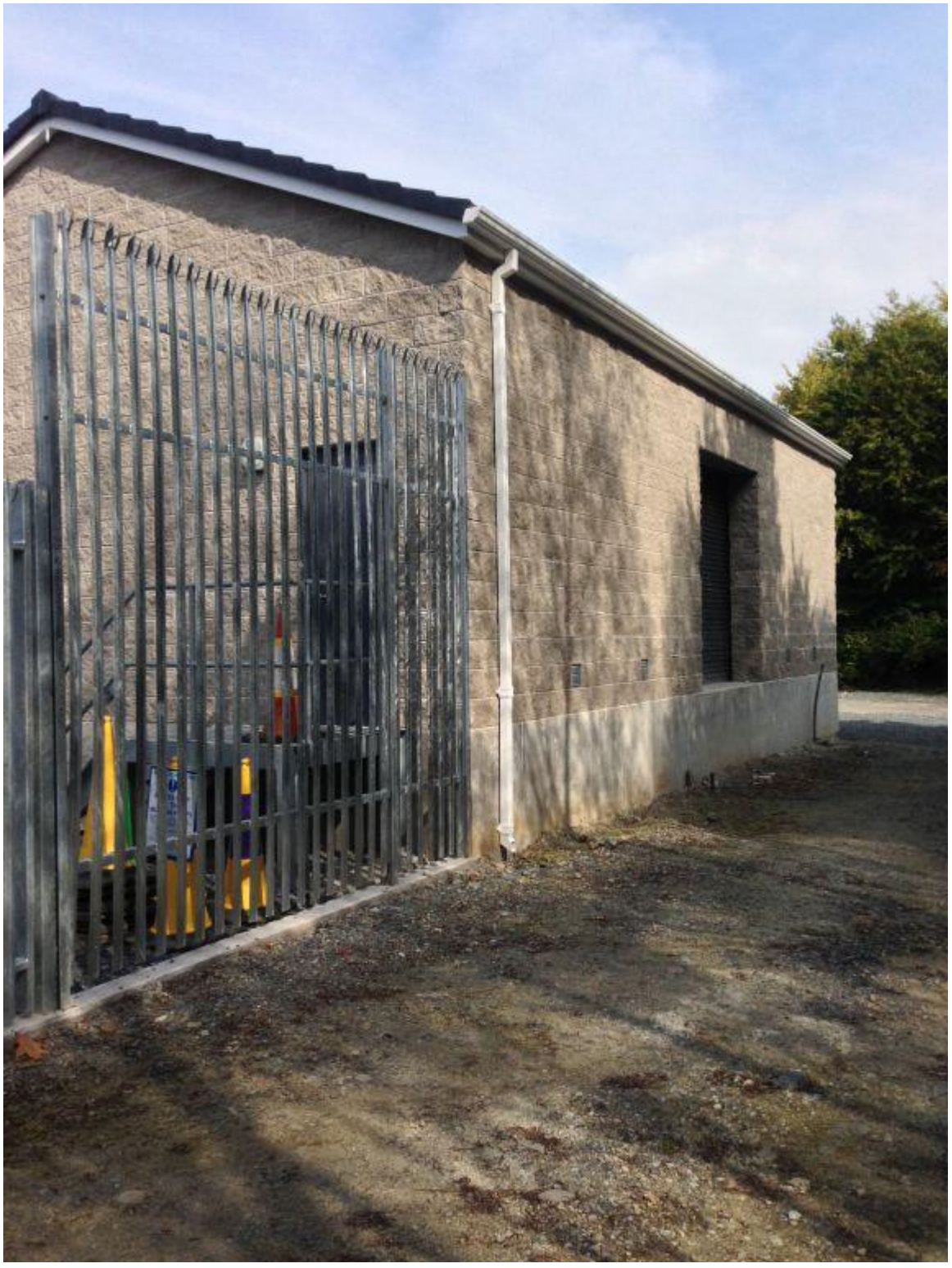

High voltage switchgear protected by a bund wall with gate access. (Courtesy WPD)

Raised building floor with step access. (Courtesy WPD)

Sealing a cable entry to prevent water ingress. (Courtesy WPD)


High voltage transformer and associated control equipment protected by a bund wall with step access. (Courtesy NIE)

Control equipment protected on a raised plinth with step access. (Courtesy NIE)



High voltage switch room under construction on a raised plinth. (Courtesy NIE)


Bund wall and flood gates protecting a site (Courtesy UKPN)


Bund wall protecting key equipment (Courtesy UKPN)

Flood Response


Incident Response Vehicle designed to carry:

Multiple water pumps & hoses
PPE & safety equipment
Chemical sand bags
Cleaning / hygiene stock
Welfare equipment incl. food
Communications incl. PMR & Mobile
Additional lighting / generation
Oil containment kit
Ladder & tools
Vehicle will:
Carry 6/7 people
Drive through 1m of flood water
Carry everything to be self sufficient for all foreseeable scenarios.

(Courtesy WPD)

Temporary Flood Barriers

(Courtesy UKPN)

Substation site protected during a flooding incident

(Courtesy UKPN)

## Appendix 2

## Electricity Networks and Futures Group
## New Task Group—Review of ETR 132

## Terms of Reference

1. Introduction

   This ETR provides guidance for Network Operators on how to improve Network performance by improving the Resilience of the Network to Vegetation related faults under Abnormal Weather conditions, including high winds, ice, snow and prolonged high temperatures.

   The winter storms of 2013/14 highlighted again the importance of ensuring that DNO overhead line networks are protected, as far as reasonably possible, against falling trees and tree branches which can cause severe damage to wood pole overhead lines.

   During discussions with DECC and Ofgem during the Christmas Storm Review process it was agreed that it would be appropriate to take the opportunity to review ETR132 and this should include considering the impact of the recent storms and any lessons learned.

2. Background to ETR 132
   Following changes to the ESQCR in 2007, revised requirements for tree control measures were introduced in the accompanying guidance notes and specifically in ENA ETR 43-8 and ETR 132. Following these changes DNOs have increased tree cutting activities and under wind storm conditions both measures, but particularly ETR132 (clearance to tree falling radius) are effective in reducing overhead line fault volumes.

   The consultations and cost impact assessments that preceded these changes limited the funding for ETR132 clearance activities to 0.8% of relevant overhead network length per annum for a period of 25 years. Thus, over this period 20% of the overhead network would be made resilient to tree damage from trees able to fall onto lines. ETR132 requires that clearance work should be prioritised on customer numbers at risk and hence tends to favour those lines feeding large numbers of customers at EHV or in semi rural areas. Those lines in remote rural areas or with lower customer numbers would be much less likely to be cut to ETR132.

   Whilst obtaining tree cutting permissions will remain a challenge for DNOs given their present powers, never the less, for wind storms tree cutting and the other measures detailed in ETR132 are some of the most effective ways of reducing the impact of storms on customers.

3. Draft TORS
   3.1 Review progress in applying the principles of ETR132 and identify any issues with the current recommendations.
   3.2 Review recent experience of overhead line performance during wind storms and identify any learning points that could be incorporated into ETR 132.
   3.3 The recent wind storms occurred during a period of very heavy rainfall. The group will assess whether the current recommendation takes sufficient account of the combined effect of high winds and extreme rainfall.
   Note: This is against a background where present Climate Change Projections do not indicate that maximum wind speeds will increase significantly but a substantial increase in rainfall is predicted.
   3.4 Review the implementation timescale and recommend whether experience with applying the ETR indicates that any change would be appropriate.
   3.5 Consider the impact of the current regulatory framework and the new price controls.