

FLOOD DEFENCES FOR ELECTRICITY SUBSTATIONS

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GENERIC ELECTRICITY SUBSTATION DESIGN MANUAL
FOR CIVIL, STRUCTURAL AND BUILDING ENGINEERING

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TITLE : FLOOD DEFENCES FOR ELECTRICITY SUBSTATIONS

FLOOD DEFENCES FOR ELECTRICITY SUBSTATIONS

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PURPOSE AND SCOPE

The purpose of this document is to detail National Grid's technical and procedural requirements for flood resilience of new and existing operational electricity substations. Operational compounds outside substations, such as cable sealing ends, are currently excluded from the scope of this document.

This specification expands upon the requirements outlined in National Grid Policy Statement PS(T)095 – 'Flood Mitigation Policy' and should also be read in conjunction with Engineering Technical Report ETR138 – 'Resilience to Flooding of Grid and Primary Substations', published by the Energy Networks Association.

It should be noted that this document includes sections on the design of site drainage to protect against local flooding due to extreme rainfall events, and as such will apply at all new substation builds, not just those deemed to be at risk of flooding from the Environment Agencies flood zone maps. It shall not generally be necessary to retrospectively apply rules on site drainage to existing sites, unless that is a particular requirement of the project.

Section 1 of this document details National Grid's requirement for flood modelling and risk assessment. This will be used to assess the need for flood mitigation measures at particular sites. For detailed guidance on *Flood Risk Assessment* methodology, run-off calculation, detailed drainage design etc. designers shall refer to recognised industry practice and the Environment Agency website. Sections 2 to 4 of this document detail requirements for particular types of flood defence and associated infrastructure. These sections are primarily intended for retrospective use on existing substation sites, but could in some instances be used for new build substation sites.

Definitions are detailed in Part 2 and are italicised throughout this specification.

All **Hold Points** in this specification shall be agreed with the National Grid Civil Assurance Engineer.

INFORMATIVE: Various references are made throughout this document to third party standards and guidance documents. Where the particular issue or revision of such documents is not stated, this is intentional and the user of this document shall refer to current issue at the time of use.

PART 1 – PROCEDURAL

1 FLOOD RISK ASSESSMENT

1.1 New Sites

- 1.1.1 All new substation sites shall be subject to a Flood Risk Assessment (FRA).
- 1.1.2 The *FRA* shall be carried out in accordance with the published guidance from the relevant authority responsible for flood risk information. In England this is the Environment Agency (EA) and in Wales this is Natural Resources Wales (NRW).
- 1.1.3 The *FRA* shall be submitted to the EA and a letter of 'no objection' obtained. It shall also be formally accepted by National Grid and referenced in the Project Execution Plan (PEP) as Survey Information.
- 1.1.4 *FRAs* should be carried out in accordance with The Flood Estimation Handbook, ETR 138 and the National Planning Policy Framework. Early consultation with the Environment Agency, Local Planning Authority and other applicable third parties (where applicable) e.g. Internal Drainage Boards shall form part of the assessment process wherever possible.
- 1.1.5 New substations shall follow current planning guidance published by the EA, NRW and the Department for Communities and Local Government. In this respect, they shall initially be treated the same way as other generic developments. However, if after applying the *sequential test* and/or *exception test*, it is deemed appropriate from a planning perspective to site the substation in *Flood Zone 2 or 3a/b*, it is still National Grid's default position to provide resilience to a level equivalent to the 1:1000 year annual risk of flooding plus allowance for climate change and errors in the model. Note: This is the 1:1000 flood level with 50 year asset life projection as opposed to the EA's default position of 100 years and includes allowances for climate change and errors in the data. This may require a bulk earthworks exercise to raise the level of the site. Localised raising of *critical equipment* or other flood defence techniques are identified in Sections 2 and Section 3 of this specification.
- 1.1.6 Where the method of providing flood resilience is localised raising of *critical equipment*, it will still generally be necessary to ensure that the depth of water above finished substation level is 300mm or less during the design flood event. This is to facilitate access on foot within the substation to maintain ancillary equipment in the event of a prolonged flood situation. This requirement is limited to the areas of the site containing *critical equipment* which may need to be maintained during a flood and the access routes from a defined access/egress point of the site perimeter.
- The following shall be considered when assessing 1.1.6;
- Expected duration of flooding e.g. tidal flooding may only last several hours.
 - Site topography i.e. changes in level, presence of troughs/manholes, trip hazards etc.
 - Expected velocity of flood waters.
- 1.1.7 PS (T) 095 – 'Flood Mitigation Policy' states "...add 300mm for errors in data if not already accounted for in information provided.". The default option shall be to include the 300mm in the flood resilience level. However, if it becomes apparent that the additional 300mm is decisive in terms of option selection or will have a significant impact on the capital cost of the scheme, then it may be prudent to carry out further sensitivity analysis to justify reduction of the 300mm. This will be dependent on the type of flooding, and the particular details of the site.
- 1.1.8 An assessment of localised surface water flooding will also be necessary to ensure the level of standing water on the site does not affect *critical equipment* during an extreme (1:1000) rainfall event. This will be largely influenced by the topography of the site and surrounding area and the permeability of the underlying strata. In some cases this may necessitate provision of surface water drainage capacity over and above what would normally be provided for.

- 1.1.9 In addition to the requirements of 1.1.8, minimum design criteria for new site drainage shall be as follows:

1:30 rainfall event – no standing water on site.

1:100 rainfall event – no standing water on operational area of the site (e.g. car parks etc. may be designed to flood in the 1:100 storm event).

In both the 1:30 and 1:100 scenarios, the design shall ensure that excess runoff that the drainage system cannot accommodate does not impact adjacent 3rd party land.

Where discharge consents or downstream capacity restrictions are in place the design shall incorporate attenuation (where required) to achieve the above requirements.

This clause shall not apply to existing drainage systems on existing sites, unless formally agreed with National Grid.

1.2 Existing Sites

In addition to the requirements of 1.1, the following section shall apply to flood defence work at existing sites only.

- 1.2.1 Where an *FRA* has previously been carried out, this will need to be assessed to determine if the information contained in it is current and fit for purpose. This shall include consultation with EA/NRW to confirm the validity of *FRA* and will ultimately inform the need for further assessment.
- 1.2.2 If there is no EA / NRW letter of 'no objection', flood modelling may be required and the findings agreed with the EA / NRW for those sites identified as requiring flood protection.
- 1.2.3 The *FRA* shall be submitted to the EA and a letter of 'no objection' obtained prior to commencement of NDP Stage 4.4.
- 1.2.4 The *FRA* shall follow 3 stages as described below:

Stage 1a) – This is a screening exercise using flood depth mapping from EA/NRW and previous *FRA* data. The outcome of this stage should be a decision on whether to proceed to detailed modelling of the existing site in Stage 1b)

This is a **Hold Point**.

Stage 1b) - During this stage, a *baseline flood model* shall be produced to determine the anticipated flood level using the criteria given in Policy Statement PS(T) 095 – Flood Mitigation Policy.

Modelling undertaken in this stage shall include flooding from all sources, including but not limited to:

Fluvial (Rivers)
Coastal/Tidal
Pluvial (Surface Water)
Groundwater

Note: Unless formally agreed with National Grid, models shall not cater for reservoir/dam breaches, canal bank breaches or water main bursts,

At this stage, the worst case scenario (or two worst case scenarios if the worst case is a *breach* scenario) shall be modelled and reported in the results. Modelling of *breach* scenarios should be done only to satisfy the requirements of EA/Planning Authority where required. Where a site benefits from an existing third party flood defence, proposals for substation flood defences should cater for *overtopping* of the third party defence (if applicable), but not *breach*.

The outcome of this stage should be a decision on whether to proceed to detailed modelling of proposed flood defences in Stage 2 and identify any additional surveys/information required e.g. river bed survey.

This is a **Hold Point**.

1.2.5 **Stage 2** – During this stage, preliminary flood defence designs shall be prepared

Where the results of the Stage 1b) modelling show areas of the substation to be at risk from flooding, the guidance in Table 1.2 below shall be applied when developing preliminary flood protection designs i.e. the decision to use localised protection or site wide protection. Note that the principles of clauses 1.1.6 and 1.1.7 for new sites apply, subject to the recommendations of a *Site Risk Assessment*. This is a **Hold Point**.

Expected depth of water	Mitigation
0-300mm	<i>Site Risk Assessment</i> to be carried out in conjunction with the Site Occupier to determine the most suitable method of defence
>300mm	Consider site wide protection (e.g. perimeter wall) to maintain operational environment.

Table 1.2 – Flood Mitigation Guidance

- 1.2.6 The *Site Risk Assessment* should make reference to EA Flood Hazard Maps which include information on the extent, depth and velocity of flood water from rivers, sea, surface water and reservoirs for a number of scenarios, where available.
- 1.2.7 Where site wide protection is proposed, a maximum wall/barrier height of 2.4m shall generally be applied. This is considered to be the practical upper limit. Calculated flood depths in excess of 2.4m shall be recorded as a residual risk.
- 1.2.8 It should be noted that where tunnels, basements, cable troughs, ducts and drains are present, perimeter defence may be more cost effective even at low water depths.
- 1.2.9 Where the calculated flood level is considered too high to man the site, and construction of a perimeter wall is not feasible, this shall be recorded in the site emergency plan. This is a **Hold Point**.
- 1.2.10 Where the calculated flood levels permit manning the site during a flood event, provision shall be made for the evacuation of staff in the event that water levels exceed the expected flood levels, or the duration of the flood necessitates evacuation of staff. This shall be considered at the design stage in consultation with the site occupier. In the case of a perimeter wall, this is likely to influence the permanent works design, for example the inclusion of pedestrian access gates and access steps in the perimeter wall/fence.
- 1.2.11 Where perimeter access steps are provided for use during a flood event, the height of the perimeter fence shall be raised locally to account for the additional climbing aid provided by the steps. Also, handrails for the access steps shall be a minimum of 2.0m away from the fence line to avoid creating a climbing aid.
- 1.2.12 The alignment of proposed flood walls should consider the existing fence line, existing services, ease of construction, access and where it is known, future use of the space within the site.
- 1.2.13 Consideration should be made to impinging the installation, maintenance, and movement of equipment from and within the site e.g. SGT replacement.

2 GLOBAL (WHOLE SITE) PROTECTION

2.1.1 Where the *FRA* indicates the need for whole site protection, the following shall be applied.

For new sites, it is anticipated that raising the site level via bulk earthworks is the most likely method of flood defence. In this case, there are no specific requirements over and above National Grid's generic requirements for civil engineering works.

For existing sites, where raising the level is not feasible a permanent flood defence shall be provided.