Capital Project 966

Substation Feasibility Assessment - Dunstown 220kV C-Type Extension

321084AE-REP-005 | B

27 April 2020

EirGrid

CP966

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Executive Summary

Jacobs was requested to prepare a set of substation feasibility reports for the EirGrid CP966 project, which is a proposed development that will help transfer electricity to the east of the country and distribute it within the network in Meath, Kildare and Dublin. The project will help meet the growing demand for electricity in the east. This growth is due to increased economic activity and the planned connection of new data centres in the region. The project will therefore require substation modifications at Dunstown and Woodland to accommodate these system upgrades.

The report content and format are suitable to support EirGrid's network development process, in step 3. substation modification to be investigated by Jacobs are as follows:

- Woodland 220kV AIS C-Type Extension
- Woodland 220kV Connection
- Woodland 400kV Connection
- Woodland 400kV Ring configuration
- Dunstown 220kV AIS C-Type Extension
- Dunstown 220kV Connection
- Dunstown 400kV Connection

Specialists were sent, during the month of November 2019, to visit each of the substation sites to investigate the current infrastructure and what would be needed for the proposed substation connections and modifications. Further to this, sets of drawings have been produced for the reports to give an indicative view of how each of the above substation modifications will look and have been referenced throughout all the reports.

This technical report examines the option for Dunstown 220kV C-type extension and highlights these findings by describing technical, environmental, deliverability, and economic factors. Throughout each of the reports, the design methodology and construction approach, and their costs have been detailed.

Whilst the EirGrid 220kV C-type extension at Dunstown substation is technically feasible, due to the constraint posed by the oversailing conductor hazard from the Maynooth 2 overhead line, this would potentially impose technical limitations on the future constructability and deliverability of the feeder bays that would utilise this C-type extension. Issues associated with this need further investigation, although it is presently considered that diversion or undergrounding of this oversailing conductor hazard associated with the Maynooth 2 circuit would be required in the future.

No major planning works involving land acquisition are anticipated to be required. Project timeline and cost implications should be considered for these works as both will increase due to substation boundary extension requirements.

1. Introduction

1.1 What is Capital Project 966?

Capital Project 966 is a proposed development that will help transfer electricity to the east of the country and distribute it within the network in Meath, Kildare and Dublin.

The project will help meet the growing demand for electricity in the east. This growth is due to increased economic activity and the planned connection of new data centres in the region.

A significant number of Ireland's electricity generators are located in the south and south west. This is where many wind farms and some modern, conventional generators are located. This power needs to be transported to where it is needed.

The power is mainly transported cross-country on the two existing 400 kV lines from the Moneypoint station in Clare to the Dunstown substation in Kildare and Woodland substation in Meath. Transporting large amounts of electricity on these 400 kV lines could cause problems that would affect the security of electricity supply throughout Ireland, particularly if one of the lines is lost unexpectedly.

To solve this emerging issue, we need to strengthen the electricity network between Dunstown and Woodland to avoid capacity and voltage problems.

Capital Project 966 aims to strengthen the transmission network between Dunstown and Woodland substations. and suggests a number of technical solutions to do so.

1.2 Framework for grid development explained

EirGrid follow a six-step approach when they develop and implement the best performing solution option to any identified transmission network problem. This six-step approach is described in the document 'Have Your Say' published on EirGrid's website [1]. The six steps are shown on a high-level in Figure 1. Each step has a distinct purpose with defined deliverables and represents a lifecycle of a development from conception through to implementation and energisation.

[1] http://www.eirgridgroup.com/the-grid/have-your-say/

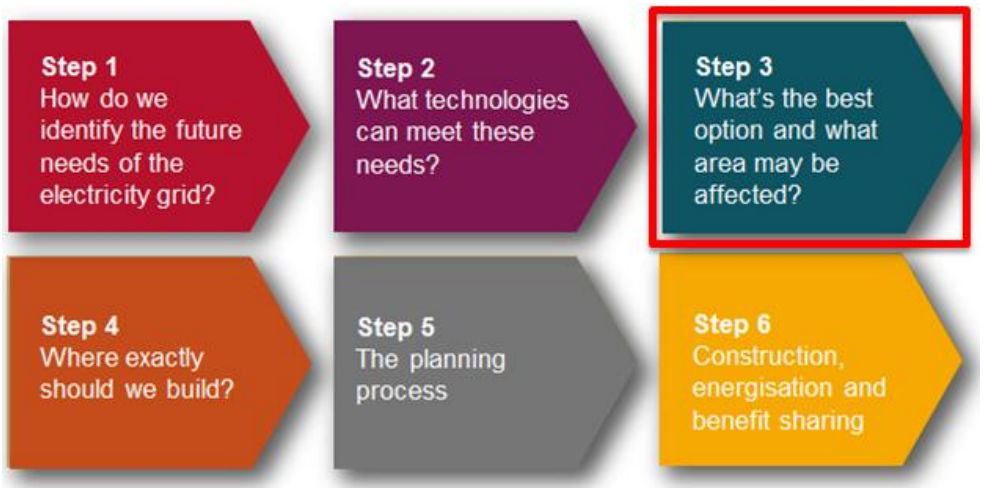

Figure 1 : EirGrid's Six-Step Framework for Grid Development

Capital Project 966 is in Step 3 of the above process. The aim of Step 3 is to identify a best performing solution option to the need identified. There are four remaining technical viable options to be investigated in Step 3. All options create a connection between Woodland and Dunstown substations and have common reinforcements associated in relation to voltage support devices and 110 kV uprates. The main four options are:

- Up-voltage existing 220 kV circuits to 400 kV to create new Dunstown – Woodland 400 kV overhead line (OHL);
- A new 400 kV overhead line;
- A new 220 kV underground cable,
- A new 400 kV underground cable.

Common reinforcements to all four options (outcome of Step 2, may change in Step 3):

- Uprating of the Bracklone – Portlaoise 110 kV overhead line
- Dynamic reactive support device in greater Dublin area rated at approximately ±250 Mvar

These options will be evaluated against five criteria: technical, economic, environmental, deliverability and socio-economic and each criteria incorporates a number of sub-criteria. It shall be noted that the overall assessment is carried out by EirGrid, but certain aspects are investigated and assessed by various consultants and their assessment will feed into the overall assessment.

1.3 Aim and context of this report

EirGrid (the Client) has engaged Jacobs to assess the required substation modifications at Woodland and Dunstown to accommodate these network changes specified by EirGrid. This report is aimed at presenting the findings of this investigation in regard to a 220kV AIS C-Type extension at Dunstown Substation. The findings will feed into EirGrid's overall evaluation of the four remaining options.

1.4 Description of criteria used to assess the options

This report uses the following criteria to assess each substation option:

- Technical

As part of technical feasibility assessment, substation layouts were developed in accordance with relevant EirGrid design standards to indicate a proposed solution. Constructability and health and safety implications for operation and maintenance activities through the achievement of appropriate electrical clearances have been considered.

- Environmental

As part of environmental feasibility, only the impact arising from any extension to the existing substation boundary has been identified and examined. For a broader environmental assessment, please refer to report 321084AE-REP-002 – CP966 Environmental Feasibility Report.

- Deliverability

As part of deliverability assessment, existing access roadways and operational/maintenance assessments were made to ensure that the solution can be safely constructed, maintained and operated.

- Economic

An approximate bill of quantities and cost estimate has been produced for each option.

- Socio-economic

As part of the social feasibility, a socio-economic assessment has been included as part of this report for the substation works only. For a broader social impact assessment, please refer to the report 321084AE-REP-003 – CP966 Social Impact Assessment Report.

1.5 Scale used to assess each criteria

The effect on each criteria parameter is presented along a range from “more significant”/”more difficult”/“more risk” to “less significant”/”less difficult”/“less risk”. The following scale is used to illustrate each criteria parameter:

In the text this scale is quantified by text for example mid-level/moderate (Dark Green), low-moderate (Green), low (Cream), high-moderate (Blue) or high (Dark Blue).

1.6 Relationship to other technical documents

Parallel to this report, Cable Feasibility, Environmental and Social Impact studies are being prepared to investigate the impact of proposed solutions on the study area.

Please read in conjunction with the following reports;

- 321084AE-REP-001 – CP966 Cable Route Feasibility Report
- 321084AE-REP-002 – CP966 Environmental Feasibility Report
- 321084AE-REP-003 – CP966 Social Impact Report

2. The Project

2.1 Site Description

Dunstown 400/220kV AIS substation is an existing substation located in County Kildare and is surrounded by farmland and is in a rural area. Aerial views of the area and substation are shown in Figure 2 and Figure 3 respectively. Further to this, Figure 4 shows the extent of land ownership held by the Transmission Asset Owner (TAO).

The substation presently contains both 400kV and 220kV equipment in a double busbar arrangement with 2 x 400/220kV transformer bays, 5 x 220kV line bays and 1 x 400kV line bay.

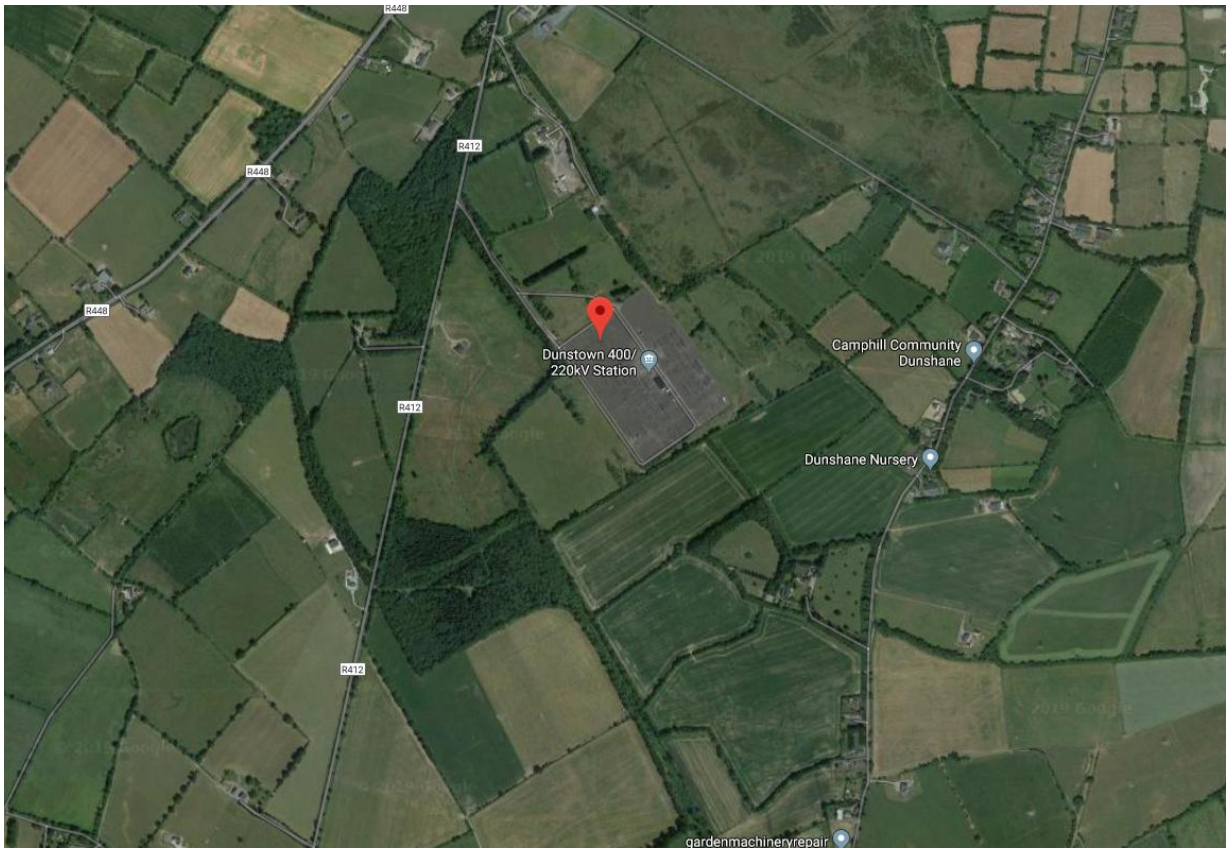

Figure 2 : Aerial View of Dunstown Substation (From Google Earth)

Figure 3 : Location of 220kV extension (From Google Earth)

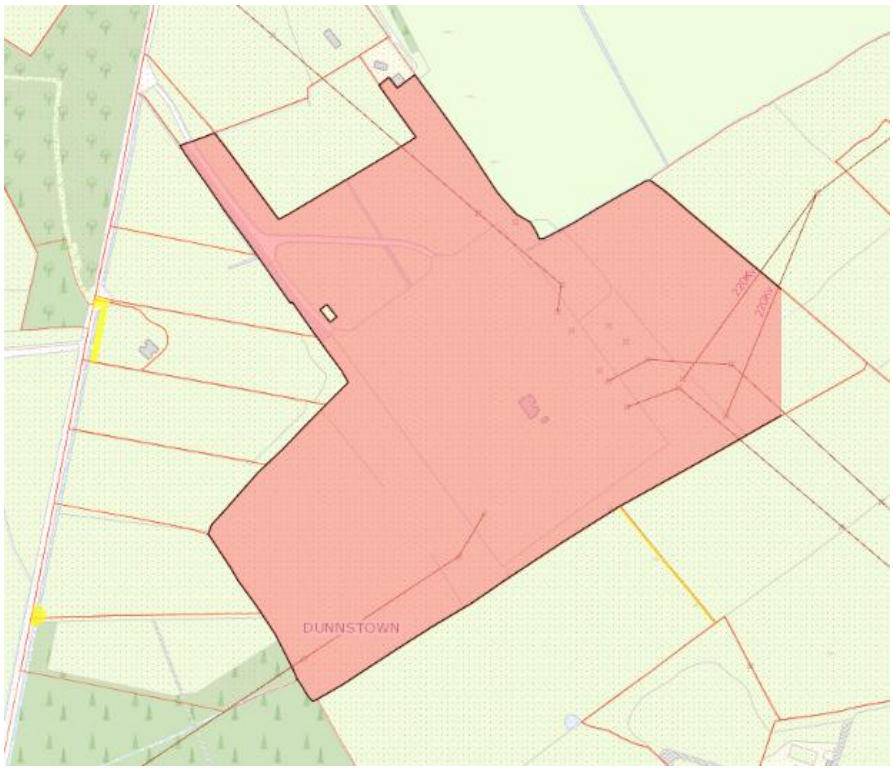

Figure 4: Extend of Land Ownership Boundary

2.2 Objective

This report will provide a feasibility assessment of the works required to extend the 220kV side of the substation with a C-type arrangement.

2.3 Technical

2.3.1 Project Requirements

The 220kV C-type extension utilises standard substation design parameters in determining the scope and extent of the substation extension works. These standard parameters ensure a safe and effective design. The extension is based on the EirGrid drawing PG406-D020-123-00, which includes 1 bus section, space for 4 future feeder bays and 1 bus coupler. For the purposes of this report, one spare bay has also been added to the existing bus section to complete a 4-bay section in accordance with EirGrids requirements. The drawing 321084AE-LAY-003 in Appendix A shows the proposed arrangement.

Refer to Figure 5 for a single line diagram schematic representation of the proposed extension works to the existing substation. Existing substation is indicated in black, new works are indicated in red and future feeder bays in blue.

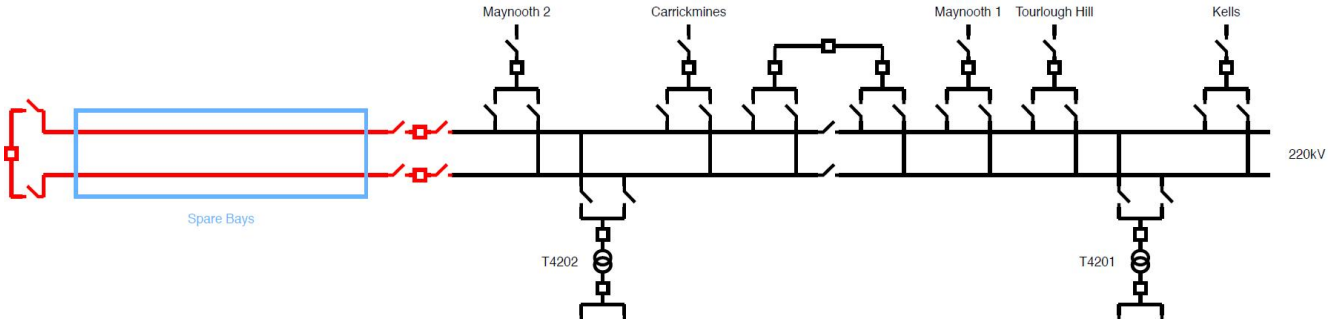

Figure 5 : Dunstown 220kV C-Type Extension

It is noted that the existing Maynooth 2 overhead line circuit angles back across the substation, and that the proposed works to accommodate the new C-type extension will come close to an existing overhead line tower that presently sits outside the substation. Redirecting the extension and access road could be done to avoid this however, at worst case, it could potentially require the relocation of this overhead line tower to enable the substation extension works.

Whilst this may not affect the technical viability of the C-type extension itself, it would potentially impact any future feeder bays connecting to this extension with the presence of this overhead line representing a major oversailing conductor hazard to both the construction works and the operation/maintenance of any future feeder bays (see drawing 321084AE-LAY-003).

This oversailing conductor hazard is unacceptable for future feeder bay works and it is expected this would require removal of this hazard for health and safety reasons either by diversion or undergrounding of the Maynooth 2 overhead line in this area or undergrounding of the future feeder bay entry arrangements. This factor does not affect the extension works and is outside the scope of this report therefore, will not be covered in any of the feasibility ratings.

2.3.2 Other requirements

Although associated work with the new 220kV C-type extension includes investigating and allocating space for new protection panels in the existing control building and an assessment of the existing LVAC and DC systems to confirm adequate capacity, these elements have not been considered at this stage as they would have no material impact on the physical extent of the construction works required.

2.3.3 Technical Feasibility

As per Section 1.5, the following scale is used to assess the technical feasibility of the new 220kV C-type extension. In respect of the C-type extension itself, which is the main subject of this report, the only technical challenge is in relation to the positioning of the Maynooth 2 overhead line tower that sits in proximity to the extension works. It is currently anticipated that the site extension can be configured to avoid this tower, although in the worst case a diversion of this overhead line to facilitate the C-type extension may be required (although this in itself would follow standard design & construction approaches). Hence the works will be undertaken in accordance with EirGrid standards and a low to moderate risk rating (light green) has been assigned.

The oversailing conductor hazard issues associated with the Maynooth 2 circuit and the impact this may have on any future line entry arrangements to the C-type extension has not been specifically assessed as part of this report, although it is noted that the mitigation measures that may be required in the future are generally of a standard technical nature and do not in themselves represent an insurmountable technical issue.

More significant/difficult/risk Less significant/difficult/risk

2.4 Site Modifications

The following site modifications will be required to accommodate the new extension as per drawing 321084AE-LAY-003 in Appendix A.

- Extend the substation perimeter fence on the north west side by approximately 36 meters.
- Existing palisade fence will need to be removed and new palisade fencing to be installed to accommodate the larger substation perimeter, along with associated civil earthworks to provide a flat and level platform for the extended substation.
- Extension of the existing access roadway required.

Figure 3 shows the location of proposed site extension work and Figure 4 shows the extent of the land ownership boundary of the substation. From this, the new 220kV C-type extension would be well within the land ownership boundary of the substation on the north east side.

The C-type extension does however interact with a ditch (potential watercourse) and vegetation which is discussed in 2.5.2. Further to this, extension on the other side of the substation (south-east) is not considered an alternative option for this extension due to crossing the TAO land ownership boundary and environmental effect on vegetation and water source.

2.5 Environmental Constraints

2.5.1 Biodiversity, Flora & Fauna

There are no designated sites in the vicinity of Dunstown substation, however an extension to the substation footprint to facilitate works would have potential temporary and definite permanent impacts on some aspects of biodiversity.

Potential impacts during construction include:

- Temporary loss of terrestrial habitat within the footprint of the Project to facilitate access roads and construction compounds;

- Disturbance, and temporary displacement of birds, mammals, amphibians, fish and other aquatic species in habitats within or in close proximity to the Project footprint;
- Impacts on aquatic species in local watercourse as a result of silty water runoff and other contaminants from the construction site; and
- Temporary loss of foraging habitat for mammals such as badger and bat.

It will be necessary to remove a section of hedgerow to facilitate the extension and there will be a loss of grassland habitat. These will be permanent effects. However, the length of hedgerow and area of grassland affected are small and so the overall impact during operation would be Moderate. Construction effects would be lower in magnitude and temporary and so less significant.

2.5.2 Soils and Water Impacts

The subsoils around Dunstown substation are varied including Marl Shell to the east and carboniferous limestone till surrounding the remainder of the site. There is also a large area of lake sediments to the west. There is one geological heritage site within 2.5km; Liffey_050, although it is outside the Substation Study Area boundary.

A field ditch runs along the north eastern boundary of the field into which the extension is proposed. Over a distance of approximately 2km, this connects into the Liffey_050. At this section, the water body is of moderate status. Dunstown substation is within the Good status Curragh Gravels East groundwater body. Groundwater vulnerability in the area is High.

The drainage ditch could potentially be affected by construction works. This would be as a result of silty water runoff from stripped surfaces or spillages of substances such as oil, in the absence of mitigation. However, there are no proposals to affect the ditch directly and there is scope for the extension to maintain a standoff of at least 5m, thereby reducing the likelihood of deleterious substances entering the ditch. There could be an increase in flows of surface water to the ditch as a result of increased hard standing, however it is anticipated that the site would be largely gravel and so permeable.

No effects on groundwater are anticipated during construction or operation.

As a result, the effects on soil and water from the proposed extension are expected to be low.

2.5.3 Impact on Land Use (forestry, farmland, bogs/peats, horticulture, roads)

The lands immediately surrounding Dunstown are predominantly agricultural pastures with an area of arable agricultural land to the south, woodland scrub to the west and natural grasslands to the north east. There is no forestry or peat/bogs present. The Regional R412 road is about 250m to the west of the site running north to south.

The proposed extension would be entirely within ESB owned land. As a result, there would be no effect on land use.

2.5.4 Landscape & Visual

The substation is within the Eastern Transition LCA which is a medium sensitivity LCA and is highly compatible with major powerlines infrastructure. There are no protected views or prospects within 2km of the Dunstown substation. There is a residential property in close proximity to the substation, which would have views of additional infrastructure as there is an absence of screening on part of the land boundary to the north of the substation. No other residential properties would have views of the proposed works, however as it is set alongside the existing substation, back from the local road network and otherwise well screened by trees and hedgerows in along local and access roads. Given the existing substation is in the current views of the nearest property, it is anticipated that there would be a low significance of impact. This would be the only impact on landscape and views from this extension. The overall assessment would be low.

2.5.5 Cultural Heritage

There are six small, roughly rectangular earthworks classified by NMS on or close to the existing substation site to the south and immediate south west of the site; there are three enclosures noted by NMS in the field to the south west of the substation; and there are further six enclosures noted by NMS, three of which are on the access road to the substation and the other three are in the field adjacent to the access from the public highway. There is none within the field proposed for the extension. There is one NIAH site, Dunstown Cottage, which is approximately 600m from the proposed extension site. There may also be a risk of unrecorded or undiscovered heritage assets, including unknown archaeology, within this area.

Whilst there is potential for archaeological assets in the area of the proposed extension this is considered to be unlikely. There is no potential for other direct effects on heritage assets. The effects would be neutral.

2.5.6 Assessment of Substation Extension at Dunstown

More significant/difficult/risk Less significant/difficult/risk

Table 2.1 Constraints Risk Assessment for Substation Extension at Dunstown Substation

Constraint	Risk
Biodiversity	
Soil & Water	
Land Use	
Landscape & Visual	
Cultural Heritage	
Environmental Summary	

Two topics are of low risk and two of neutral risk; only biodiversity effects would be a moderate risk. However these are not high enough to affect the overall environmental assessment of the proposed extension, which is considered to be low risk.

2.6 Social Constraints

2.6.1 Amenity

The substation lies within a small area (SA2017-087018005). This has a small population of 360 people; almost all of whom live in a house or bungalow. The majority of people consider their health to be Good or Very Good.

In terms of amenity effects, these occur when there are two or more significant 'nuisance' effects on communities. These nuisance effects are generally taken to be visual impacts, traffic, noise and air quality. They are most likely to combine to create an amenity effect during the construction phase of any project.

The substation is largely distant from local properties and set back from the main road; as a result, there are unlikely to be amenity effects during construction. It is possible there would be amenity effects on the property close to the substation, north of the proposed extension site but these effects would be low.

During operation, there would be no traffic or air quality issues associated with the new equipment. There may be noise issues from the equipment but as the equipment would be more than 200m from the nearest residential property, it is unlikely to present a significant impact.

In operation, the main issues associated with the proposed works would be visual impacts, however this would be limited as there is an existing substation and any new infrastructure would be alongside it, and at a distance from local properties and roads. As is stated in Section 2.5.4 the visual impacts would be of low significance.

As such, the impacts on amenity are considered to be low.

2.6.2 Economy

The majority of people in the area are in employment, students, looking after a home or family or retired. The percentage of people unemployed is very low. Industry in the area is largely Commerce or Professional Services. It is not likely there would be a significant benefit from construction work or local expenditure as a result of this project. During operation there would be no significant effects on land use or existing commercial premises; no significant effects on local industry and commerce are expected.

The lands immediately surrounding Dunstown are predominantly agricultural pastures with an area of arable agricultural land to the south, woodland scrub to the west and natural grasslands to the north east. There is no forestry or peat/bogs present. There would be no significant effect on land use, as stated in Section 2.5.3, therefore there would be no significant effect on the local economy as a result of changes to land use.

There are no tourist sites nearby and the local roads are not likely to be used by tourists en route to attractions as there are none near the substation.

As such the impacts on economy are likely to be neutral.

2.6.3 Traffic & transport

The Regional R412 road is about 250m to the west of the site running north to south. The majority of people in the area travel to school or work by car and take less than 45 minutes to get to school or work, indicating relatively local schools and places of employment. The substation is accessed from the R412 via a bespoke access track. This means that construction traffic delivering materials and workers to the site for the proposed works are unlikely to have a significant effect on local road users.

As such the effects on traffic and transport are expected to be neutral.

2.6.4 Utilities

There are unlikely to be any significant issues relating to utilities within the footprint of the substation, aside from managing the existing substation layout. The land in which the proposed extension would be constructed is already owned by ESB and so it is expected that any third party utilities in this area would be already known.

As such the effects on utilities are expected to be neutral.

2.6.5 Assessment of Social Impacts

More significant/difficult/risk Less significant/difficult/risk

Table 2.2 Constraints Risk Assessment for Substation Extension at Dunstown Substation

Constraint	Risk
Amenity & Health	
Economy	
Traffic & Transport	
Utilities	
Social Summary	

The proposed extension is unlikely to generate social impacts; the location of the extension to the front of the existing substation does present some amenity effects for the nearest residential property, during construction and operation but these are expected to be low. They could also be mitigated by extending the hedgerow and creating screening of the extension and the substation.

2.7 Deliverability

2.7.1 Construction

No significant issues are identified for the deliverability of the new 220kV C-type section as the works are in accordance with standard substation construction parameters. New earthworks would be required for extending beyond the existing substation perimeter. New foundations and cable troughs will also be required for the new 220kV C-type section. The substation earthing grid will need to be extended as per the new substation boundary.

Construction of the perimeter fence extension may potentially be undertaken in proximity to the Maynooth 2 overhead line and tower as mentioned previously in the technical feasibility assessment (Section 2.3.3), although this is not anticipated to have a significant impact on this element of the construction works.

2.7.2 Outage requirements

Majority of the construction and earthworks for the new 220kV C-type extension can be done as an offline build without the need for outages. Single busbar outages will be required during final busbar connections and commissioning works.

The diversion of the Maynooth 2 overhead line if required to address the oversailing conductor hazard issues would also require outages on this circuit, although the duration of these would be dependent on the diversion solution chosen which has not currently been assessed. Whilst any line outage would need to be planned in advance, it is not currently anticipated that this should be a significant constraint within the timescales of the project.

2.7.3 Deliverability Feasibility

As per Section 1.5, the following scale is used to assess the deliverability of the new 220kV C-type extension. The potential need for a diversion of the Maynooth 2 circuit would add to the complexity of the project, although it is not presently anticipated that this would be required as part of the C-type extension works. There are no other deliverability challenges for this extension work and no complex/extended outages required and the build will be done to EirGrid standards therefore, the extension has been given a low to moderate risk rating (Light Green).

More significant/difficult/risk Less significant/difficult/risk

2.8 Economic

2.6.1 Cost Estimate

The following assumptions have been made for the cost feasibility assessment:

- The cost has been developed based on standard equipment configuration using information from the Transmission Asset Owner (TAO) and includes electrical plant items/works and associated civils costs.
- The works associated with planning and extension of the substation perimeter fence and substation grounds have not been included nor have any costs associated with the potential modification of the Maynooth 2 overhead line to avoid oversailing conductor issues.
- This assessment has been made using the information currently available and therefore indictive at this stage. A complete feasibility assessment using EirGrids scale has not been carried out.
- There are outstanding stages to this extension and therefore costs outstanding meaning this should not be taken as end results for this extension option.

Item No.	TAO Cost Ref.	Item Description	TAO Rate Gross €	Quantity	Gross Cost Estimate Amount €
1	S220-29	New 220 AIS Coupler/Wing Coupler in existing 220kV AIS Double Busbar Station / "C-Type" Station	€ 1,700,000	1	€ 1,700,000
2	S220-22	New 220kV AIS Double/Twin Sectionaliser Bay excluding Disconnects in existing 220kV Enhanced "C-type/Ring" Type Outdoor Station inc CB (Strung/Tubular Busbar)	€ 1,970,000	1	€ 1,970,000
3	NSS-10	Incremental Bay 220kV AIS	€ 90,000	5	€ 450,000
TOTAL					€ 4,120,000

3. Conclusion

Whilst the EirGrid 220kV C-type extension at Dunstown substation is technically feasible, due to the constraint posed by the oversailing conductor hazard from the Maynooth 2 overhead line, this would potentially impose technical limitations on the future constructability and deliverability of the feeder bays that would utilise this C-type extension. Issues associated with this need further investigation, although it is presently considered that diversion or undergrounding of this oversailing conductor hazard associated with the Maynooth 2 circuit would be required in the future.

No major planning works involving land acquisition are anticipated to be required. Project timeline and cost implications should be considered for these works as both will increase due to substation boundary extension requirements.

Assessment Criteria	Scale
Technical Feasibility	
Environmental Feasibility	
Social Feasibility	
Deliverability	
Combined Feasibility	

Appendix A. Drawings

321084AE-LAY-003 - Dunstown 220kV C-Type Extension RevB