WESTERN POWER DISTRIBUTION ADAPTATION TO CLIMATE CHANGE REPORT

June 2011

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Contents

Summary

Current and future climate change presents a major challenge for all distribution network operators. The impact of both extreme weather events and gradual climate changes directly affects Western Power Distribution's business objective of providing a safe, reliable and efficient electricity supply to our customers.

Western Power Distribution understands the advantages of early adaptation with regard to the long life assets encountered in network infrastructure and has been proactive in the identification and quantification of climate change risks working collaboratively with other electricity network operators and engaging world class expertise from the Met Office Hadley Centre. Information from UKCP 09 has been invaluable by providing the predicted future weather probabilities for each of the three emission scenarios.

This report is our response to the Department for the Environment, Food and Rural Affairs (DEFRA) direction to report under the Climate change Act 2008 and the contents comply with the requirements of these four directions (one for each of our four licence areas). Contained within this report is the ENA Engineering Report 1 (ERep1) – May 2011, which identifies common climate change impacts on electricity distribution and transmission network operators and proposes mechanisms for monitoring and actions to respond to these probable climate change impacts.

This report contains details of Western Power Distribution's risk management process and describes how this process identifies, assesses and manages the implementation of control measures for climate change adaptation.

Our three priority assessed climate change risks are described within the regional context of our four licence areas and some resulting adaptation policies are detailed. Recognising the need for a better understanding of specific aspects of other identified climate change impacts, a summary of four relevant Research and Development project work has also been provided.

This report shares Western Power Distribution analysis of the risks associated with future climate change impacts. It describes how we have used available projected climate data to assess these risks. Details how our risk management system will embed the identified risks into the day to day process resulting in the appropriate adaptation control measures being developed and implemented.

In conclusion, it needs to be recognised that adaptation for climate change is only one area of change that is affecting Distribution Network Operators and that delivering the government's 'Low Carbon Transition Plan'[1] may well have a greater impact on distribution network infrastructure in terms of demand requirements and capacity constraints. Solving these issues is likely to contribute to the management of the climate change impacts

[1] http://www.decc.gov.uk/en/content/cms/publications/lc_trans_plan/lc_trans_plan.aspx

1 Introduction

1.1 The Climate Change Act

The Climate Change Act (2008) gave Government the power to direct certain public bodies to report on their climate risks and adaptation plans. Western Power Distribution received a direction to report issued by The Department for Environment, Food and Rural Affairs (Defra) in March 2010.

The direction asks us to provide a report by 30th June 2011 containing:

- An assessment of the current and predicted impact of climate change in relation to the reporting authority's functions, including;
    - Summary of statutory and other functions
    - Method used to assess the climate change impact
    - Findings of the assessment
- A statement of the reporting authority's proposals and policies for adapting to climate change in the exercise of its functions and the time scales for introducing those proposals and policies.

1.2 Who we are and what we do

Western Power Distribution is the distribution network operator (DNO) for the East and West Midlands, South Wales and the South West. We deliver electricity to over 7.6 million customers in a 55,300 sq km service area. Our service area includes the major cities of: Birmingham, Cardiff and Bristol.

Our network consists of 216,000 km of overhead line and underground cable and 184,000 substations. We are responsible for:

- Maintaining this electricity network on a daily basis
- Repairing this electricity network when faults occur
- Replacing assets within the network when warranted by condition
- Reinforcing this electricity network to cope with changes in the pattern of demand
- Extending this electricity network to connect new customers

Western Power Distribution does not generate electricity or buy electricity from generating stations. We do not sell electricity to end-use customers.

1.3 Regulation

The Electricity Act 1989[2] places a duty on Western Power Distribution to develop and maintain an efficient, co-ordinated and economical system of electricity distribution and to facilitate competition in the supply and generation of electricity within its authorised area.

Under the Utilities Act 2000[3] the energy market in the United Kingdom is regulated by the Gas and Electricity Markets Authority (GEMA), which conducts its business through the Office of Gas and Electricity Markets (Ofgem). All licensed distribution network operators report to Ofgem and they undertake a comprehensive a price control typically every five years. The current price control for our activities covers the period 1st April 2010 to 31st March 2015. In October 2010, following consultation, Ofgem published a new regulation framework - Sustained Network Regulation[4]. This uses the RIIO model – Revenue set to deliver strong Incentives, Innovation and Outputs. Ofgem intend to replace the existing system with this framework in April 2015.

1.4 Climate Change is a priority for us

The assessment of climate change risk is embedded into our organisation via the company's Asset Risk Management process, which registers all significant risks that impact on our business. Western Power Distribution has been investing both time and finance into the assessment of identified risks and development of suitable control measures. We have been proactive by; leading a national Adaptation to Climate Change Task Group to identify common risks to the electricity networks, developing our adaptation strategies to priority climate change risks and investing in targeted Research and Development projects to develop knowledge and reduce uncertainty.

[2] www.legislation.gov.uk/ukpga/1989/29/section/9
[3] www.legislation.gov.uk/ukpga/2000/27/contents
[4] www.ofgem.gov.uk/Networks/rpix20/ConsultDocs/Documents1/Decision%20doc.pdf

2 Our approach

2.1 General

Western Power Distribution considers that understanding and quantifying climate change risks to the electricity distribution network infrastructure is the priority. This infrastructure has a long lifetime (typically in excess of 40 years) and the regulation planning cycles means that the financial provisions needed to make adaptations to existing infrastructure have to be agreed five to eight years in advance. Due to these long asset lifetimes, we believe that there is a low marginal cost to adapting our network infrastructure now for potential future Climate Change impacts. Discussions with the Regulator (Ofgem) are required to ensure that sufficient financial provisions are included in the next planning cycle.

To adapt new construction for both Asset Replacement and New Build, changes to national Electricity Industry (ENA) specifications are required and we will support this activity with our specialists. Although risks to operational practices are being identified, generally they do not have the same adaptation lead times.

Predicted changes in customer behaviour as a result of climate change is an area of uncertainty, as this could result in an increase in summer peak demand, in particular from potential future Air Conditioning load. It is anticipated however, that this change will be less significant to our demand patterns than that caused by other factors such as the predicted shift from carbon intensive fuels to electricity (in the transport and heat areas), which under certain scenarios could double existing electricity demand. Using smart grid technology to maximise the capability of electricity distribution infrastructure to manage this increased demand is an area that the electricity distribution network operators are currently investigating, through mechanisms such as Ofgem's Low Carbon Network Funding (LCNF) incentive.

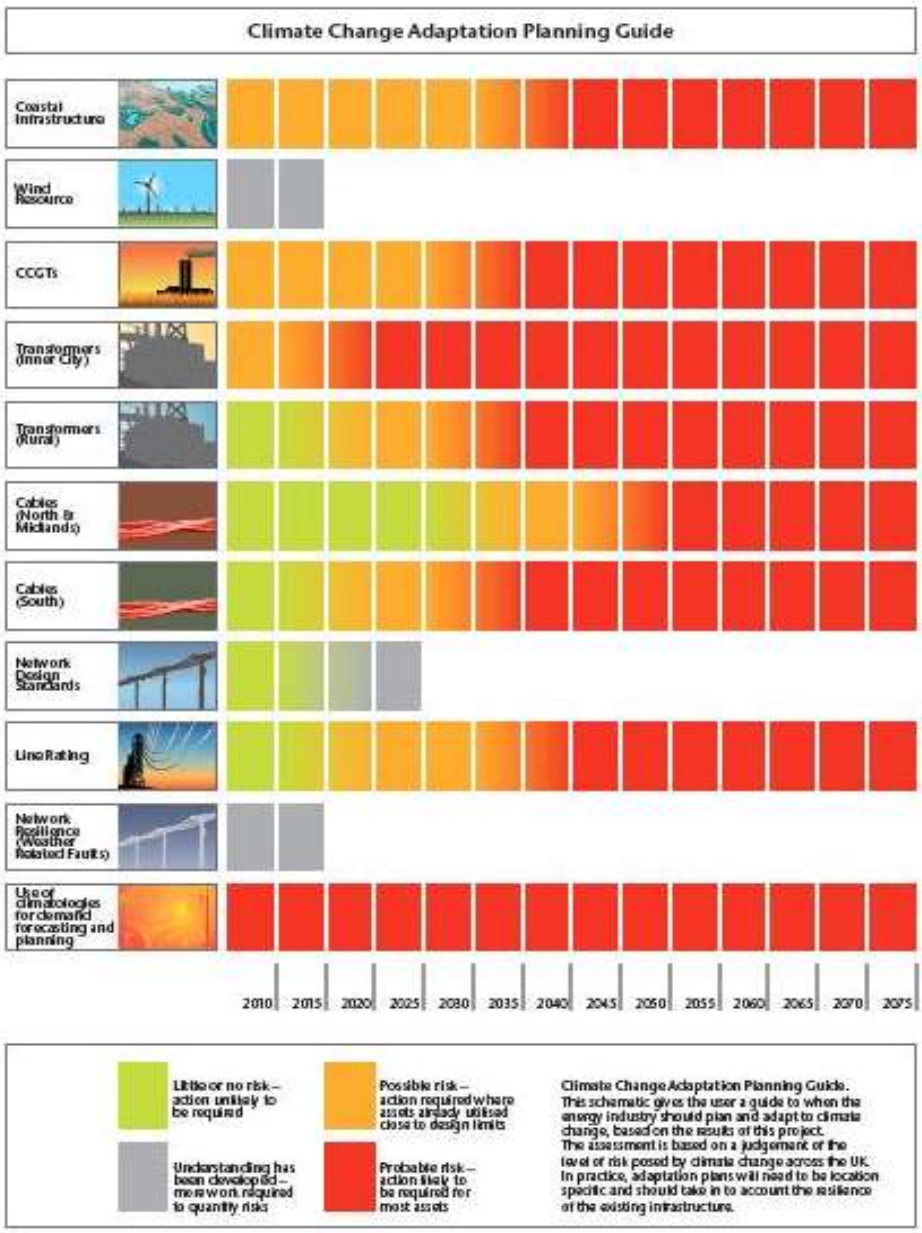
2.2 Engaging expertise

Since 2007, experts from Western Power Distribution (and other energy companies) have been collaborating with climate scientists from the Met Office, Hadley Research Centre[5] to understand the impact of weather and climate change on susceptible electricity infrastructure. This initiative was the first project sponsored by an entire sector to review the specific impacts of climate change on their industry. The Energy Project (EP2) considered various components on the electricity network and used current industry techniques to calculate the effect of climate change to 2099. The final report included a pictorial climate change adaptation planning guide and this together with the four conclusions relevant to electricity network operators are detailed below:

- With few exceptions, such as the thermal ratings of equipment and apparatus, there is currently no evidence to support adjusting network design standards. For example, existing mechanical design standards for overhead lines conductors do not require change.
- The risk profile for transformers will be affected. Design thresholds of temperature will be exceeded more often and there will be more hot nights in cities.

[5] www.metoffice.gov.uk/services/climate-services/case-studies/energy

- Soil conditions will change; higher temperatures and seasonal differences in soil moisture are expected. Summer soil temperature values currently used for the underground cable (CRATER) design tool will need to be increased by around 0.5 °C per decade.
- Historical climatologies are no longer valid because climate is not stationary. The new climatologies that take account of climate change are already being adopted and will improve demand forecasting and planning out to ten years ahead.



2.3 Identifying Common Risks to Electricity Distribution Networks

Distribution Network Operators in the UK have similar network designs and equipment based on International (IEC), National (BS EN) and Electricity Industry (ENA) Specifications and in 2010 Western Power Distribution chaired an ENA Adaptation for Climate Change Task Group of

electricity distribution and transmission network operator members of ENA to identify the common national impacts and assessment methodologies to the Electricity Networks. The task group included representation from the Department of Energy and Climate Change (DECC) and received inputs from Ofgem, the Department for Environment, Food and Rural Affairs (Defra), Environment Agency (EA), the Met Office and other organisations. A copy of the final report of this task group (ENA Engineering Report 1 – May 2011) is attached as Appendix 1.

As part of the EP2 energy project, it was identified that there was insufficient information available on the changes in extreme weather patterns that might affect electricity network resilience and therefore further collaborative research was undertaken with the Met Office to investigate this. This work was commissioned by all UK Distribution Network Operators and a summary of the Met Office national report can be found in Appendix 2. The Met Office used their own models to correlate fault rates with extremes of weather: Wind and Gales; Lightning; Snow, Sleet and Blizzards; Heavy Rainfall; Solar Heat and Freezing Fog. In addition to this national report, the Met Office developed individual reports for each distribution network operator license area and these are considered in section 4.1.

Following the floods in Carlisle in 2005, the Government asked electricity network operators to assess the flood risk to major substations. In the aftermath of the floods affecting South Yorkshire, the Midlands and Gloucestershire in 2007, the Government sought proposals for a programme of flood mitigation works and Western Power Distribution worked with other operators through their trade body, the Electricity Networks Association (ENA), to develop industry guidance. This collaborative work was accepted undertaken in partnership with the Environment Agency, SEPA (its equivalent Scottish body), Department for Energy and Climate Change (DECC), the Met Office and the industry Regulator (Ofgem). As a result of this work ENA Engineering Technical Report (ETR 138) was issued in 2009.

2.4 Risk Management

Within Western Power Distribution there is a staged process for managing any significant risks that could have an adverse effect on our network. Generic Risks, including those associated with Climate Change, are documented in our Risk Management process. These risks are addressed through individual Company Directives.

Our approach is designed to ensure that significant risks are anticipated, evaluated and controlled. Regular review processes ensures the continued effectiveness of the assessment of each risk and appropriateness of the control measures. An Emerging Risk Register, documents recently identified risks where it is believed that control measures are required. Items on this Emerging Risk Register are initially assessed as High Risk and each risk will have an Action Plan, which will detail the actions to be taken to further assess the severity of this risk.

Risks are assessed based on their likelihood and consequence, to determine the risk severity and those judged to be High or Medium risk will require Control Measures to be developed and documented.

These High and Medium Risks will have Parent Documents and Policies containing detailed information of the risks created. The details of the application of the control measures will be contained in new or revised Standard Techniques.

The Distribution Director and designated direct report managers are responsible for ensuring that the control measures are implemented.

The Risk Register is reviewed annually by the responsible managers who report to the Distribution Director. Consideration is given to Asset life cycles, Business processes, External factors and Resources and Logistics. The individual Company Directives are reviewed and revised at defined periodic intervals, depending upon the risk, technology, objectives, regulatory or statutory requirements and asset performance.

Currently there are thirteen Climate Change issues on the Emerging Risks – Action Plan. The risks are listed below:

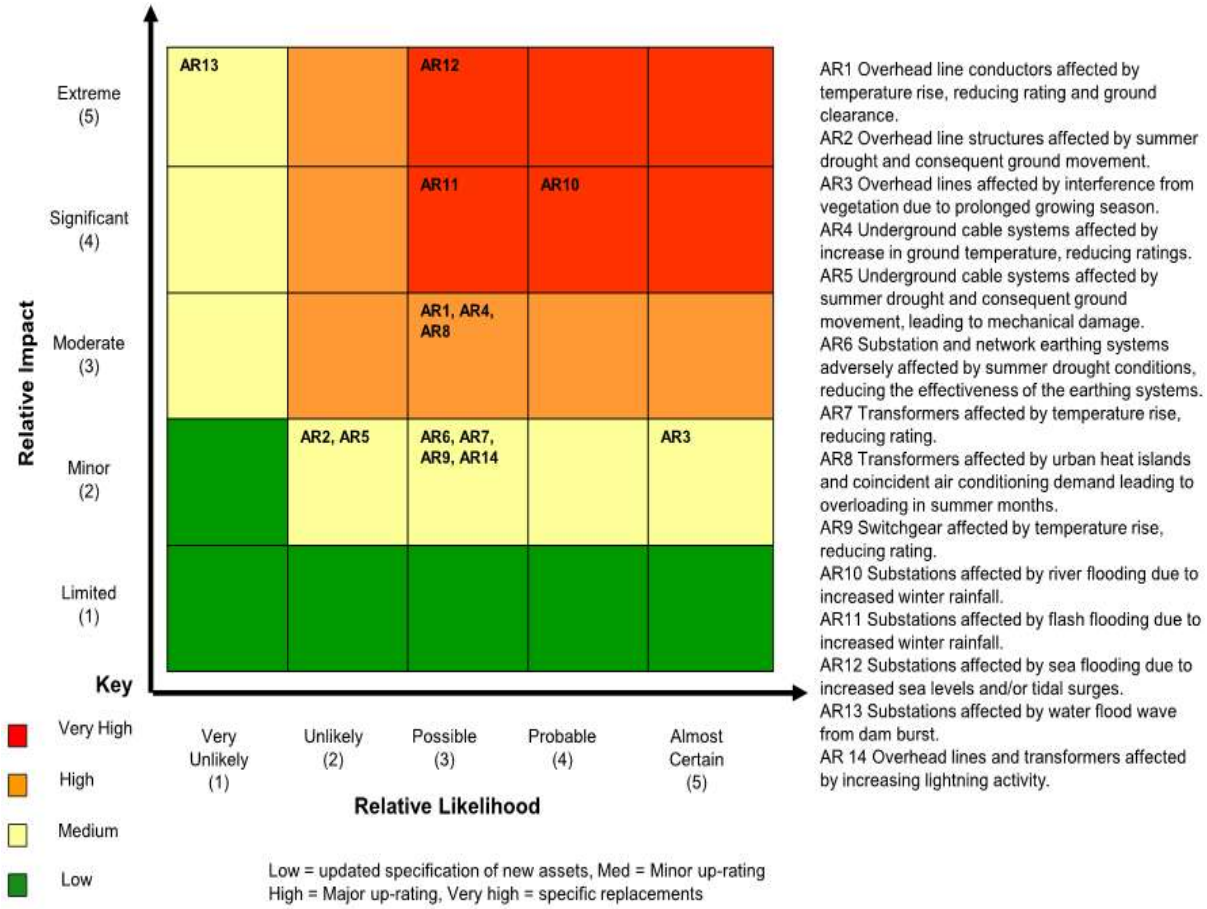
No.	**RISK**
25.1	Overhead Line Rating
25.2	Underground Cable Ratings
25.3	Equipment Fault Rates
25.4	Structural Design of Overhead Lines and Plant
25.5	Transformer and other Plant Ratings
25.6	Earthing Systems
25.7	Annual Growth Rate of Trees and their consequential effect on Overhead Lines
25.8	Predicted Flood Levels
25.9	Supply Chain
25.10	Transport
25.11	Animal Diseases
25.12	Staff Sickness
25.13	Electrical Demand

Western Power Distribution will pursue the adaptation actions as identified in section 6 of the ENA Engineering Report 1.

3 Present and future climate

3.1 Climate change impacts

ENA Engineering Report 1 identified the common impacts from future Climate Change to the distribution and transmission electricity network operators in the form of a Risk Matrix. The matrix assumes no adaptation measures have been taken and was based on UKCP09 projections for the end of the century, assuming a High Emissions Scenario and 90% probability level.



This ENA Engineering Report was prepared as the 'core' assessment in response to the requirements placed on energy reporting authorities by the Climate Change Act and has therefore been included as an annex to this document (Appendix 1). The purpose of this report was:

- Identification of climate change impacts on the functions of licensed electricity distribution and transmission companies.
- Proposed mechanisms for monitoring and actions to respond to the likely impacts of climate change adaptation.

The intention here is not to duplicate the work in the ENA Engineering Report, but to provide a regional context with regard to Western Power Distribution's approach to climate change impacts and to amplify our specific priorities and activities. We strongly recommend the ENA Engineering Report is studied in conjunction with this document.

3.2 Principle sources of Data on future Climate Change impacts

Western Power Distribution has used the UK Climate Change projections (UKCP 09) which are the most recent set of climate change scenarios released by the UK Climate Impacts Programme (UKCIP). Developed by the Met Office Hadley Centre they describe how the UK climate might change during the 21st century. The main difference from their predecessor UKCIP02 is the systematic incorporation of some of the uncertainties associated with the climate system. The result is climate change projections that are probalistic in nature and explore a much larger range of possible climate futures.

The Environment Agency provides high level maps of potential flooding risks in two basic categories:

- 1:1000yrs risk of Fluvial Flooding
- 1:100 yrs risk of Fluvial Flooding or 1:200 yrs risk of Tidal Flooding (Breach of Sea Defences)

3.3 Other sources of Data on Climate Change and impacts

Western Power Distribution is continuing to work with specialists to understand the impact of climate change on particular issues that will affect our network. Some of the specialist organisations and their areas of expertise are listed below. These specialists use UKCP 09 data when creating forward modelling scenarios:

- ADAS Environment Consultancy – Vegetation Management and Pluvial flooding
- Birmingham University – Urban Heat Island (UHI) impacts
- Cranfield University – Soil properties
- British Geological Society (BGS) – Underlaying rock permeability and resistivity

4 Managing our priority climate change risks

Western Power Distribution covers a large geographical area with diverse topographical features and climate change will impact its constituent parts in slightly different ways dependent on regional geography, historic development and demand requirements. Understanding how the common risks will affect Western Power Distribution's assets and the identification of our specific risks has lead to us prioritising three issues:

- Extreme Events
- Temperature increase impact on overhead lines
- Major substation sites at risk from fluvial or sea breach flooding

4.1 Extreme Events

The resilience project work undertaken with the Met Office identified the relationship between severity of weather conditions and incidents of faults in each of our licence areas. This allowed the construction of the following table which ranks the various types of weather related faults in terms of the resulting customer interruptions across all voltages (using data from 1980 to 2008).

Rank	East Midlands Licence Area	West Midlands Licence Area	South Wales Licence Area	South West Licence Area
1	Wind & Gale			
2	Snow, Sleet & Blizzard	Lightning		
3	Lightning	Snow, Sleet & Blizzard		
4	Rain			
5	Flooding		Solar Heat	
6	Freezing Fog & Frost	Solar Heat	Flooding	
7	Solar Heat	Freezing Fog & Frost		

This represents the network vulnerability to the current climate conditions and allowed the Met Office to calculate how predicted regional climate changes in the future will impact on the associated electricity networks. The conclusions for the three main causes of interruptions are detailed below:

- **Wind and Gale** = This predominately affects overhead lines. For all areas future projections of the risk metric indicate little change in the future risk of wind and gale faults. There is however, considerable uncertainty associated with modelling of future wind.

A DEFRA report[6] on UK Climate Projections concluded that any climate change signal on future changes to storms and anticyclones affecting the UK 'is swamped by natural variability and sampling uncertainty resulting in a lack of any robust signal of changes for the UK.'

[6] http://ukclimateprojections.defra.gov.uk/content/view/2091

Risk from Wind and Gale Faults		East Midlands Licence Area	West Midlands Licence Area	South Wales Licence Area	South West Licence Area
2020	Minimum	-10%	-12.5%	-11%	-7%
	Mean	No Change	No Change	-11%	No Change
	Maximum	+10%	+12.5%	+11%	No Change
2050	Minimum	No Change	-12.5%	-11%	-7%
	Mean	No Change	No Change	No Change	No Change
	Maximum	+10%	+12.5%	No Change	No Change
2080	Minimum	-10%	-12.5%	-11%	-7%
	Mean	No Change	No Change	-11%	No Change
	Maximum	+10%	+12.5%	No Change	No Change

- **Lightning** – This predominately affects overhead lines and associated equipment. Most models indicate that lightning activity is projected to increase in the future, resulting in an increase in the risk to the network of faults from this cause.

Risk from Lightning Faults		East Midlands Licence Area	West Midlands Licence Area	South Wales Licence Area	South West Licence Area
2020	Minimum	No Change	No Change	No Change	No Change
	Mean	+11%	No Change	No Change	No Change
	Maximum	+11%	No Change	No Change	+11%
2050	Minimum	+11%	No Change	No Change	+11%
	Mean	+11%	No Change	No Change	+11%
	Maximum	+22%	+16%	+16%	+22%
2080	Minimum	No Change	No Change	No Change	No Change
	Mean	+22%	+16%	+16%	+22%
	Maximum	+33%	+16%	+16%	+33%

- **Snow, Sleet and Blizzard** = This predominately affects overhead lines. Although the projected number of days when snow will occur will significantly decrease, there is a level of uncertainty associated with these projections and no guarantee that the snow intensity will be any less than that which currently occurs when these events happen. As the network vulnerability to these events is the most significant factor when calculating the number of faults, the number of faults per event will not necessarily decrease, only the probable frequency of such events.

Risk from Snow, Sleet and Blizzard Faults		East Midlands Licence Area	West Midlands Licence Area	South Wales Licence Area	South West Licence Area
2020	Minimum	-44%	-40%	-33%	-40%
	Mean	-22%	-20%	No Change	-20%
	Maximum	No Change	-20%	No Change	No Change
2050	Minimum	-55%	-80%	-66%	-40%
	Mean	-44%	-40%	-33%	-40%
	Maximum	-44%	-40%	-33%	-40%
2080	Minimum	-66%	-80%	-66%	-80%
	Mean	-55%	-60%	-66%	-40%
	Maximum	-55%	-40%	-33%	-40%

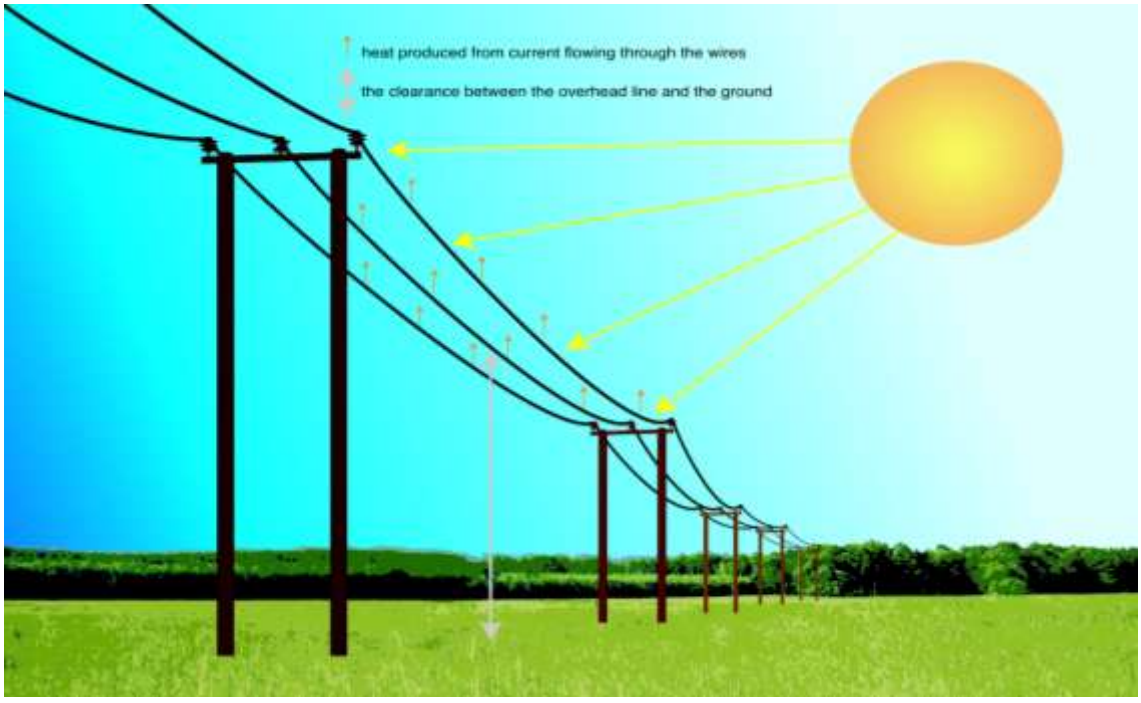
Of these three main causes of faults, only the increase in Lightning activity is predicted to have a significant impact on customer interruptions. In recent years improvements in the reliability of lightning protection devices have resulted in an increased amount of these devices being fitted to our network and a revised guidance document (ENA Engineering Report ETR 134) was issued in 2008. This provided information on how to determine where lightning protection is required and the various forms that this protection can take.

4.2 Temperature increase impact on overhead lines

Western Power Distribution has a significant population of overhead lines distributed across our four licence areas. The table below details the overhead line circuit length by system voltage.

Asset Type	East Midlands Licence Area	West Midlands Licence Area	South Wales Licence Area	South West Licence Area
132kV Overhead Circuit	2,384km	1,368km	1,924km	1,840km
66kV Overhead Circuit	-	793km	357km	-
33kV Overhead Circuit	2,702km	1,037km	1,227km	2,900km
HV Overhead Circuit	12,572km	14,538km	12,207km	16,591km
LV Main Overhead Circuit	5,071km	6,120km	3,193km	7,460Km

Overhead line conductors produces some heat as electrical current is passed through them. The amount of current is limited by the resulting thermal expansion of the conductors, as this expansion reduces the clearance between the overhead line and the ground (sag). This clearance is subject to a minimum statutory distance to protect the general public and therefore cannot be reduced. Predicted increases in ambient temperature will therefore mean that less current can be passed through the conductor before the thermal limits are reached.



UKCP 09 data has allowed predictions in the ambient temperature increase to be considered for each of our four licence areas. Below are the probable (90 percentile) range of mean daily ambient temperature increases expected.

Period	Emission Scenario	East Midlands Licence Area	West Midlands Licence Area	South Wales Licence Area	South West Licence Area
2010-2039 Summer	High	2.2 – 2.7 C	2.3 – 2.7 C	2.2 - 2.6 C	2.3 - 2.7 C
	Medium	2.3 – 2.7 C	2.4 – 2.8 C	2.3 - 2.8 C	2.5 - 2.9 C
	Low	2.3 – 2.7 C	2.4 – 2.7 C	2.3 - 2.7 C	2.4 - 2.8 C
2010-2039 Winter	High	2.1 - 2.2 C	2.0 - 2.2 C	1.9 - 2.1 C	2.0 - 2.1 C
	Medium	2.1 C	2.0 – 2.1 C	1.9 - 2.0 C	1.9 - 2.1 C
	Low	2.0 – 2.1 C	2.0 – 2.1 C	1.9 - 2.0 C	1.9 - 2.0 C
2040-2069 Summer	High	4.3 – 5.2 C	4.4 – 5.2 C	4.3 - 5.2 C	4.6 - 5.3 C
	Medium	3.8 – 4.6 C	4.0 - 4.7 C	3.9 - 4.7 C	4.1 - 4.8 C
	Low	3.6 – 4.3 C	3.6 – 4.2 C	3.5 – 4.2 C	3.7 – 4.3 C
2040-2069 Winter	High	3.5 – 3.8 C	3.5 – 3.8 C	3.3 – 3.5 C	3.3 - 3.6 C
	Medium	3.2 – 3.4 C	3.2 – 3.4 C	3.0 – 3.2 C	3.0 - 3.2 C
	Low	3.0 – 3.1 C	2.9 – 3.1 C	2.7 – 2.9 C	2.8 – 3.0 C
2070-2099 Summer	High	6.7 - 8.0 C	6.9 - 8.1 C	6.7 - 8.1 C	7.1 - 8.3 C
	Medium	5.3 - 6.4 C	5.6 - 6.5 C	5.4 - 6.5 C	5.7 - 6.7 C
	Low	4.2 – 5.0 C	4.3 – 5.1 C	4.2 – 5.1 C	4.5 – 5.2 C
2070-2099 Winter	High	5.2 – 5.6 C	5.1 – 5.6 C	4.8 – 5.2 C	4.9 – 5.2 C
	Medium	4.4 – 4.7 C	4.3 – 4.6 C	4.1 – 4.4 C	4.1 – 4.4 C
	Low	3.8 – 4.0 C	3.7 – 3.9 C	3.5 – 3.7 C	3.5 – 3.8 C

These predicted temperature increase ranges indicate that it is justified to take an identical approach to all the four licence areas and consequently Western Power Distribution have introduced new overhead line design requirements that will ensure that new and rebuilt lines will have additional ground clearance to allow for these levels future climate change. At the same time we have prepared new conductor ratings for our existing overhead lines. Further information on how this is achieved in practice is provided in Section 5.1 of the ENA Engineering Report (E Rep1) in Appendix 1.

4.3 Flooding

Following the issue of the guidance document ENA Engineering Technical Report ETR138 in 2009, Western Power Distribution has proceeded with developing site specific flood risk assessments and proposed protection solutions, using specialist flood risk contractors. The industry regulator Ofgem has allowed £31M for flood protection at susceptible major substation sites in Western Power Distribution during the current price control period (2010 – 2015). Depending upon the projected depth of flood water on a given site, the solutions ranged from:

- Protection of individual items of equipment on a site
- Protection of buildings
- Perimeter protection
- In extreme situations – possible relocation

Additional funding for flood protection work will be required in subsequent price control periods, which will require further discussions with Ofgem, especially if it becomes necessary for Western Power Distribution to carry out work at those substation sites where currently flood protection is interdependent with the work of other Government Agencies.

The following table identifies the sites susceptible to fluvial and tidal flooding, where a flood risk assessment is in progress or completed. The criteria for susceptibility is:

- Grid and Bulk Supply Sites protected to 1:1000 yrs risk of Fluvial Flooding
- Primary Sites protected to 1:100 yrs risk of Fluvial Flooding or 1:200 yrs risk of Tidal Flooding (Breach of Sea Defences)

Substation Site and flood risk	Flood Assessment	East Midlands Licence Area	West Midlands Licence Area	South Wales Licence Area	South West Licence Area
Grid & B.S. Sites (Fluvial & Tidal)	Complete	8	5	16	15
	In progress	8	4	0	0
Primary Sites (Fluvial & Tidal)	Complete	13	2	31	56
	In progress	15	2	0	0

Case study: Reducing Flood Risk to Critical Infrastructure

When replacing major substations on flood plains, Western Power Distribution has taken the opportunity to modify the designs and raise them above the projected flood level. The photographs below show where this approach has been applied to two new major substation buildings at Exeter and Gloucester. The marginal cost of considering the flood risk mitigation solution at the same time as normal asset replacement activity proved to be substantially cheaper than other functional equivalent options.

Western Power Distribution has also had close engagement with the Environment Agency regarding their consultations on:

- National Flood and Coastal Erosion Risk Management Strategy and the Guidance on co-operation and requesting information.

- Shoreline Management Plans, which look at proposed future policy for coastal flood defences and the impact of climate change on them.

We have a concern that the recent DEFRA consultation, relating to future funding of Coastal Flood Defence has introduced uncertainty as to the delivery of the works indicated by the Shoreline Management Plans. This may leave some of our sites exposed to tidal flooding and it may be necessary to consider acting independently to protect the electricity network assets.

5 Managing our other climate change risks

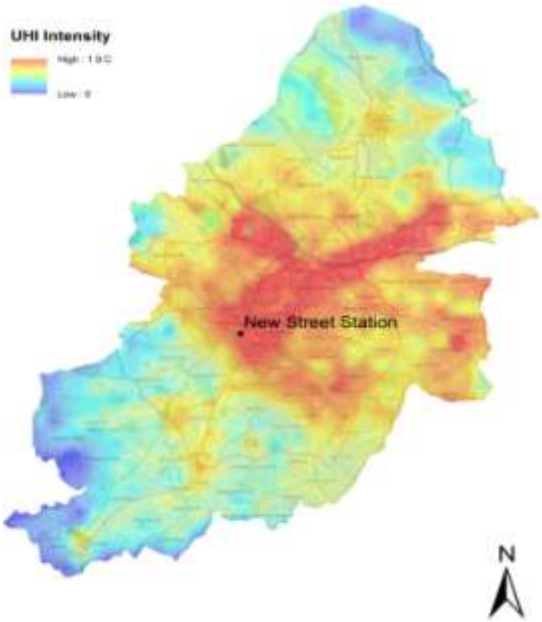
5.1 Planning for the future

Several Climate Change impacts identified in the ENA Engineering Report are still being analysed and the severity of the risk to Western Power Distribution's network is still being assessed. For example, details of the derating of underground cable networks can be found in section 5.3 of the ENA Engineering Report in Appendix 1. Once these assessments are complete, any policy changes required for early adaptation will be identified.

5.2 Research and Development Projects

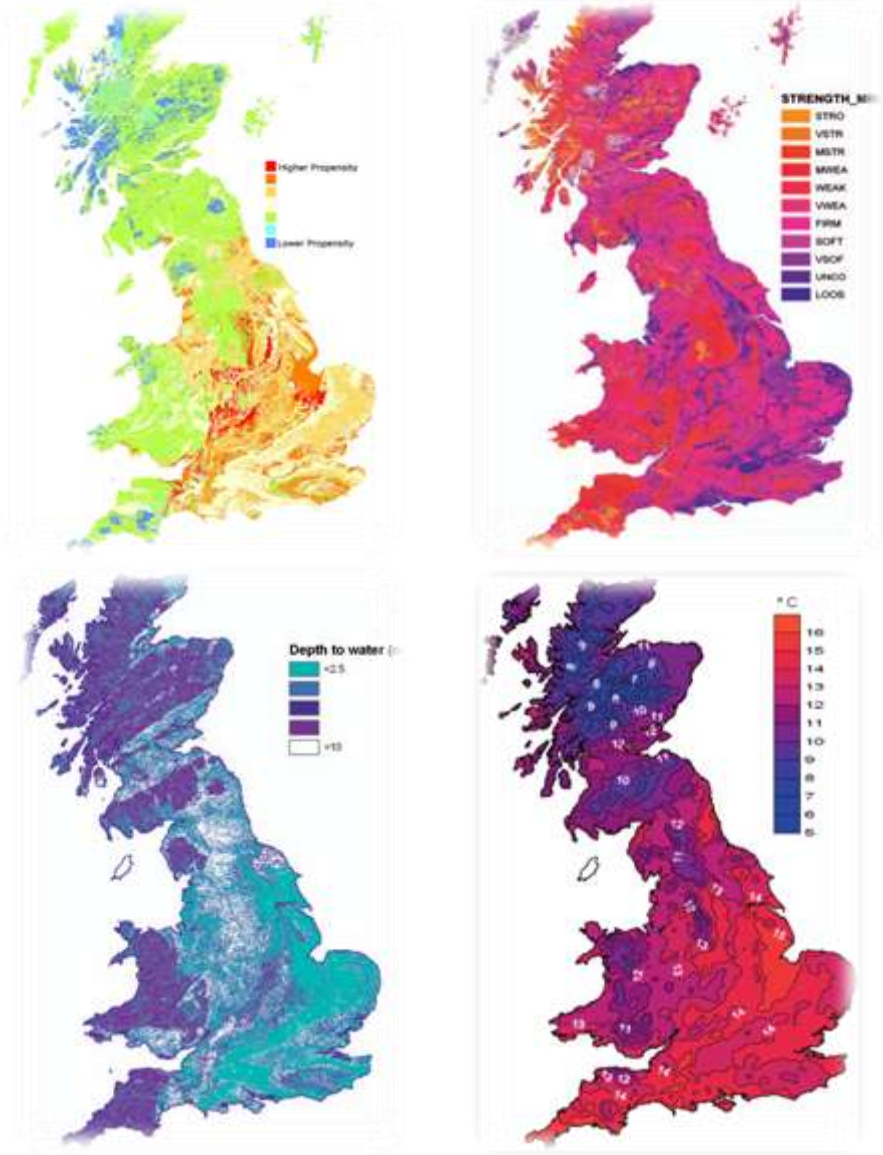
5.2.1 Urban Heat Island effects on equipment ratings

The EP2 report suggested an expected temperature rise of 0.5degC/decade could cause problems with Equipment Ratings, especially in Urban areas where Heat Island Effects will additionally result in an increase in night time temperatures, which will reduce the diurnal cooling effect and potentially detrimentally effect transformer capacity / life. Western Power Distribution initiated a Knowledge Transfer Partnership (KTP) project in 2009 with Birmingham University to provide a better understand of the Urban Heat Island Effects on our distribution network assets. As part of this project, temperature sensors have been installed to monitor transformer and ambient temperatures across the Birmingham conurbation.



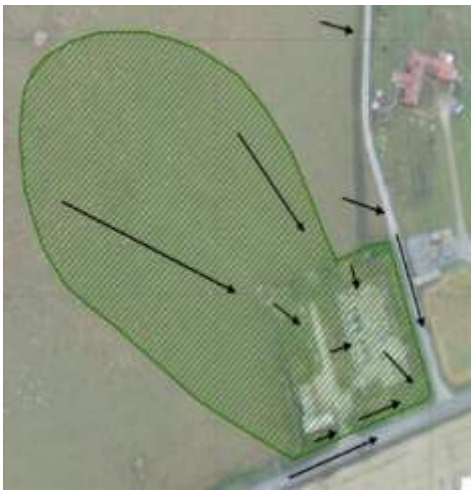
5.2.2 Predicting where significant changes in Earthing resistance will occur

Earthing is required for the correct operation of our distribution network assets, it relies on soil resistivity, which is affected by moisture content and temperature. A joint Western Power Distribution / UKPN research project with Cranfield University (National Soil Association) and British Geological Survey (BGS) has been developing an overlay for our Geographical Information System (GIS) to provide engineers with details of underlying soil and rock conditions and calculate what is necessary to achieve specific earthing resistance at different locations. A second phase of the project has been initiated in 2011 and this will identify those areas where significant changes to existing earthing system resistances are probable in the future with UKCP09 climate predictions. Further information can be found in section 5.4 of the ENA Engineering Report in Appendix 1.



5.2.3 Pluvial Flooding Screening Assessment

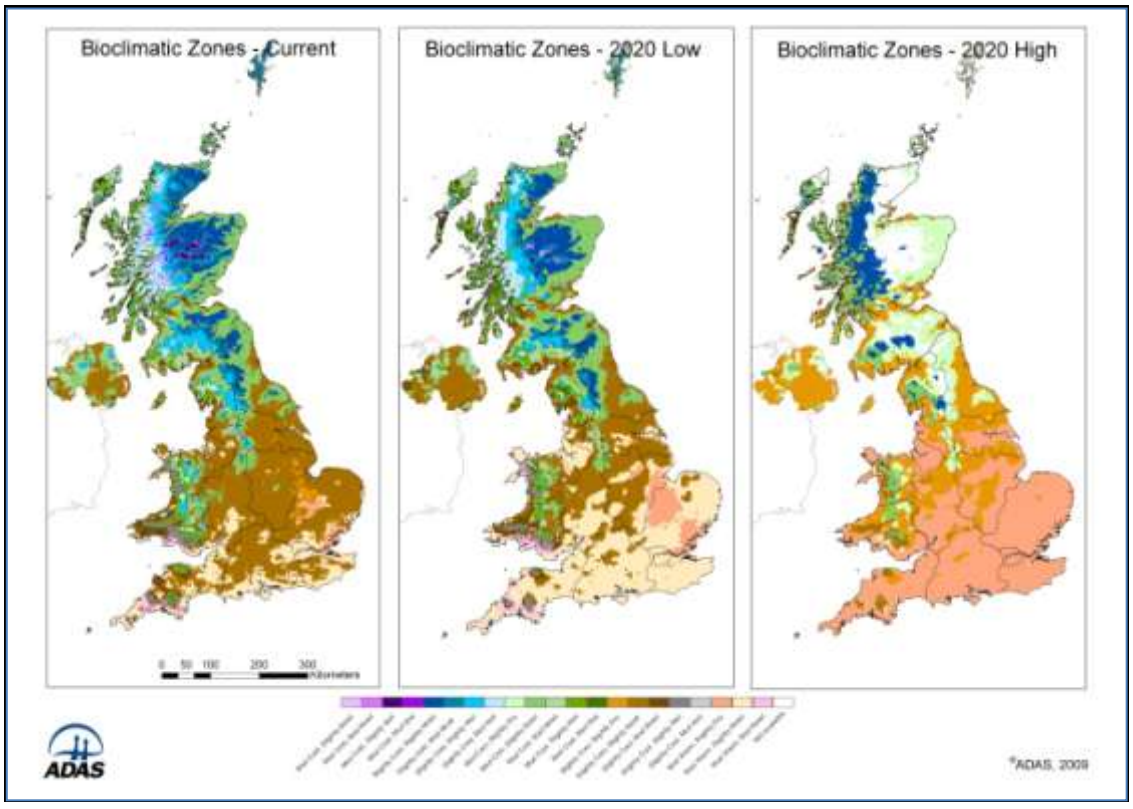
Although a significant amount of fluvial and tidal flooding information is available from the Environmental Agency, there was limited information on how to identify sites susceptible to pluvial (flash) flooding. Western Power Distribution has therefore been working with ADAS since 2008 to develop, validate and refine a pluvial flood screening tool, which can be used to determine the pluvial flood risk at specific sites. The tool uses a combination of topographical analysis and several rainfall runoff estimation methods to delineate catchment areas and estimate the peak flow rates to determine the susceptibility of pluvial flooding at a specific site.



Substation Sites screened	Pluvial Flood Susceptibility	East Midlands Licence Area	West Midlands Licence Area	South Wales Licence Area	South West Licence Area
Grid, B.S. and Primary Sites	High	38	38	Substation sites under consideration for screening	
	Medium	102	69		

5.2.4 Vegetation Growth

Trees and other vegetation near our overhead lines needs to be managed to prevent faults from occurring when they touch or fall into the overhead lines. It is estimated that climate change has already resulted in an extension of the growing season by 10 days since the early 1960's. This has a knock on effect on the performance of our overhead line assets and since 2009 a joint Distribution Network Operator (DNO) research project with ADAS has been looking at micro climates across the UK to identify geographical variations in vegetation growth and using UKCP09 climate predictions to determine future vegetation management requirements. Further details can be found in section 5.2 of the ENA Engineering Report in Appendix 1. Another collaborative project also with ADAS and Reading University is looking at commercially available Tree Growth Regulators (TGR) which may be part of the solution to future vegetation management. These can improve tree health whilst regulating growth and are already used in orchards.



Annex 1 – ENA Engineering Report 1 (ERep 1)

See separate accompanying Document

Annex 2 – Met Office Resilience Project - National Findings

Future Climate Risk Assessment for the UK Electricity Network

Wind and gale faults

For all future time periods throughout the UK on both the distribution and transmission networks, estimates of wind and gale faults range from changes that are negative to changes that are positive, therefore it is possible that these faults may increase or decrease in the future.

In the 2080s the projected change in future UK wind and gale faults ranges from a decrease of 23% to an increase of 20% on the distribution network, and from a decrease of 30% to an increase of 25% on the transmission network.

Regionally there is more evidence of a reduction in faults in Northern England and Scotland compared to the South; however, this signal is not consistent over all the regional climate model runs.

Lightning faults

Lightning faults are projected to increase in the future as a consequence of more days with higher convection.

In the 2080s the projected change in future UK lightning faults ranges from a decrease of 3% to an increase of 75% at most, on both the distribution and transmission networks.

There is regional variation in the estimates; in particular the change may be smallest in the Midlands and the South East of England and greatest in North England, North Wales and Scotland.

Snow, sleet and blizzard (SSB) faults (including ice)

SSB faults are projected to decrease throughout the year. This signal is due to a decrease in the number of days when snow falls; this highlights a decrease in the frequency of SSB fault days, but not necessarily a decrease in the intensity of events when snow does fall.

In the 2080s the projected change in future SSB faults is for a decrease of approximately 50% to 90% on both the distribution and transmission networks. Regionally, the North of Scotland projections exhibit a smaller reduction than the rest of the UK.

Solar heat faults (analysis for distribution network)

For all future time periods throughout the UK, the incidence of solar heat faults is expected to increase, due to projected increases in maximum temperatures.

The future fault distribution for solar heat faults has not been estimated – their rare occurrence in the baseline period means that statistically robust relationships between fault numbers and weather parameters cannot be determined. Instead, a threshold exceedance analysis based on maximum daily temperature has been used as an indicator of the direction of change in the incidence of solar heat faults in future.

In the 2080s the projected change in future exceedance of the 90th percentile maximum temperature across the UK ranges from an increase of 88% to an increase of 246%, and the projected change in future exceedance of the 98th percentile maximum temperature across the UK ranges from an increase of 137% to an increase of 707%. The 90th and 98th percentiles of maximum temperature vary regionally (e.g. higher values in South East England than in Scotland would be expected), so there is little evidence for significant regional variations in the frequencies of exceedance of these thresholds.

Flooding faults (analysis for distribution network)

A UK-wide event-based analysis has been conducted for flooding. In the 2080s, for all events considered, projections show a mean increase in exceedance of rainfall amounts which have caused significant flooding events in the baseline period. The possibility of decreases cannot be ruled out, however, as some model runs still project slight decreases in exceedance for some of the rainfall events.

The absence of a flooding event in a particular licence area during the baseline period does not mean that that area is not vulnerable to flooding events. Major flooding events are statistically rare and the baseline period is short in terms of the occurrence of these events. The general increase in heavy rainfall projected by this analysis should therefore be considered as relevant to all licence areas.