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Tullabeg 110kV Substation Construction Methodology

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TABLE OF CONTENTS

Tullabeg 110kV Substation
Co Wexford

Construction Methodology

1 INTRODUCTION

The purpose of this document is to outline the envisaged construction techniques for a 110kV/33kV substation development which will serve a solar farm at Tullabeg, Medophall, Medophall Demense and Ballyclogh, Co. Wexford. Terra Solar II Limited are seeking a 10-year planning permission for development at Tullabeg, Camolin, Co. Wexford comprising a 110kV 4-bay C-type electricity substation (with 33kV customer compound) (including two control buildings, lightning protection, perimeter security fencing, security lighting, drainage infrastructure, temporary construction compound) to connect to and serve a proposed solar farm (under Wexford County Council Reg. Ref. 20191272); associated loop-in infrastructure to tie into an existing 110kV overhead transmission line including underground 110kV cabling and 2 No. new end masts with 110kV line diversion cabling; vehicular entrance and access track from public road; all associated site development works including formation of berms and landscaping.

The purpose of the substation and grid connection is to serve a solar farm development in the townlands of Ballyclogh, Tullabeg, Medophall and Medophall Demesne. The application for planning permission for the solar panels, support infrastructure and associated ancillary development works has been made to Wexford County Council as part of a dual consent process. The applicant for that proposed development is also Terra Solar II Limited. Notwithstanding this dual consent process, this report considers the full combined development for the purposes of completing a robust assessment of the entire project.

The proposed Tullabeg 110 kV substation is situated proximate to the existing Crane to Banoge 110kV line, which traverses the northwestern portion of the proposed solar farm development. It is proposed to break this 110kV overhead line with the construction of two new overhead line/cable interface end masts both contained within the Tullabeg site. Generally, these structures will be of similar scale and character to the existing pylon sets on other 110 kV circuits. An underground cable connection will link the new 110kV interface with the new 110kV substation. Please refer to Malachy Walsh and Partners Drawing C-5021 which accompanies this planning application for full details of the layout and arrangement of the site.

2 SUBSTATION CONSTRUCTION

The Tullabeg 110 kV / 33 kV substation is proposed in an overall site of c.99.8 hectares, spread across two land parcels. The substation itself is proposed on the larger, northern land parcel in the townland of Tullabeg. The substation will occupy an area of approximately 14,145 m². It will consist of a compound containing outdoor Air Insulated Switchgear (AIS) equipment comprising busbars, line bays, grid transformers and associated bays, house transformers, two Control Buildings and associated equipment. The size of the substation has been determined by EirGrid's design requirements. Equipment will include a Supervisory Control and Data Acquisition (SCADA) system, which will allow for off-site monitoring via a communication system.

The two 110 kV and 33 kV Control Buildings will be of block work cavity construction complete with slate tiled pitched roofs. These buildings will house both electrical switchgear and control/protection equipment. The 110kV and 33 kV substation Control Buildings are approximately 25 m x 15 m x 7.56 m high and 11.1 m x 10 m x 6.26 m high respectively.

The existing site profile is relatively flat – the contour varies from 44.75mOD to 46.25mOD, rising from the south east to the north west. Site investigations undertaken by Malachy Walsh and Partners on 9th July 2019 indicate that the subsoils in the substation location are not suitable for reuse to establish a structural base for the substation.

The site contours and the associated very modest rise suggest that a compound level of 45.5mOD should be established on site for the compounds. This reflects a very modest cut/fill requirement with fill primarily to the south east corner. The intent is to retain excavated material on site to form berms. These provide a screening benefit as well as allowing for disposal of the excavated material. It is estimated that approximately 12,000m³ of excavation will be required in the area of the substation. The volume of imported hardcore will be of the order of 14,000m³. This will be crushed rock to ESB specification.

The Control Buildings will be generally unmanned, which the exception of some infrequent operational visits for inspection, audits and maintenance. Sanitary facilities will be provided for

these visits and will comprise a single toilet and wash hand basin for very occasional use, with discharge to holding tanks that will be sized to reflect the anticipated frequency of use. These will be located outside of the fenced area to allow them to be maintained without requiring access.

Potable water supply will be from a private well which will be constructed so as to prevent contamination. Thereafter water will be tested and treated as necessary to meet the requirements of the European Communities (Quality of Water Intended for Human Consumption) (Amendment) Regulations 2000.

Drainage arising from roof surfaces within the substation and from transformer bunds will be discharged to existing site drainage following passage through an appropriate oil interceptor. A separate Drainage Report is provided as part of this planning submission. The grid transformer will be located within an impermeable bund capable of oil retention in the event of a total leakage from the transformer. The bund will have a capacity of at least 110% of the volume of oil to preclude any release of contaminants to the environment.

A permanent 2.6 m high palisade fencing is required for public safety reasons and will be provided around the substation compounds only. Its need arises from the presence within the compound of high-voltage electrical equipment to which public access must be prevented. The colour of the security fencing will be agreed with the planning authority prior to construction. There will be two access gates provided with one accessing each of the 110 kV and 33kV sides of the compound respectively. There will also be internal fences to segregate different areas.

When constructed, Tullabeg 110 kV Substation will be owned and operated by ESB Networks (ESBN).

The construction work will take place in two broad phases:

2.1 Main Construction

The project specific programme of works will be proposed and agreed with the Contractor prior to mobilisation on site. The following is a non-exhaustive list of the works to be carried out:

- Verify that all planning and environmental conditions have been satisfied
- Site entrance.
- Site establishment.
- Construction of temporary site drainage works.
- Bulk earthworks, including site levelling and entrance road construction.
- Existing OHL enabling works.
- 110 kV and 33 kV buildings, including foundations works, blockwork, precast ceilings and pitched roofs.
- Construction of transformer compounds.
- Permanent foul and surface water drainage works.
- Paving
- Fencing

- Completion works
- Landscaping

All works shall be carried out in accordance with the Building Regulations and up-to-date design codes at the time of mobilisation. A waste management plan will also be implemented to mitigate against undue impacts.

2.2 Working Areas

The average working area for construction of a 110/33 kV Substation compound will encompass the footprint of the compound plus an area of 10m outside the proposed post and rail fence. This equates to an approximated area of 18,000m^2. This area will be agreed prior to the commencement of works and will be delineated on site. For the duration of the construction phase of the substation, there will be temporary welfare facilities installed.

2.3 Construction Equipment Required

- 4x4 vehicle
- Concrete vibrator
- Water pump
- Wheeled dumper or Track dumper
- Timber or other Shuttering boxes
- 360˚ tracked excavator of varying size
- Transit van
- Delivery trucks
- Chains and other small tools
- Concrete delivered by supplier to closest convenient point
- Winch tractor
- Tractor and trailer
- Crane
- Teleporter

2.4 Duration of Substation Compound Works

The duration of the substation compound works will be detailed in full and in advance of any construction activities taken place and subject to confirmation. However, it is expected the average duration for the substation compound and building works are as follows:

• Civil works	36 weeks
• Electrical	39 weeks
TOTAL	**75 weeks**

2.5 Electrical Installation Including Transformer

A traffic management plan will be implemented for the delivery and installation of the 110 / 33 kV transformer. A waste management plan will also be implemented to mitigate against undue impacts of the electrical installation.

There will be other electrical installation works of a lesser scale to the delivery and installation of the 110 / 33 kV transformer. The following is a non-exhaustive list of these works to be carried out:

- Delivery and installation of all other HV equipment.
- Wiring and cabling of HV equipment and protection and control cabinets.
- Commissioning of all newly installed equipment.

3 OVERHEAD 110 KV CONSTRUCTION

The proposed Tullabeg substation is situated proximate to the 110kV Line. The overhead line runs in a south west to north east direction to the north west of the Tullabeg substation site. It is proposed to break this 110 kV overhead line with the construction of two new end lattice steel line/cable interface end masts approximately 20m in height (both contained on the Tullabeg site) between the existing pole sets. Generally, these structures will be of similar scale and character to the existing steel lattice masts on other 110kV circuits. The proposed Tullabeg substation will be connected to these new overhead end masts by means of an underground cable connection.

There may be a requirement to modify the existing wooden 110 kV overhead line polesets either side of the two newly proposed steel end masts. These modifications will be determined subject to confirmation and agreement with EirGrid prior to the commencement of the substation development. These works will be carried out by EirGird and the methodology in carrying this out is to be confirmed.

3.1 110 kV Overhead Line Construction

The construction techniques carried out will be in line with international best practice and full compliance with all health and safety requirements. In general, the construction phase can be broken down into the following parts:

- Verify that all planning and environmental conditions have been satisfied
- Carry out pre-construction site investigations including access review and ground conditions
  Delineation of any on-site working area (e.g., erection of temporary fencing)
- Setting out of end mast foundations and polesets
- Site preparation works including minor civil works such as removal of fences and erection of temporary fencing.
- Installation of end mast foundations

- Erection of end masts
- Stringing of conductors and commissioning

The existing 110kV line consists of double wood polesets at intermediate locations. The proposed 110kV line connection will be constructed of galvanised steel lattice masts at angle positions. This style of construction is the standard type of construction used for 110kV single circuit lines in Ireland. Typically, double wood polesets are used for all straight line structures and steel angle masts are only used where the line changes direction or terminate.

Prior to commencement of work, the contractor will prepare a detailed Construction and Environmental Plan which will include method statements and work programmes that outline more detailed phasing of the work. The Construction and Environmental Plans will detail access to structure sites, archaeological and ecological sensitive sites (if applicable) and will take account of third party requirements, mitigation measures outlined in the various sections of the Environmental Report and site investigations carried out prior to construction. It should be noted that this outline planning Construction Methodology is indicative and based on the experience in similar transmission line projects. Any issues specific to this project, for example unique planning conditions, will be incorporated fully into the appointed contractor scope of work and careful supervision and management will be carried out to ensure full compliance.

The method statements produced by the contractor will be agreed with the appropriate parties. A specialist team will be employed to monitor the construction phase of the project and ensure works are being carried out in accordance with the agreed method statement, safety procedures, pollution control etc.

3.2 Installation of End Masts

All structure locations will be checked for underground services such as cables, water pipes etc. Consultation with the landowner will help to confirm the location of these underground services. If field drains are encountered these will be diverted and all diversions identified to the landowner.

The end masts will be set out and pegged prior to foundation excavation. This may require excavation of some existing ditches or drains to allow clear pegging of each individual leg footing for excavation. All such removals are restored upon completion of foundation works. Excavations are set out specifically for the type of mast and the type of foundation required for each specific site. It should be noted that pre-construction site investigations may show that ground conditions unsuitable to the standard foundations are present. In this case a modified, special foundation will be designed. A larger footing may be required in the case of weak soils, pile foundations may be required in the case of deep low strength soils and reduced footing size foundations may be required in the case of rock being encountered at shallow depths.

The end mast stubs (lower part of mast leg) will be concreted into the ground. For each leg of the mast (4 in total) a foundation is excavated using a tracked excavator and the formation levels (depths) checked by the on-site foreman. Each of the four corners of the mast will be separately anchored below ground in a block of concrete. Any water in the excavation is pumped out prior to any concrete being poured into the foundation. Concrete trucks shall be brought as close as

possible to the excavation to pour directly into the excavation. After this, the concrete shear block or neck is formed using shuttering.

In areas of poor ground or high water table it may be necessary to use sheet piles supported by hydraulic frame(s) to prevent collapse of the sides of the excavation and also to prevent the excavation becoming too large. During any dewatering activities a standard water filtration system will be utilised to control the amount of sediment in surface water runoff.

During each pour the concrete shall be vibrated thoroughly using a vibrating poker. In the event that sheet piles have been used these are removed (pulled) at this stage. Care is taken not to damage the base members of the mast. The shear block formers are removed at this stage. The end mast foundations are backfilled one leg at a time with the excavated material. The backfill is placed and compacted in layers. All dimensions are checked following the backfilling process. If the excavated material is deemed unsuitable for backfilling, imported fill material may be used also compacted in layers. When the base construction crew leave site they shall ensure to remove all surplus materials from the site including all unused excavated fill.

Once the end mast base is completed and fully set (usually after seven days) it is ready to receive the mast body which is normally constructed in an area near the foundation site ready to be lifted and bolted into place.

The steel for the remainder of the mast is delivered to the site by lorry and various sections of the mast, depending on weight and method of construction of the mast, are pre- assembled on the ground beside the end mast before lifting into position. The end mast will be built using a suitable mobile crane.

3.3 Foundation Sizes

The average foundation size for each mast leg used on the 110kV transmission system is 4m x 4m x 3.0m.

3.4 Working Areas

The average working area for construction of a 110kV end mast will extend 10m all around the footprint of the base of the mast.

3.5 Construction Equipment Required

- 4x4 vehicle
- Concrete vibrator
- Water pump
- Wheeled dumper or Track dumper
- Timber or other Shuttering boxes

- 360˚ tracked excavator.
- Transit van
- Chains and other small tools
- Concrete delivered by supplier to closest convenient point
- Winch tractor
- Tractor and trailer
- Crane
- Teleporter

3.6 Erection of End Mast

The preferred method for constructing the steel angled transmission line end masts is using a mobile crane. The mobile crane will provide optimal construction conditions for the steel mast ensuring that the works are carried out safely. Crane size and weight will be dependent upon the properties of the masts in question with the end mast erection procedure completed in various sections due to the weight of the differing components. End mast sections will be assembled on the ground and lifted into place using the crane.

3.7 Duration of End Mast Works

The average duration of each foundation and mast installation works are as follows:

Foundation	4 weeks
Angle mast	4 weeks
TOTAL	8 weeks

4 ACCESS ROUTE

In order to access the individual substation and associated end mast sites, the contractors will be required to utilise the local public road network. From here, access to the actual site will be via private land.

The existing lands on the Tullabeg site currently serves as farming land with some small farm outhouses. The site will be accessed via an existing farmland track that meets a tertiary public road that runs to the west of the lands. This tertiary public road is accessed via the N11 national road. The existing farmland track will be widened and upgraded to cater for all traffic to and from the site. The proposed substation and solar farm shall be accessed via this new access. All construction traffic will approach the site from the west. The construction access is discussed in detail in the Traffic and Transport Assessment accompanying the planning application

5 EARTHWORKS

Soil associated with cutting a level platform for the substation compound will be relocated and formed into berms around the substation perimeter.

6 REINSTATEMENT OF LANDS

Once all works to the substation and end masts are complete, the construction areas will be restored to their original condition or better. This will be in keeping with the surrounding area. Generally, this work is carried out by a specialised agricultural contractor and is carried out in accordance with the relevant IFA agreements and in consultation with the individual landowner.

7 WASTE MANAGEMENT

All waste arising during the construction phase will be managed and disposed of in a way that ensures the provisions of the Waste Management Act 1996 and subsequent amendments and regulations and any of the relevant Local Authorities Waste Management Plans are satisfied.

A Construction Waste Management Plan will be implemented to minimise waste and ensure correct handling and disposal of construction waste streams in accordance with the *Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects, Department of the Environment, July 2009*.

8 CONSTRUCTION AND ENVIRONMENTAL PLANS

Prior to commencement of development, a detailed Construction Environment Management Plan (CEMP) shall be submitted to, and agreed in writing with, the planning authorities, following consultation with relevant statutory agencies. This plan shall incorporate the mitigation measures indicated in the Environmental Report, and any others deemed necessary, and shall provide details of intended construction practice for the proposed development, including:

a) location of the site and materials compound(s) including area(s) identified for the storage of construction refuse;

b) location of areas for construction site offices and staff facilities;

c) details of site security fencing and hoardings;

d) details of on-site car parking facilities for site workers during the course of construction;

e) details of the timing and routing of construction traffic to and from the construction site and associated directional signage, to include proposals to facilitate the delivery of abnormal loads to the site;

f) measures to obviate queuing of construction traffic on the adjoining road network;

g) measures to prevent the spillage or deposit of clay, rubble or other debris on the public road network;

h) details of appropriate mitigation measures for noise, dust and vibration, and monitoring of such levels;

i) containment of all construction-related fuel and oil within specially constructed bunds to ensure that fuel spillages are fully contained; such bunds shall be roofed to exclude rainwater;

j) disposal of construction/demolition waste and details of how it is proposed to manage excavated soil;

A record of daily checks that the works are being undertaken in accordance with the CEMP shall be available for inspection by the planning authority. Monitoring reports shall be submitted to the planning authorities and other relevant statutory bodies in accordance with the requirements of the planning authorities.

9 SUMMARY

Construction of the Tullabeg 110 / 33 kV Substation Project can be summarized as follows:

- Prior to commencement of development, a detailed Construction Environment Management Plan (CEMP) shall be submitted to, and agreed in writing with, the planning authorities, following consultation with relevant statutory agencies.

- All the substation construction activities will take place at fixed construction sites within the Tullabeg site.

- Further to recent site investigations at the proposed substation location, soil which is excavated to form the compound platforms for the substation will be reused to form landscaped berms around the substation. This will ensure that there will be no requirement to export soil from site.

- Modifications to the existing overhead line and construction of the new steel angle end masts will take place across are relatively localised area adjacent to the proposed substation.

- Works will only be carried out during normal working hours unless otherwise agreed with relevant parties.

- All planning conditions will be complied with and contractor(s) will be supervised and managed closely to ensure full compliance.