Laois – Kilkenny Reinforcement Project

Construction Methodology

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1 Introduction

The purpose of this document is to outline and explain the construction techniques which will be used on the proposed Laois–Kilkenny Reinforcement Project. This document is intended to be used as an aid to understand the implications of the project on the environment.

While this is an outline of construction methodology proposed for the Laois–Kilkenny Reinforcement Project, the impact on the environment is assessed and proposed mitigation measures are detailed in the Environmental Report accompanying the planning application.

A detailed Construction Environmental Management Plan (CEMP) will be prepared prior to commencement of the development to detail all the processes and procedures which will be undertaken as part of the construction of the proposal. This report will incorporate any requirements arising from planning conditions attached by An Bord Pleanála. Such conditions may lead to amendments to the outlined construction methodology.

2 Substation Construction

2.1 Coolnabacky 400/110kV Substation

This substation is proposed in a 6.7 hectares field in the townland of Coolnabacky near the town of Timahoe, Co. Laois. The substation installation will consist of two steel framed buildings within a 117m x 98m plan area secured by a 2.6m high palisade fence. One of the buildings will house the 400 kV switchgear (electrical equipment) whilst the other building will house the 110kV switchgear (electrical equipment). A 400kV gantry and associated line equipment will be required to divert the 400kV overhead lines into the 400kV GIS building. The support gantrys will be located outdoors behind the 400kV building. The installation also includes two 400/110kV, 500MVA transformers and two shunt reactors. These will be positioned in bunded enclosures between the two steel framed buildings. The enclosures shall be (plan area 25m x 10m each) for transformers and (plan area 14m x 10m each) for shunt reactors. Both shall be surrounded on three sides by fire walls approximately 10m high.

The 400kV indoor station (building dimensions 64m x 15.3m x 12m) will be equipped with 8 bays (2 no. lines (Moneypoint & Dunstown), 2 no. transformers, 2 shunt reactors and 2 spare bays).

The 110kV indoor station (building dimensions 50m x 11.5m x 12m) will also be equipped with 8 bays (3 no. lines (Athy, Portlaoise, Ballyragget), 2 no. transformers and 3 spare bays).

It is proposed to store excavated material on site in the form of berms. The berms volume will be approximately 11,000m^3 over a plan area of 5,000m^2.

It is proposed to store excavated material on site in the form of berms. The berms volume will be approximately 11,000m^3 over a plan area of 5,000m^2.

It is proposed that 8 separate sedimentation/attenuation ponds (average area 110m^2) will be constructed on site. A group of 4 northwest of the substation and 4 to the east of the compound. Two of these ponds will be used temporarily to treat the runoff from the berm, with the remaining 6 used to treat surface water being discharged from the compound prior to entry into the water streams.

The proposed access to the station shall be via a modification to the existing road (that currently serves a farmstead with dwelling and a disused sand/gravel quarry near the station site) in the townlands of Esker and Coolnabacky. The access road will be 1.2km (total area = 0.865Ha) from the R426 (public road) to the substation compound gates (bringing the total development area for Coolnabacky 400/110kV substation to 7.6 hectares). The modifications to the existing road shall include:

- Moving the junction (at the public road) south by 25m with 160m of new access road to be created to accommodate this new junction.
- Expansion of an existing bend to accommodate turning circles of large vehicles.
- New section of road 250m through land owner's property to accommodate large vehicles.

Detailed drawings are contained in Volume 1 Statutory Particulars submitted as part of this planning application.

The construction work will take place in two broad phases:

2.1.1 Main Construction

The exact programme of works will be proposed by the Contractor prior to mobilisation to 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.
- 400kV and 110kV GIS buildings, including foundations works, structural steelwork erection, cladding and building finishing works.
- 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. At planning stages there are no activities planned which are abnormal in the context of civil construction projects.

2.1.2 Electrical Installation Including Transformers

- Delivery and installation of two 400/110kV transformers. These are unusually large and the deliveries will be managed in accordance with regulations governing the movement of large loads. Further details in relation to these deliveries are in section Traffic section of the Environmental Report.
- 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.

For the duration of the construction phase of the substation there will be temporary welfare facilities installed. A traffic management plan will be implemented to mitigate against undue impacts. A waste management plan will also be implemented to mitigate against undue impacts.

2.2 Ballyragget 110 kV /38 kV / MV Substation

The new Ballyragget 110kV/38kV/MV substation will be constructed adjacent to the existing 38kV/MV substation in the townland of Moatpark near Ballyragget. The site area is approx. 1.5 hectares. The existing 38kV/MV Ballyragget substation will ultimately be decommissioned and replaced.

This new substation will be in a compound of 61m x 70m plan area secured by a 2.6m high palisade fence. The substation compound will contain 1 no. 31.5MVA and 1 no. 5MVA transformer positioned in transformer bunds and 1 no. 200A Arc Suspension Coil between the substation buildings. 2 no. lightning masts 14m in height will also be placed in the compound.

The 110kV electrical swtichgear equipment will be housed in a steel framed building (dimensions 50m x 11.5m by 12m high) designed for 6 no. Line Bays, 2 no. Transformer Bays, a coupler Bay and busbar.

The 38kV and MV switchgear equipment will be housed in a block built building (dimensions 24.5m x 8m by 7m high). This building will be designed for 8 no. 38kV Line Bays, 2 no. 38kV/MV Transformer Bays, 1 no. 38kV Sectionaliser Bay and 1 no. 38kV Riser Bay along with 2 no. MV Transformer Bays, 10 no. MV Line Bays, 2 no. MV House Transformer Bays, 1 no. MV Sectionaliser Bay and 1 no. MV Riser Bay.

Access to the station will be via a new access road (60m long) from an existing gate to the substation field. The existing gate will be modified by removing sections of hedgerow, chainlink fence and a section of block wall to the left and right to allow the required sightlines to be achieved.

The foul water treatment on site will be via a septic tank and percolation area. The surface water treatment on site will be via soakaway areas.

On completion and energisation of the new Ballyragget substation the existing 38kV substation will eventually be dismantled. Two of the 38kV end masts in this substation will be retained with line-cable interfacing equipment being mounted on them.

Detailed drawings are contained in Volume 1 Statutory Particulars submitted as part of this planning application.

The construction work will take place in three broad phases:

2.2.1 Main Construction

The exact programme of works will be proposed by the Contractor prior to mobilisation to 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.
- 110kV and 220kV GIS buildings, including foundations works, structural steelwork erection, cladding and building finishing works.
- 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. At planning stages there are no activities planned which are abnormal in the context of civil construction projects.

2.2.2 Electrical Installation Including Transformers

- Delivery and installation of two 110/38kV transformers. These are unusually large and the deliveries will be managed in accordance with regulations governing the movement of large loads.
- 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.

For the duration of the construction phase of the substation there will be temporary welfare facilities installed. A traffic management plan will be implemented to mitigate against undue impacts. A waste management plan will also be implemented to mitigate against undue impacts.

2.2.3 Dismantling Existing 38kV Substation

The exact programme of works will be proposed by the Contractor prior to mobilisation to site. The following is a non exhaustive list of the works to be carried out:

- Removal of electrical equipment
- Dismantling the supporting steelwork
- Removal of the control room building (4mx4mx3m)
- Removal of chain link compound fence

All works shall be carried out in accordance with the building regulations and up-to-date design codes at the time of mobilisation. At planning stages there are no activities planned which are abnormal in the context of civil construction projects.

2.3 Changes to Kilkenny 110kV Substation

The changes to the existing Kilkenny 110 kV substation consist of the installation of outdoor air insulated equipment including, circuit breaker, disconnects and instrument transformers mounted on concrete plinths.

The construction work will take place in two broad phases: (sequence to be agreed with ESB Networks/contractors prior to construction commencement)

2.3.1 Main Construction

- 110kV modification works, including AIS substation works as per drawings and structural steelwork erection.
- Extension to the busbar.
- Fencing.
- Completion works, full reinstatement of lands.

2.3.2 Electrical Installation

- 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.

A traffic management plan will be implemented to mitigate against undue impacts.

A waste management plan will be implemented to mitigate against undue impacts.

3 Overhead Line Construction

3.1 400 kV Overhead Line Construction

The connection to the proposed Coolnabacky substation from the Moneypoint – Dunstown 400kV line will be made by way of 400kV overhead line. This will be achieved by 2 new single circuit spans (280m and 295 m respectively) connecting to 1.2km of 400kV double circuit line which brings the 400kV circuits onto a support gantry in Coolnabacky 400/110kV substation.

The proposal includes 2 new 400 kV single circuit angle masts (MDC2 & MDC8) within the alignment of the existing 400kV line of heights 37.25m & 32.25m respectively; 2 new 400kV double circuit angle masts (MDC3 & MDC7) both 55.5m in height and 3 new 400kV intermediate masts (MDC4, MDC5 & MDC6) all 57.75m in height extending from the existing 400kV line to the proposed substation. One of the existing 400kV intermediate masts on the existing 400kV line and approximately 150m of the existing 400kV overhead line between the 2 connection points to the Moneypoint – Dunstown 400kV line will be removed.

The line and structure positions were selected to minimise impact on the environment by paralleling an existing transmission line and avoiding locating support structures in hedges. This line route is also the shortest possible. This 'unit' is necessary to connect the existing 400kV line into the new 400/110 kV substation.

The structures proposed can be identified using the Detail Description Schedule document (doc number: PE687-F0261-R261-018-002) to establish the correct structure drawing. All relevant structure drawings are included in the planning application.

The construction techniques carried out will be in line with international best practice and full comply 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
- Carryout 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 tower foundations
- Site preparation works including minor civil works such as removal of fences and erection of temporary fencing.
- Installation of tower foundations
- Erection of tower
- Stringing of conductors and commissioning

The proposed 400kV line will consist of galvanised steel lattice towers of varying heights at intermediate and angle locations. The construction methodology will be similar to that used on existing 400kV lines. Figure 3.1 shows the proposed intermediate towers.

Figure 3.1: 400kV double circuit intermediate towers near Moneypoint generating station Co. Clare.

The terrain is generally flat with favourable ground conditions. Access to the various structure sites will be fully agreed with the landowners and in wet areas temporary roads or bog-mats may be required in order to access sites without causing excessive damage.

Prior to commencement of work the contractor(s) will prepare a Construction and Environmental Plan which will include method statements and work programmes that show more detailed phasing of work. The appointed contractor(s) will develop a series of detailed plans for the erection of the tower and the stringing of the line. These construction and environmental plans will detail access to structure sites, archaeological and ecological sensitive sites which have been identified in the Environmental Report 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 the construction methodology given in the Environmental Reports is indicative and based on ESB/EirGrid's long experience in similar transmission line projects but does consider the particular characteristics of the receiving environment in respect of this proposed development. Any issues specific to this project, for example planning conditions attached to any approval An Bord Pleanála may decide to grant, will be incorporated fully into the appointed contractors' scopes of work and careful supervision and management will be carried out to ensure full compliance.

The Construction and Environmental Plans produced by the contractor(s) will be agreed with the appropriate authorities. ESB Networks will employ a team 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. An access officer will be appointed by the contractor to liaise with the landowners along the line route and ensure that their requirements for entry are met so far as is possible.

3.2 110kV Overhead Lines

There are three elements (or units) relating to 110 kV construction in the proposed development. The structures proposed can be identified using the Detail Description Schedule document (doc number: PE687-F0261-R261-018-002) to establish the correct structure drawing. All relevant structure drawings are included in the planning application.

3.2.1 New connection to Coolnabacky from the existing Athy - Portlaoise 110kV line

The proposed Coolnabacky substation is situated beside the Athy – Portlaoise 110kV line. It is proposed to replace intermediate polesets AP98 and AP99 with lattice steel line/cable interface masts approximately 21m in height (both these structures contained on the Coolnabacky site). These structures have a generally similar scale and character to the existing angle towers on this circuit. Short lengths of cable will connect the new line/cable interface masts AP98 (100m) and AP99 (190m) into the 110kV building within the Coolnabacky compound.

Approximately 150m of existing overhead line will be removed between AP98 and AP99.

3.2.2 Ballyragget – Coolnabacky 110kV Line

This 110kV circuit will consist of 26km of overhead line and 2 short lengths of cable at Ballyragget and Coolnabacky substations. The overhead line will consist of 143 double wood polesets with height above ground level ranging from 13.7m to 21.7m and 17 lattice steel angle masts with height above ground level ranging from 18m to 24.5m supporting three electrical conductors and two earthwires.

3.2.3 Ballyragget – Kilkenny 110kV Line Modification

This section will consist of the replacement of all the structures along the existing line with similar structures along the same alignment. The 110kV circuit will consist of 21.9km of overhead line and 2 short lengths of cable at Ballyragget and Kilkenny substations.

The overhead line will consist of 90 double woodpole structures with height above ground level ranging from 13.7m to 21.7m and 14 lattice steel angle masts with height above ground level ranging from 13m to 24.5m supporting three electrical conductors. For approximately the first 1.73km out of Ballyragget and approximately the first 1.84km out of Kilkenny the structures will support three electrical conductors and two earthwires.

3.2.4 Athy - Portlaoise 110kV Line Modification

The modification is the retrofitting of earthwire onto the existing Athy – Portlaoise 110kV line from Coolnabacky towards Athy (AP98 to AP85) for 2.32km and from Coolnabacky towards Portlaoise (AP 99 to AP105) for 1.29km.

To achieve this all structures will be replaced by similar structures except for structure AP105 which is a poleset and will be replaced with a lattice steel angle mast. The overhead line in this unit will consist of 17 double wood polesets with height above ground level ranging from 13.7m to 21.7m

and lattice steel angle masts with height above ground level ranging from 18m to 24.5m supporting three electrical conductors and two earthwires (2 of these lattice steel towers are already mentioned in section 2.2.3).

3.3 110 kV Overhead Line Construction

The construction techniques carried out will be in line with international best practice and full comply 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
- Carryout 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 tower foundations and polesets
- Site preparation works including minor civil works such as removal of fences and erection of temporary fencing.
- Installation of tower foundations
- Erection of towers and polesets
- Stringing of conductors and commissioning

The proposed 110kV line will be constructed of double wood polesets at intermediate locations and galvanised steel lattice towers at angle positions. This style of construction is the standard type of construction used for 110kV single circuit lines in Ireland. Figures 3.2 and 3.3 below show the structure types to be used on this project. Double wood polesets are used for all straight line structures, angle towers are only used where the line changes direction.

Figure 3.2: Typical Wood poleset

Figure 3.3: Typical steel angle structure

The terrain is generally undulating and access to the various structure sites will be fully agreed with the landowners and in wet areas temporary roads or bog-mats may be required in order to access sites without causing excessive damage.

Prior to commencement of work the contractor(s) will prepare a Construction and Environmental Plan which will include method statements and work programmes that show more detailed phasing of work. The appointed contractor(s) will develop a series of detailed of these plans for the erection of the tower and the stringing of the line. These Construction and Environmental Plans will detail access to structure sites, archaeological and ecological sensitive sites 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 construction methodology is indicative and based on ESB/EirGrid's long experience in similar transmission line projects. Any issues specific to this project, for example unique planning conditions, will be incorporated fully into the appointed contractors' scopes of work and careful supervision and management will be carried out to ensure full compliance.

The method statements produced by the contractor(s) will be agreed with the appropriate authorities. ESB will employ a team 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. An access officer will be appointed by the contractor to liaise with the landowners along the line route and ensure that their requirements for entry are met so far as is possible.

4 Construction and Environmental Plans

Prior to construction the contractors will be required to submit Construction and Environmental Plans for the proposal. These plans will include method statements to comply with all the mitigation measures set out in the Environmental Report and other planning application documentation. These plans will be agreed with the relevant authorities.

The specific mitigation measures for this project can be seen in the Environmental Report and other reports submitted with the planning application.

5 Access Routes

In order to access individual structure sites, the contractors will be required to utilise the local public road network in the vicinity of the line. From here, access to the actual site will have to be via private land utilising existing private track or road wherever possible.

Access routes will be fenced/barriered off to keep disturbance to a minimum.

Maximum use will be made of both existing farm entrances and also farm tracks or roads. Access to structure locations will be carefully selected to avoid impact to the surrounding area. Careful and considered local consultation will be carried out with all affected landowners such that a minimum amount of disturbance will be caused.

Figure 5.1: Temporary Stone and Aluminium Panel tracks

Machinery and vehicle access for overhead line construction is assessed prior to entry. Where peat areas are encountered access is achieved using wide tracked low ground pressure vehicles to minimise damage to ground and or combined with bog mats in sensitive areas. On occasion where very poor soft or boggy ground is encountered, a temporary access road or track may have to be constructed. Generally temporary roads are constructed using stone; however in certain sensitive situations aluminium road panels can be used. Stone road construction involves the excavation of the topsoil and storage of this to one side of the track. Geotextile reinforcement would be placed on the subsoil surface and approximately 200mm of stone placed on top and compacted to form the track. Alternatively in soft bog a stone or panel road as described above may not be appropriate and in this case timber sleepers can be used.

5.1 Construction equipment required

- 4x4 vehicle
- Wheeled dumper or Track dumper (6 to 8 tons)
- 360˚ tracked excavator (13 ton normally, 22 ton for rock breaker)
- Teleporter or other mobile aerial platform and lifting equipment.
- All terrain crane (depending on site)
- Transit van
- Chains and other small tools

- Road material delivered by supplier to closest convenient point (38 ton gross)
- Crew size: 3 workers

5.2 Duration of access route works

The duration of access road construction is typically very short with one day being the norm. For a very long road two working days maybe required.

5.3 Traffic Management

Traffic Signs Manual issued by the Department of the Environment provides details of the traffic signs which may be used on roads in Ireland, including their layout and symbols, the circumstances in which each sign may be used and rules for positioning them. Chapter 8 of the 1996 Traffic Signs Manual will be used on this project.

6 Installation of Steel Towers

6.1 Installation of 400 kV steel tower foundations

The foundations will be excavated using a rubber tyre or tracked excavator. Depending on the location a wheeled or tracked dumper may deliver the ready-mix concrete to the excavation.

Figure 6.1: Typical Excavator and dumper used in OHL foundation installation

The standard ESB foundation practice is to have four individual footings for each tower leg. The tower 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 tower and the type of foundation required for each specific site. A larger footing may be required in the case of weak soils, pile foundations may be required in the case of deep bog and reduced footing size foundations may be required in the case of rock being encountered at shallow depths (in the case of deep bog – no deep bog is expected based on the soils and geology review).

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

In areas of poor ground and high water table it may be necessary to use sheet piles supported by hydraulic frame(s) to prevent collapse of the sides and also to prevent the excavation becoming too large. In this case the requirement for a concrete pipe (which is normally used in tower foundations) is removed. During any dewatering activities a standard water filtration system will be utilised to control the amount of sediment in surface water runoff.

When each leg is excavated the formation levels (depths) are checked by the on site engineer. Once the levels have been achieved the concrete pipes (if used) are lowered into position. Once in position and all water is pumped from the excavation, concrete is poured outside the concrete ring. When this concrete has set a paving slab is set within the concrete pipe to provide a stable base on which the tower stubs will rest.

A setting template (see figure 6.2) is used to set and hold the tower stubs in position while the concrete is being poured and cured. 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. In the event of this not being possible concrete shall be transported in 6T dumpers fitted with concrete chutes.

After this concrete pour the remaining part of the foundation, the shear block or neck is shuttered. Once the shuttering is complete the concrete may be poured and the foundation completed. The tower foundations are backfilled one leg at a time usually with the material already excavated. The backfill is placed and compacted in layers.

Once the tower base is completed and fully cured it is ready to receive the tower body. When the base construction crew leave site they shall ensure to remove all surplus materials from the site including all unused excavated fill. As outlined in Environmental Report, it is not anticipated that any spoil will have to be transported off site. Use of small quantities of spoil within the farm will be under the guidance and approval of the on site ecologist. In the highly unlikely event that this does arise the material shall be disposed of to a licensed facility.

Figure 6.2: Photograph setting template being prepared for final concreting

6.1.1 Foundation Size

The average foundation size for each tower leg used on the 400kV transmission system is 5.3m x 5.3m x 3.6m for single circuit angle tower, 5.1m x 5.1m x 4m for double circuit angle tower and 3.4m x 3.4m x 2.8m for double circuit intermediate tower.

6.1.2 Working Area.

The average working area for construction of a 400 kV tower will extend 10 metres all around the footprint of the base of the tower.

6.1.3 Construction equipment required

- 4x4 vehicle
- Concrete vibrator
- Water pump
- Wheeled dumper or Track dumper (6 to 8 tons)
- Timber or other Shuttering boxes
- 360˚ tracked excavator (13 ton normally, 22 ton for rock breaker).

- Transit van
- Chains an other small tools
- Concrete delivered by supplier to closest convenient point (38 ton gross)

6.1.4 Duration of foundation works

The average duration of foundation works is as follows:

- Angle tower 6 - 10 days
- Piled foundation 10 days
- Crew size 4 to 6 workers

6.2 Erection of tower body

The Environmental Report presented and assessed the construction impacts of predominately crane construction for the 400kV line as it presents the greater potential for environmental impact and local disturbance. The most common and cost effective method of constructing a transmission line of this nature is that of “derrick pole”. Both methodologies are outlined below.

6.3 Derrick Pole Methodology

The tower can be erected using a derrick / gin pole and tractor. The derrick pole is a very simple and straight forward way to build the tower where small sections of steel are lifted into place using the derrick and a winch. As illustrated the derrick consists of either a solid or lattice aluminium or steel pole which is held in position using guy ropes anchored to the ground. This methodology is available for use if required

Figure 6.3 Derrick pole at tower base

Figure 6.4: Lower part of the tower head being dropped into position

6.3.1 Construction equipment required

- 4x4 vehicle
- Winch (see appendix 3 for details)
- Tractor and trailer
- 360˚ tracked excavator (13 ton normally)
- Derrick pole
- Teleporter
- Transit van
- Chains an other small tools

6.3.2 Duration of tower erection works

The average duration of tower building works is as follows:

- Angle tower 4 days
- Intermediate tower 3 days
- Crew size 7 workers

6.4 Mobile Crane Methodology

Mobile cranes can also be used to construct steel towers, however due to cost and access issues they are generally restricted to sites which provide optimal construction conditions. End towers in or close to the substations are good examples where use of a mobile crane can present advantages. Crane size and weight is generally dependent upon the properties of the tower in question with the tower erection procedure completed in various sections due to the weight of the differing components. Tower sections are assembled on the ground and lifted into place.

Figure 6.5: Tower erection by mobile crane

6.4.1 Construction equipment required

- 4x4 vehicle
- All terrain mobile crane
- Tractor and trailer
- Teleporter
- 360 degrees Excavator
- Transit van
- Chains an other small tools

6.4.2 Duration of tower erection works

The average duration of tower building works is as follows:

- Angle tower 4 days
- Intermediate tower 3 days
- Crew size 7 workers

6.5 Installation of 110kV steel tower foundations

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 tower 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 tower 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 bog and reduced footing size foundations may be required in the case of rock being encountered at shallow depths (in the case of deep bog – no deep bog is expected based on the soils and geology review).

The tower stubs (lower part of tower leg) will be concreted into the ground. For each leg of the tower (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 tower will be separately anchored below ground in a block of concrete as per Figure 4.1 below. 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. In the event of this not being possible concrete shall be transported in dumpers, in the event that the ground is very poor and wheel dumpers will not transport the concrete over the terrain, track dumpers may be used.

In areas of poor ground or high water table it may be necessary to use sheetpiles 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.

After this, the remaining part of the foundation, the concrete shear block or neck is formed using shuttering.

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 tower. The shear block formers are removed at this stage.

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

Figure 6.6: Photograph of steel tower base in open excavations.

6.5.1 Foundation Size

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

6.5.2 Working Area.

The average working area for construction of a 110kV tower will extend 10 metres all around the footprint of the base of the tower.

6.5.3 Construction equipment required

- 4x4 vehicle
- Concrete vibrator
- Water pump
- Wheeled dumper or Track dumper (6 to 8 tons)
- Timber or other Shuttering boxes
- 360˚ tracked excavator (13 ton normally, 22 ton for rock breaker).
- Transit van
- Chains an other small tools
- Concrete delivered by supplier to closest convenient point (38 ton gross)

6.5.4 Duration of foundation works

The average duration of foundation works is as follows:

- Angle tower 6 - 10 days
- Piled foundation 10 days
- Crew size 4 to 6 workers

6.6 Erection of tower body

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

6.6.1 Construction equipment required

- 4x4 vehicle
- Winch Tractor/Pole erector
- Tractor and trailer
- Crane
- Teleporter
- Transit van
- Chains an other small tools

6.6.2 Duration of tower erection works

The average duration of tower building works is as follows:

- Angle tower 4 days
- Crew size 7 workers

6.7 Replacing Existing Angle Masts

It is intended to replace most of the existing angle masts on the Ballyragget – Kilkenny and the Athy – Portlaoise 110 kV lines. In all except one case these angle masts will be constructed the site of the existing angle mast in the same manner as described above. Prior to construction the existing angle mast will be dismantled and removed, then the foundations removed and disposed of to a licensed facility.

7 Installation of Polesets

7.1 Delivery of material to site

The required poles will be collected from the storage yard and delivered as close as possible to the required location.

7.2 Pole base excavation and pole erection

- The excavation for each pole will be carried out using a wheeled or tracked excavator.
- Each of the two poles are lined up with the excavated holes and the machine operator then drives forward pushing the pole up until the pole is in an almost vertical position. The pole never passes through the point of balance in the vertical position.
- The pole is supported at all times and the holes manually backfilled to a minimum depth of 1.0m.
- After excavation and erection of the poleset a further excavation 0.8m deep is necessary. This is a linear excavation perpendicular to the line necessary to install wooden sleepers. These sleepers add additional stability to the poleset and are attached to the poleset using a u-bolt.
- The two installed poles are connected near the top by a steel crossarm from which three insulators are attached. The conductor is then attached to these insulators during the stringing process.
- As much of this overhead line is designed as an earthwire line an earthgird is required on all polesets. This earthgrid is a section of earth conductor forming a loop underground around the installed poleset. It is connected to the shieldwire on the pole top by another section of earth conductor running along the length of the pole.
- In poor ground conditions staywires may be required at some poleset locations. These wires add stability to the pole and are supported by means of stayblocks. These stayblocks are made of concrete and are buried underground.

7.2.1 Working Area.

The average working area for construction of a 110kV poleset will extend 10 metres all around the footprint of the base of the poleset.

7.3 Construction equipment required

- 360˚ tracked excavator
- Winch Tractor/Pole erector
- Transit van
- Chains and other small tools

7.4 Duration of poleset installation works

The average duration of poleset installation works is as follows:

- Per poleset 1/2 days
- Crew size 3 workers

7.5 Replacing Existing Polesets

It is intended to replace all of the existing polesets on the Ballyragget – Kilkenny and some on the Athy – Portlaoise 110 kV lines. In most cases these polesets will be constructed next to the existing structure in the same manner as described above. Figures 7.1, 7.2 & 7.3 gives a graphic detail of 110kV poleset replacement. The waste poles will be disposed of by a licensed contractor.

Figures 7.1, 7.2 & 7.3: Details of 110 kV poleset replacement.

8 Stringing of conductors

Stringing of overhead lines refers to the installation of phase conductions and shieldwires on the supporting poleset or tower structures. The conductor is kept clear of all obstacles along the straight by applying sufficient tension. This method requires the pulling of a light pilot line (nylon rope) which is normally carried by hand into the stringing wheels. This in turn is used to pull a heavier pilot line (Steel rope) which is subsequently used to pull in the conductors from the drum stands using specifically designed “puller – tensioner” machines, see photograph below. The main advantages with this method are (a) the conductor is protected from surface damage and (b) major obstacles such as road and rail crossings can be completed without the need for major disruption.

Figure 7.1: Puller – Tensioner machine

Once the conductor has been pulled into position, one end of the straight is terminated on the appropriate tension fittings and insulator assemblies. The free end of the straight is then placed in temporary clamps called “come-alongs” which take the conductor tension. The conductor is then cut from the puller-tensioner and the conductor is sagged using a chain hoist.

Figure 7.2: Typical stringing equipment

8.1 Construction equipment required

- 4x4 vehicles
- Puller - tensioner X 2 (see appendix 4 for details)
- Teleporter X 2
- Drum stands X 2
- Drum carriers X 2
- Stringing wheels
- Conductor drums
- Compressor & head
- Transit vans
- Chains an other small tools

8.2 Duration of stringing works

The average duration of stringing works is typically 1 week per straight. This figure is approximately the same for all straights regardless of length as the most time consuming aspect is the movement and setup of stringing equipment. Stringing crews are typically quite large and could have as many as 15 workers.

9 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. 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.*

10 Reinstatement of land

Once all works are complete, the access route and the construction areas around the over head line structures are restored to their original condition or better. Generally this work is carried out by a specialised agricultural contractor and is carried in accordance with the relevant IFA agreements and in consultation with the individual landowner.

A landscape proposal for the Ballyragget and Coolnabacky forms part of the planning application which will be implemented towards the end of the construction phase.

11 Commercial Forestry and Hedging

11.1 Commercial Forestry

The normal corridor widths centred on the line to be left clear of trees for the various line voltages are as follows:

- 10kV, 20kV and 38 kV: 20 metres
- 110kV: 2 x max tree height + 9 metres
- 400kV: 2 x max tree height + 22 metres

All trees must be outside their falling distances from overhead line support structures, 26m is usually taken as the maximum tree height.

11.2 Hedges

Hedges need to be kept under control under powerlines. All trees must be outside their falling distance from any part of any overhead line support.

12 Construction Environment Management Plan

Prior to commencement of development, a 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) alternative arrangements to be put in place for pedestrians and vehicles in the case of the closure of any public road during the course of site development works,

(i) details of appropriate mitigation measures for noise, dust and vibration, and monitoring of such levels,

(j) 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,

(k) disposal of construction/demolition waste and details of how it is proposed to manage excavated soil,

(l) a water and sediment management plan, providing for means to ensure that surface water run-off is controlled such that no silt or other pollutants enter local water courses or drains,

(m) details of a water quality monitoring and sampling plan.

(n) If peat is encountered - a peat storage, handling and reinstatement management plan.

Monitoring of the construction phase shall be carried out by an environmental engineer and an ecologist each of whom shall be appropriately qualified and experienced, to ensure that all mitigation measures contained in the CEMP are implemented.

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.

13 Summary

Construction of the Laois – Kilkenny Reinforcement Project can be summarised as follows:

- Prior to commencement of development, a 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. For Coolnabacky and Ballyragget the works will be large scale construction works whilst the scale at Kilkenny substation will be lower.
- Overhead line construction will take place across relatively long linear sites.
- Overhead line construction is low density in terms of traffic and intensity at both farm and local level.
- Overhead line construction uses small scale machinery – farm equipment would be very comparable in terms of size and scale.
- Work on the overhead lines will only be carried out during normal working hours.
- All planning conditions will be complied with and contractor(s) will be supervised and managed closely to ensure full compliance.
- Any temporary access roads required will be done under guidance of environmental experts and will be removed upon completion of works.
- Suitable mats to be used in wetland and/or sensitive habitats.