Electricity Policy Document 355

Issue 4 **December 2017**

Substation Flood Protection

Contents

Approved for issue by the Technical Policy Panel

Issue and Amendment Summary

Amendment No. Date	Brief Description and Amending Action
0 01/05/07	Issue 1 First Issue Prepared by: R A Wells Approved by the Technical Policy Panel and signed on its behalf by:
0 05/07/12	Issue 2 Policy updated in line with ETR138, from lessons learned during construction and from improvements in flood risk data capture. The process required to ensure the installation of flood protection where it is needed has been clarified. Prepared by: A J Crozier Approved by the Technical Policy Panel and signed on its behalf by: P J Whittaker
0 13/04/17	Issue 3 Policy updated in line with the requirements and recommendations of the revised ETR138 and the Government's National Flood Resilience Review (GNFRR). It also takes account of the effects of Storms Desmond and Eva and includes guidance for distribution substation planners. Prepared by: I McCormack Approved by the Technical Policy Panel and signed on its behalf by Steve Cox, Engineering and Technical Director
0 18/12/17	Issue 4 Updated the hyperlink to Environment Agency Flood Map for Planning in Section 3.1. Prepared by: I McCormack Approved by the Technical Policy Panel and signed on its behalf by Steve Cox, Engineering and Technical Director

SUBSTATION FLOOD PROTECTION

1. INTRODUCTION

The serious incidents of flooding in the South Midlands and South Yorkshire during the summer of 2007, and the incident at Carlisle in 2005 highlighted the potential vulnerability of electricity substations to major flood incidents. More general concerns over climate change and rising sea levels also bring into question whether historic levels of protection from flooding will be adequate in the future.

Following the incidents in 2007, the Energy Minister requested a comprehensive assessment of the resilience to flooding of primary and higher voltage substations and the steps that may be taken to mitigate current and future risks. The Energy Networks Association (ENA) Substation Resilience to Flooding Task Group, reporting to the Energy Emergencies Executive Committee, (E3C) was asked to lead this work within agreed Terms of Reference.

The Task Group Report was delivered to E3C and The Energy Minister at the end of March 2008. The Report was accepted and a further phase of work requested to oversee the implementation of the recommendations in the Phase 1 Report and the production of Engineering Technical Report (ETR) 138 in October 2009. A subsequent review and update of this document took place in April 2016.

It was recognised that Electricity North West policy on flood protection was in need of an update to bring it into line with these guidelines and the outcome of the update is incorporated into this document. This policy has also been updated from lessons learned during construction and from improvements in flood risk data capture which have enabled more accurate flood risk assessments and clarified the process required to ensure the installation of flood protection where it is needed.

Further flooding events, notably Storms Desmond and Eva in the winter of 2015/16, have called into question the adequacy of existing flood preparedness and prompted the Government to commission a National Flood Resilience Review, the results of which were published in September 2016.

The findings of this Review and the lessons learnt by Electricity North West during Storms Desmond and Eva have also been incorporated into the latest update of this EPD.

In order to comply with Regulation 3(1)(b) of the Electricity Safety, Quality and Continuity Regulations 2002 (ESQCR), Network Operators are required to ensure that equipment is constructed, installed and protected so as to prevent interruption of supply so far as is reasonably practicable.

This Electricity Policy Document sets out the policy principles that Electricity North West Limited, hereinafter referred to as Electricity North West, shall follow when assessing sites for new and existing substations situated in flood plains, and the adoption of assets provided under a competitive connection scenario.

2. SCOPE

This policy applies to potential flooding of Electricity North West electricity substations sited within a defined flood plain.

Electricity North West flood protection is aimed at managing floodwaters from overflowing rivers (Fluvial), breech of coastal defences (Tidal) and events caused by flash flooding as a result of heavy rainfall and inadequate localised drainage (Pluvial).

Potential dam breaks shall also be considered in any flood risk assessments carried out.

3. GOVERNMENT PLANNING POLICY

3.1 Flood Zones

Her Majesty's Government Planning Policy Statement PPS25 "Development and Flood Risk" applies to this class of infrastructure. PPS25 defines the flood zones, i.e. the probability of river and sea flooding, ignoring presence of defences, as follows:

Zone 1 - Low Probability

This zone comprises land assessed as having less than 1 in 1000 probability of river or sea flooding in any year (<0.1%).

Zone 2 - Medium Probability

This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1%-0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5%-0.1%) in any year.

Zone 3a - High Probability

This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.

Zone 3b - The Functional Floodplain

This zone comprises land where water has to flow or be stored in times of flooding with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%) flood. The zones applicable to a particular geographical location can be found by entering a postcode on the Environment Agency website:

https://flood-map-for-planning.service.gov.uk/

3.2 Flood Risk Vulnerability Classification

Developments are classified as follows:

Essential Infrastructure

Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk, and strategic utility infrastructure, including electricity generating and grid and primary substations. Essential infrastructure should be designed and constructed to remain operational and safe for users in times of flood.

Highly Vulnerable

Police stations, ambulance stations, fire stations and command centres and telecoms installations required to be operated during flooding, emergency dispersal points, basement dwellings, etc.

More Vulnerable

Hospitals, residential institutions, dwelling houses, student halls of residence, etc.

Less Vulnerable

Shops, restaurants, waste treatment, water treatment, mineral working and processing, etc.

Water-compatible Development

Flood control infrastructure, water transmission infrastructure, docks, marines, MOD defence installations, ship building, navigation facilities, lifeguard and coastguard stations, etc.

Flood Risk Vulnerability classification	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	✓	Exception Test Required	✓	✓
Zone 3a	Exception Test Required	✓	×	Exception Test Required	✓
Zone 3b	Exception Test Required	✓	×	×	×

Key: ✓ Development is appropriate × Development should not be permitted

Table 1 - Flood Risk Vulnerability and Flood Zone 'Compatibility'

(Extract from PPS25-Table D.3)

3.3 Exception Test

For the exception test to be passed (section D9 of PPS25):

(a) It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk

(b) the development should be on developable previously-developed land or, if it is not on previously developed land, that there are no reasonable alternative sites on developable previously-developed land and

(c) a Flood Risk Assessment must demonstrate that the development will be safe, without increasing flood risk elsewhere, and where possible, will reduce flood risk overall.

While PPS25 classifies Grid and Primary Substations as Essential Infrastructure, Distribution substations are not explicitly classified in PPS25 but align with the definition of More Vulnerable.

4. NEW SUBSTATIONS

4.1 New Distribution Substations

New distribution substations shall not normally be sited within a Zone 3a flood plain unless the customer base to which it is to provide supply is also sited in part or in whole, upon the same flood plain and no other alternative site is available or it is not economically viable to place the substation elsewhere.

Where a new distribution substation is placed by necessity on the flood plain, no special protection requirements will be required unless a majority of properties (assessed as >60% of the customers to be supplied) are designed so they will not be damaged by flood water and hence require a supply post flood.

Note: This requirement excludes flood protection provided from the general public expenditure.

Where the plant is provided to supply Emergency Services infrastructure then consideration shall be given to the installation of flood protection measures after a risk assessment which takes into account the presence of other flood defences provided at the public expense.

Ground mounted distribution substations, without any exception, shall not be sited within a Zone 3b flood plain. However, in these situations consideration may be given to installing a pole mounted substation, particularly where supply is required to essential infrastructure.

4.2 New Primary Substations

Primary substations shall as much as possible be sited within Zones 1 and 2. Primary substations can also be sited in Zones 3a and 3b provided there is no economically acceptable alternative engineering solution to position the site within Zones 1 or 2. In this case the substation shall be designed and constructed to remain operational and safe for users in times of flood.

Where the site is for a customer/developer and the customer/developer insists on siting the substation within the Zone 3a or 3b flood plain, then flood protection shall be provided and appropriate additional costs shall be charged to the customer in accordance with the company's connection charges.

No Primary substation shall be placed in an underground situation within Zones 2, 3a and 3b, where it is wholly funded by Electricity North West. Where funding is provided either wholly or partially by a customer/developer, then the substation may be placed underground if there is no other economically acceptable engineering alternative, but the additional flood protection measures shall be recharged totally to the customer.

4.3 New Bulk Supply Substations and New Grid Substations

The principles for the installation of Primary Substation sites shall apply to Grid and Bulk Supply substations. During the design stage of the project Electricity North West will work with all interested parties to ensure that appropriate positioning and flood protection measures are incorporated into the final design to ensure compliance with ESQCR requirements.

Note: Note this clause is intended for new sites and not for the extension of existing Grid facilities. Extensions and additions shall be dealt with under the policy for existing substations and infrastructure (see Section 5 below).

5. EXISTING SUBSTATIONS AND INFRASTRUCTURE

It shall be Electricity North West policy that;

5.1 Existing Grid and Primary Sites

All existing Grid and Primary sites shall be assessed as described in ETR138. This identifies a target level of resilience for 132kV substations to Level 1 i.e. 1:1,000 year flood risk and for Primary substations a target of Level 2 i.e. 1:100 year flood risk (1:200 for coastal flooding). In addition the Government's National Flood Resilience Review, published following the winter storms of 2015/16, suggests that sites serving more than 10,000 customers should be protected to Level 1 as well. Electricity North West will identify its Primary substations that serve this number and ensure that they are resilient to Level 1 subject to appropriate regulatory funding.

Those sites determined to be at risk shall be further risk assessed so as to determine the need, if any, for the proactive installation of flood defences. This assessment will identify the predicted height of flooding (for the resilience level applicable to the site) and the height Above Ordnance Datum (AOD) of the substation, the difference between these values being the predicted flood depth. These assessments shall be the responsibility of the Asset Investment Manager and shall be repeated once for each regulatory cycle or as required by circumstances.

As described in ETR138, the predicted level of flooding will also need to take into account the uncertainties surrounding climate change. Based on current advice provided by the Environment Agency, it is recommended that, for those sites identified as being at risk of flooding, the information on flood depth is increased by the following amounts:

Freeboard

By 300mm to allow for uncertainties in data and modelling.

Fluvial and Pluvial Flooding

By 20%, on the predicted flood depth, to allow for climate change impacts during the lifetime of the assets.[1]

Due to the unpredictability of flood levels, and following the experience of the flooding events in Storms Desmond and Eva, a further safety factor will be applied by Electricity North West to the resultant flood defence height after inclusion of freeboard and climate change factors. The additional safety factor to be applied is 600mm.

Overall Flood Defence Height Assessment

(Predicted flood depth from site assessment + Freeboard (300mm) + Climate Change (20% of predicted flood depth)) + Safety Factor (600mm)

Sea Level Rise

In accordance with DEFRA Flood and Coastal Defence Appraisal Guidance, FCDPAG3 (Economic Appraisal), Supplementary Note to Operating Authorities – Climate Change Impacts, Table 1, the North-West region has a predicted rise of 87.5 mm between 1990 and 2025 followed by a further 210mm rise between 2025 and 2055.

Clearly, the addition of these contingencies is likely to increase the cost of any protection works and this will be taken into account in the detailed assessment of the costs and benefits for each site. Societal risk shall also be considered in this assessment. Surveys and cost/benefit analysis shall be carried out in accordance with the flow chart in Appendix A.

Substations that are found to be at high risk may require flood defences to be proactively installed as a special programme of works, subject to appropriate regulatory funding. The mitigation of the risk could either be a permanently installed defence or a reactive flood protection plan. This provision ensures compliance with ESQCR on maintaining supplies.

Where analysis indicates that installing flood defence solutions is not cost effective, consideration should be given to network solutions such as interconnectors or automated switching points which will enable supplies to be rapidly restored to affected customers in the event of loss of the substation.

5.2 Existing Distribution Substations

When replacing distribution substation assets, their risk of flooding shall be assessed. The Environment Agency Long Term Flood Risk Information Maps shall be checked for the flood risk at the substation location and, where they indicate that the substation is in an area at High risk of flooding and the substation passes the exception test described in Section 3.3, then consideration shall be given to flood protection of the assets. Substations known to have previously flooded shall also be considered for flood protection.

The EA Long Term Flood Risk Information Maps can be accessed via this link.

https://flood-warning-information.service.gov.uk/long-term-flood-risk

[1] This allowance is the Environment Agency peak river flow allowance for the North West river basin district, upper end allowance category for 2015 to 2039.

A site risk assessment shall be completed to determine the most appropriate approach to be employed. When risk assessing a substation, the effects of its loss due to flooding should be taken into account with consideration given to such factors as the number and nature of the customer base served, impact on the network of its total loss, knowledge of the effect of any previous flooding and the nature of the works required to prevent its future loss from flooding. It should be noted that flood risk mitigation applications can include network alterations e.g. HV interconnectors or additional link boxes, to enable supplies to be restored quickly to customers in the event of substation loss

5.3 Existing Grid and Primary Sites on Floodplains

Where existing Grid and Primary substations sited on existing flood plains, are subject to a major project and the flooding risk assessment indicates that the site is medium or high risk, the need for additional flood protection measures shall be further assessed and considered as part of the project scope and design. The need shall be stated in the project scope. The final decision to install flooding protection shall be part of the scope and solution sign off by the project approval group.

If a customer requests Electricity North West to protect its assets within the customer's curtilage for a site that does not otherwise require work in accordance with this policy, then Electricity North West will recover all appropriate costs of the project.

6. SPECIAL CASES

Electricity North West will provide flood protection to other specific substations in accordance with HM Government's direction through the Department of Business, Energy and Industry Strategy (BEIS), other appropriate governmental departments that may from time to time have responsibility for flood defences and by regulatory instructions, providing that regulatory funding is made available or the additional costs to Electricity North West are met.

Note: Under emergency legislation Electricity North West may be compelled to provide flood protection at its own cost. In these circumstances cost recovery would be sought through the next regulatory review or by application for funding if said funding is greater than any relevant materiality threshold in force at the time of the expenditure.

7. FLOOD PROTECTION METHODS

Electricity North West shall not rely on the placement of temporary protection against flooding unless the risk to plant is shown as extremely low and that transport links to the site will be sufficiently clear to allow placement in good time from the issuance of an appropriate warning of flood.

The method of providing flood protection shall be assessed for each individual location as per ETR138 and an appropriate solution proposed, which might include one or more of the following options:

- Bunding the site with fixed or controllable structures including flood gates.
- Provision of an earth mound incorporating "Bentonite" or similar substances.

- Raise foundations and plinths etc thus increasing the floor level above a predicted flood.

- Raising the plant by addition of stilts or floatation devices.

- Adding flood defences to the perimeter. Attention shall be given to any ducting and ventilation which may need to be relocated accordingly.

- Application of approved proprietary flood protection systems.

- Application of demountable or temporary flood defence equipment where the risk is sufficiently low and temporary protection can be reliably applied.

- In addition to these methods, Electricity North West will consider electrical interconnection solutions to make substations flood resilient.

Reliance on existing publicly provided flood protection shall only be made after a full risk assessment is carried out at the design stage of the Electricity North West project to which it is to be relied upon. Maintenance of the flood protection shall be considered in the risk assessment. Generally, publicly provided protection alone shall only be acceptable where there is evidence that the defences are maintained by a publicly funded body and that the maintenance is most likely to be continued for the foreseeable future.

Subject to the outcome of a cost benefit analysis, the height of the sites' defences shall not be less than the levels described in paragraph 5.1 above.

A record shall be kept of all flood installations within the corporate database and DSMC informed of the detailed flooding resilience and defences at each of the sites where work has been completed.

Each site shall have an appropriate approved sign confirming the flood alleviation works and date completed.

Where none of the above options for defence are considered adequate, then (and subject to a proven need by risk assessment), in extreme and exceptional circumstances, consideration will be given to relocating the substation to an area currently assessed as not at risk of flooding.

8. APPLICATION OF REACTIVE FLOOD DEFENCES

Where a Grid or Primary site is inundated by a coastal or river based event the site shall have flooding protection applied as soon as reasonably practical after the event.

Where flooding occurs due to inundation from rainwater draining off surrounding land, flood protection may be installed after completion of a risk assessment and appropriate studies of local drainage, etc.

Distribution substations that have flooded and caused loss of supplies should be considered for reactive flood defences in line with the requirements of Section 5.2

9. ASSET ADOPTION

Where Electricity North West are required to adopt assets created by a third party under a competitive bidding process, adoption shall not occur unless the design and construction of the assets comply with this policy.

Note: This does not preclude connection of Independent Distribution Network Operator's (IDNO) networks, where the IDNO chooses not to install flood protection to their assets.

Adoption of assets from NGET shall also follow this principle. At joint National Grid sites the principles outlined in ETR138 Appendix 6 shall be applied. These principles outline the responsibilities of each party at individual sites and the working arrangements that should be put in place to enable a programme of flood mitigation works to be achieved.

10. DOCUMENTS REFERENCED

Electricity Safety, Quality and Continuity Regulations 2002 (ESQCR)

Her Majesty's Government Planning Policy Statement PPS25 - December 2006 "Development and Flood Risk" (updated December 2009)

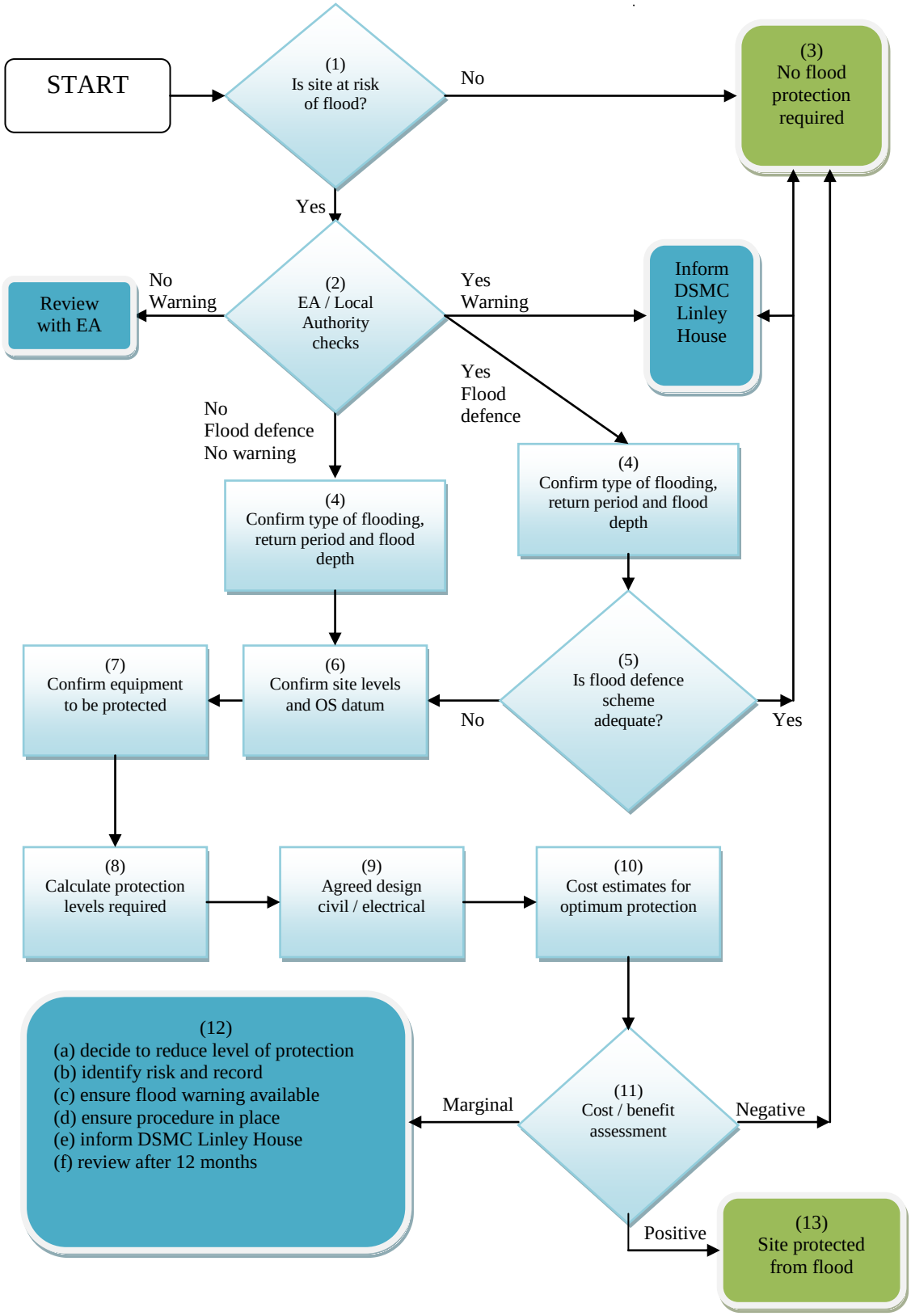
ENA ETR 138 Issue 2 2016 Resilience to Flooding of Grid and Primary Substations

DEFRA Flood and Coastal Defence Appraisal Guidance, FCDPAG3 (Economic Appraisal), Supplementary Note to Operating Authorities – Climate Change Impacts)

11. KEYWORDS

Substation

APPENDIX A – FLOOD PROTECTION RISK ASSESSMENTS AND MITIGATION



See explanatory notes overleaf.

Appendix A flowchart explanatory notes

(1) Desk top survey by Flood Survey Consultants

(2) Checks to include:

(i) Flood warning available?

(ii) Local/national flood defence scheme?

(3) Ensure database updated. Will require re-survey in next regulatory period. If no protection from cost/benefit analysis then must ensure risk register is updated and re-survey in 1 year.

(4) Coastal, fluvial, pluvial or dam break?

(5) Confirm any EA or LA flood defences are adequate and are maintained. If any doubt then treat as if not adequate. If adequate and maintained ensure recorded with DSMC and databases.

(6) Need to ensure that site contours are considered.

(7) Consider position of small wiring, fuses, etc. Also whether marshalling kiosks have wiring and fuses at a higher level internally. Consider if any protection is affected by small wiring in transformer and disconnector marshalling kiosks.

(8) Use ETR 138 paragraphs 8.3 and 8.4 and table in appendix 2. Also need to confirm risk (likelihood of flood) after proposed works completed.

(9) Ensure design meets all civil and electrical criteria and approved by Design Manager.

(10) Must consider least cost option including any option for transformer/disconnector marshalling kiosk wiring mods.

(11) As per ETR 138 – consider numbers of customer, critical customers, asset replacement plans, extra design costs, overall budget, priority due to level of flood risk, etc. If negative then review design before deciding not to protect.

(12) Must ensure risk register is updated.

(13) Construction work approval. All data recorded when complete. DSMC informed. Databases updated.