Options Report
Part B
Capital Project CP1021

January 2021

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2 Introduction

EirGrid follow a six step approach when we 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] and is known as the framework for developing the grid. The six steps are shown on a high-level in Figure 1. Each step has a distinct purpose with defined deliverables.

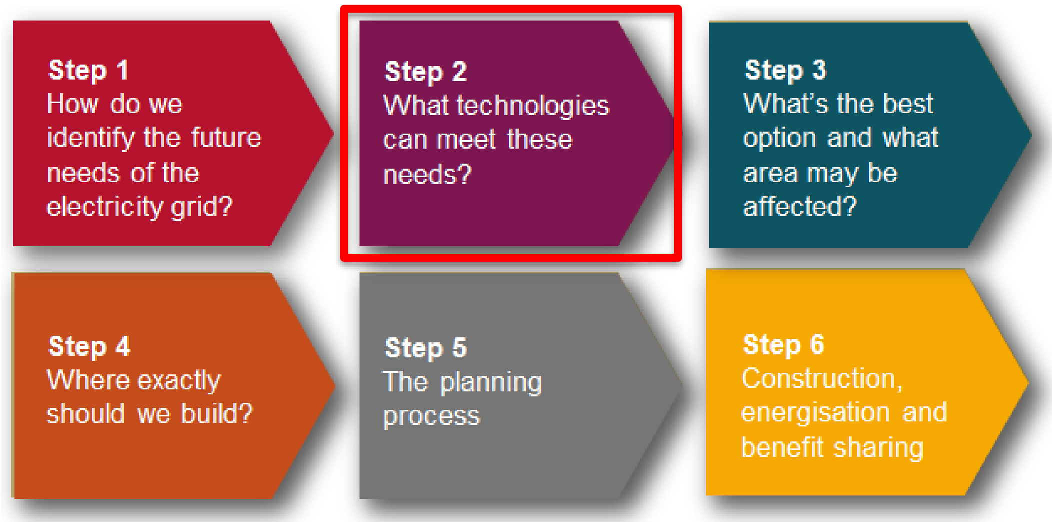

Figure 1 *High Level Project Development Process*

The transmission network problem was identified and described in previous Step 1 and was documented in the Need Report.

The need, in this case, involves a transmission network problem relating to the transfer of power across the existing 220 kV transmission network from the Woodland 400 kV substation to the north Dublin area. The issues encountered involve the capacity of the transmission system in the area.

In Step 2 there are two reports to be delivered, namely Options Report Part A and Options Report Part B. The Options Report Part A, covers the aspects that will be considered when creating the long list of options and the first refinement of this list. The outcome of the second part of refinement of the list is presented in Options Report Part B (this document).

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

3 Process followed and criteria

3.1 Description of process

The transmission network problem was identified and described in previous Step 1 and documented in the Need Report. Following on from Step 1, the process of identifying viable technology solution options starts. This involves a rigorous process spanning over two steps namely, Step 2 and Step 3. The outcome of Step 2 is a list of best performing solution options which will be taken to Step 3 for further investigation and evaluation. At the end of Step 3 we will have a best performing solution option which will be developed for construction and energisation. This report details the outcome of the second part of the refinement of the long list in Step 2.

Figure 2 provides an overview of the process and different tasks in Step 2. The first three tasks were covered in Options Report Part A. The outcome of these three first tasks was a refined long list.

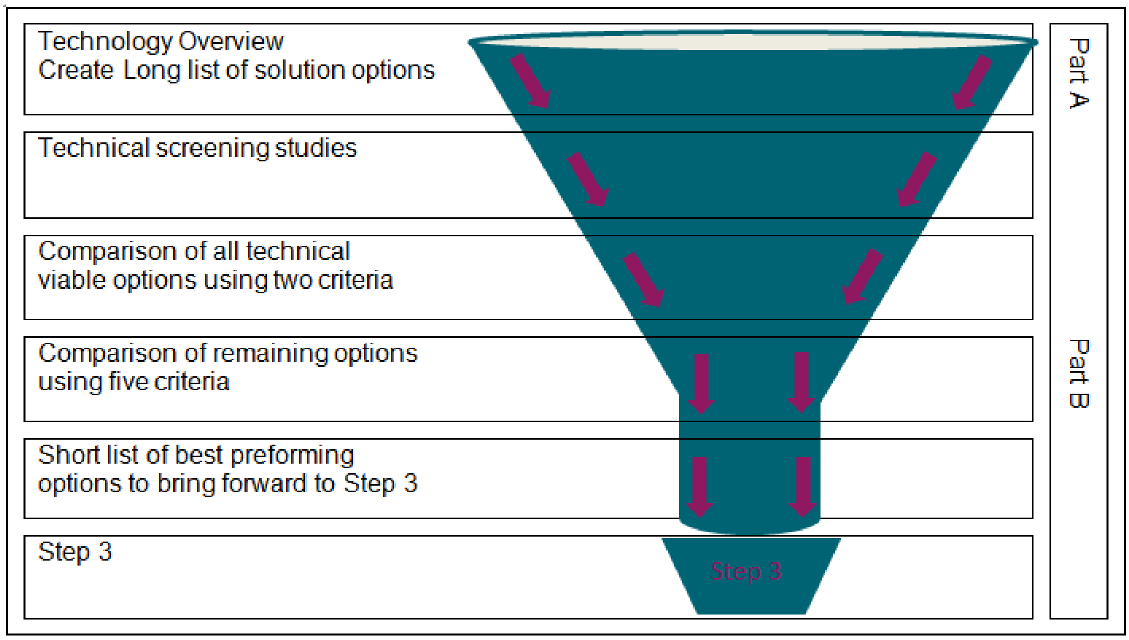

Figure 2 *Illustration of the process of developing of options in Step 2*

The list is further refined in Step 2, this time using a multi-criteria comparison against five criteria namely, technical performance, economic performance, environmental aspects, deliverability aspects and socio-economic aspects. Each remaining option is assessed against the five criteria. This is discussed in Section 7 Detailed evaluation of the options. The outcome of Step 2 is a short list of solution options which will be taken to Step 3 for further investigation and evaluation.

3.2 Criteria used for comparison of remaining options

The second time the performance matrix is used in Step 2, each remaining option is assessed against the five criteria. The five criteria are technical performance, economic performance, environmental aspects, deliverability aspects and socio-economic aspects. Descriptions of the five criteria are outlined below. It should be noted that the assessments provided are for comparison against each other and not absolute assessments of the individual options.

3.2.1 Technical performance

In Part B in Step 2 the technical performance criteria is based on compliance with Transmission System Security and Planning Standards (TSSPS) and compliance with current transmission investment policies. Only options that meet the minimum technical requirements set out in the TSSPS qualify for consideration in Step 2 Part B. Options which extend or enhance technical performance margins beyond minimum acceptable levels are favoured over others.

The options will be assessed against three technical performance criteria to be able to distinguish between their individual technical performances. The technical criteria in Step 2 Part B relate to the needs identified and are thermal overload, short circuit performance and performance during maintenance conditions. A short description of these is given below.

3.2.1.1 Thermal overload criteria

The need identified in Step 1 was related to thermal overload due to a number of drivers. For this reason the thermal overload criterion is a key indicator of the technical performance of the options.

The options are assessed for compliance with the Transmission System Security and Planning Standards (TSSPS). If thermal overload violations are identified additional potential reinforcements will be required in addition to the options to fully meet the TSSPS. For this technical criterion we have assessed the options based on the number and magnitude of thermal overloads remaining after the option has been added. This will provide an indication of how the options are performing in terms of adding thermal capacity.

3.2.1.2 Voltage

No voltage needs were identified in Step 1. However, underground cable is the technology choice for some of the options. Underground cables, through their predominately capacitive characteristic, can increase system voltages beyond allowed limits at times of light load and low availability of reactive power control from on-load generation. This means that additional equipment will be required, such as reactors or STATCOMs, to help control high voltages within limits. The Dublin area is already known to face high voltage challenges at low load periods. The options are assessed on their influence on increasing voltages outside allowed limits at times of low load.

3.2.1.3 Short circuit performance

The options are assessed based on the scale that they affect the existing short circuits levels in existing substations. Additional circuits and/or transformers connected into substations will create another path for the fault current to flow into the substation and as such the short circuit levels will increase in the substation. Similarly, if circuits are removed the number of paths for the fault current to flow has reduced and as such the short circuit levels will decrease in the substation.

3.2.1.4 Performance during maintenance conditions

The options are assessed based on their requirement for additional reinforcements to keep the network within standards following an unplanned loss of plant or equipment whilst another is out for planned maintenance. It should be noted that investments resulting from violations during planned maintenance are subject to an economic appraisal of the value in solving the identified problem compared to constraining generation. Before we would bring these forward as projects we will individually appraise whether each of these reinforcements could be financially justified. To ensure value for money, we will defer a decision until much closer to the required commissioning date of the best performing option. This will allow us to take account of new requirements for each reinforcement, which may include both local and regional needs which could have emerged in the meantime. As such, for the purpose of this assessment in Step 2, we have only assessed the number of indicated violations of thermal capacity for each option. It should be noted that these possible additional reinforcements are not included in the full solution list of the options in Section 4.3.

3.2.2 Economic performance

In Part B in Step 2, the economic performance is based on estimated Total Project Cost (TPC) for each option for comparison purposes. The TPC will comprise both estimated capital costs and an estimated cost for the Transmission System Operator (TSO) element for development of the options.

The primary source for capital cost estimates have been developed with input from the Transmission Asset Owner (TAO) and are based on desktop designs and costings for similar works. The capital cost includes all items to achieve a fully compliant solution with Transmission System Security and Planning Standards (TSSPS), but are excluding reinforcements driven by maintenance conditions as discussed in section 3.2.1.5. Where capital costs were not available for a particular technology the best, most recent estimates or quotes from manufacturers or assumed costs based on EirGrid or international experience have been used.

The TSO cost is the cost for the Transmission System Operator to develop the project during the planning and construction phase. The cost is made up of, among other things, project management, wayleaving and landowner engagements and cost attributed to developing the planning application. The estimated cost is based on experience of developing previous projects.

3.2.3 Environmental

This is a high-level consideration of environmental impacts in the context of the project. It is largely based on a desktop study. Under this criterion, consideration is given to biodiversity, soil and water, climatic factors, material assets and noise. Note that cultural heritage, landscape and visual are examined under the heading of Socio-economic and not repeated in this section.

3.2.4 Deliverability

Deliverability captures timelines until energisation (assesses significant differences) as well as engineering and planning risks which could extend delivery timescales and costs.

A high-level assessment of the impacts of any planned transmission equipment outages required to carry out the necessary work is also carried out.

Various permissions and wayleaves required to proceed to construction are also considered in this criteria.

3.2.5 Socio-Economic

This is a high-level consideration of social impacts in the context of the project. It is largely based on a desktop study. Under this criterion consideration is given to settlement and communities; recreation and tourism; landscape and visual; and cultural heritage and other relevant issues.

3.3 Scale used to assess each criterion

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:

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

In the text this scale is quantified by text for example

high (Dark Blue),

high-moderate (Blue) or

mid-level/moderate (Dark Green),

low-moderate (Green),

low (Cream).

4 Development of a short list

In Step 2, the identified list of options are refined twice with the aim to establish a short list of best performing solution options to bring forward for further investigation in Step 3. The outcome from the first part of the refinement of the long list is presented in the Options Report Part A. The second time the list is refined, each remaining option will be assessed against the five criteria. The summary of this assessment is presented in this section and further details are given in section 7, Detailed evaluation of options.

4.1 Options brought forward from Part A of Step 2

The outcome of the first part of the refinement of the long list is presented in the Options Report Part A. This assessment identified seven solution options using two different technologies that would address the need identified. The technologies were:

- Overhead line (OHL)
- Underground cable (UGC)

All the seven remaining solution options reinforce the transmission network between the existing Woodland substation in County Meath and either the Corduff, Finglas, or Belcamp substations in County Dublin. The seven solution options in the refined list were:

- New Corduff – Woodland 400 kV OHL Circuit
- New Corduff – Woodland 400 kV UGC Circuit,
- New Corduff – Woodland 220 kV OHL Circuit,
- New Finglas – Woodland 220 kV OHL Circuit,
- New Finglas – Woodland 400 kV UGC Circuit,
- New Finglas – Woodland 400 kV OHL Circuit,
- New Belcamp – Woodland 400 kV OHL Circuit.

4.2 Summary of assessment of remaining options

The seven remaining solution options were assessed against the five criteria. Table 1 provides a summary of the performance of each option against the five evaluation criteria. The detailed assessment of each option is presented in section 7, Detailed evaluation of options.

The outcome of the multi criteria assessment in Step 2 is that the options that connect Woodland to Finglas or Belcamp perform the best overall and these will be brought forward into Step 3 for further more detailed assessment.

Options	Technical Performance	Economic Performance	Environmental	Deliverability	Socio-economic	Combined Performance in Step 2 Part B
New Corduff – Woodland 400 kV OHL						
New Corduff – Woodland 400 kV UGC						
New Corduff – Woodland 220 kV OHL						
New Finglas – Woodland 220 kV OHL						
New Finglas – Woodland 400 kV UGC						
New Finglas – Woodland 400 kV OHL						
New Belcamp – Woodland 400 kV OHL						

Table 1 *Overall comparison of options using five criteria in Step 2 Part B*

In addition to the three indicated solution options (**Dark Green**) in Table 1 above, it was deemed prudent to include an UGC version of the Belcamp – Woodland 400 kV OHL option in Step 3.

This solution option was set aside in Step 2A as it overall provided a less favourable combined technical and economic performance compared to the other options. The reasons and justification for bringing the option back into the assessment is to take on board previous feedback from stakeholders for other new circuit development, and to allow for the fact that the new development will traverse a mix of urban and rural environments to connect the two substations where underground cable is deemed necessary. The Belcamp – Woodland 400 kV UGC option was therefore added to the short list.

This means that two technologies are still being investigated in Step 3 to choose the best performing solution option.

In Step 3, these technologies and the options using them will be investigated in even more detail. In Step 3 the five main criteria are broken down into sub-criteria, which the remaining options will be assessed against. It should be recognised that two of these technologies have features and technical aspects which have not yet been studied or investigated.

The underground cable technology (AC cable) requires very detailed specific technical analysis to determine if they are technically feasible. These studies include analysis to investigate Temporary Over Voltages (TOV) and harmonic distortion among other things. Previously, for other projects, the acceptable length of underground cable (AC) has varied depending on voltage and location of the cable within the network. A full investigation into these aspects will be completed in Step 3 for both remaining underground cable options. The result of these analyses may determine that some options are not technically feasible or that further investments are required to accommodate them. The best performing option determined in Step 3 may be a combination of the technologies in one circuit, a partial overhead and partial underground circuit, to maximise performance in relation to all the criteria evaluated.

4.3 Recommended short list of best performing options

The options in the refined list were assessed against the five criteria. This resulted in four solution options being brought forward for more detailed analysis in Step 3. All options involve a transmission network reinforcement centred on strengthening the network between existing Woodland 400 kV substation in County Meath and either the Finglas, or Belcamp substations in County Dublin. The four options are:

- New Finglas – Woodland 400 kV overhead line (OHL)
- New Finglas – Woodland 400 kV underground cable (UGC)
- New Belcamp – Woodland 400 kV overhead line (OHL)
- New Belcamp – Woodland 400 kV underground cable (UGC)

5 Stakeholder Engagement

The aim of stakeholder engagement in Step 2 is to transparently communicate our findings so far in the project to key stakeholders and receive feedback on chosen technologies and refined short list.

The stakeholder engagement for Capital Project 1021 in Step 2 was divided into two phases, phase A and phase B in order to ensure appropriate stakeholder feedback and inform our decision-making process during Step 2.

In phase A we have identified and consulted with relevant key strategic stakeholders such as the Government Departments, the Commission for Regulation of Utilities, Meath and Fingal County Council Chief Executives and Senior Executives, the IDA, Enterprise Ireland, the Eastern and Midlands Regional Assembly, and Meath and Fingal Chambers. This phase was completed between November 2019 and January 2020.

This engagement has enabled us to understand the spatial and economic planning that is underway at local and regional authority level, as well as the potential requirements for future investments by large energy users in the area. It has also allowed us to brief key stakeholders in the area, and to hear their view of the opportunities and challenges that exist for the project, as well as receive feedback on chosen technologies and the refined short list.

In phase B, an 8-week consultation period started in October 2020 and finished in December 2020. The consultation period covered a broad range of stakeholder engagement with the general public, local communities, and their elected representatives, as well as re-engagement with the key stakeholders from phase A.

A virtual meeting with Ratoath Municipal District Councillors was held to introduce them to the project. All Ashbourne Councillors were contacted with information on the project. All Councillors in Howth-Malahide and Blanchchardtown/Mulhuddart districts were contacted and introduced to the project along with all TD's & Senators in the Meath East, Dublin Fingal, and Dublin West Dáil constituencies.

A door-door letter drop to all residents within a 2km radius of Woodland Substation was conducted in early August 2020. The letter provided information on the status of the North South Interconnector project, CP966 Kildare Meath Grid Upgrade and provided an introduction to CP1021 East Meath to North Dublin Grid Reinforcement.

All stakeholders had the opportunity to provide feedback in relation to the assessment carried out to date and the solutions to be brought forward for further consideration in Step 3.

A small number of responses were received, and these were mostly enquiring about the relationship between this project CP1021 and other on-going projects around Woodland substation such as CP0966 Kildare – Meath Grid Upgrade, and the North South Interconnector. Many stakeholders also welcomed the opportunity for early engagement. No additional technology options were either removed or added as a result of the consultation period.

As part of the 8-week consultation period the following tasks were carried out:

- published project related material on the project website, including reports and project brochures (see Appendix 3 for a record of website traffic);
- issued a press statement to the media; and
- communicated details of our work on this project to local elected representatives and offering briefings.

6 Assessment of project complexity

Each project may be of a different scale and/or complexity. To reflect the unique features of each project, the framework for grid development introduced three categories of projects, called Tiers.

The Tier of a project indicates the required level of governance, external consultation and engagement, social impact assessment and analysis.

To decide the Tier for a project a number of factors have to be considered. An assessment should consider different aspects such as project complexity, customer impact, deliverability, health and safety, legacy issues, operational risks, stakeholder engagement, and technical risks.

Capital Project 1021 has been assigned a Tier 3 which is the most complex category with the highest level of governance. This is based on the most complex remaining options. In this case, it is a new 400 kV overhead line. New linear projects have the potential to traverse many different stakeholders and as such increasing the number of stakeholders that need to be considered. As well as this, the potential impact on society and the environment also require significant investigations and consideration. For this reason this project has been assigned a Tier 3.

7 Detailed evaluation of options

This section will describe in detail the assessment of each of the seven remaining options against the five criteria. The criteria are described in section 3.2 and the below assessment of the options require an understanding of these. All remaining solution options reinforce the transmission network between the existing Woodland 400 kV substation, and Corduff, Finglas or Belcamp 220 kV substations.

7.1 New Corduff - Woodland 400 kV OHL circuit

7.1.1 Description of option

This option involves a transmission network reinforcement to strengthen the network between the existing Woodland 400 kV substation in County Meath and the Corduff 220 kV substation in North County Dublin. The reinforcement consists of a new 400 kV overhead line linking the Woodland 400 kV substation to the Corduff 220 kV substation, and a new 400 kV busbar and 400/220 kV transformer at Corduff.

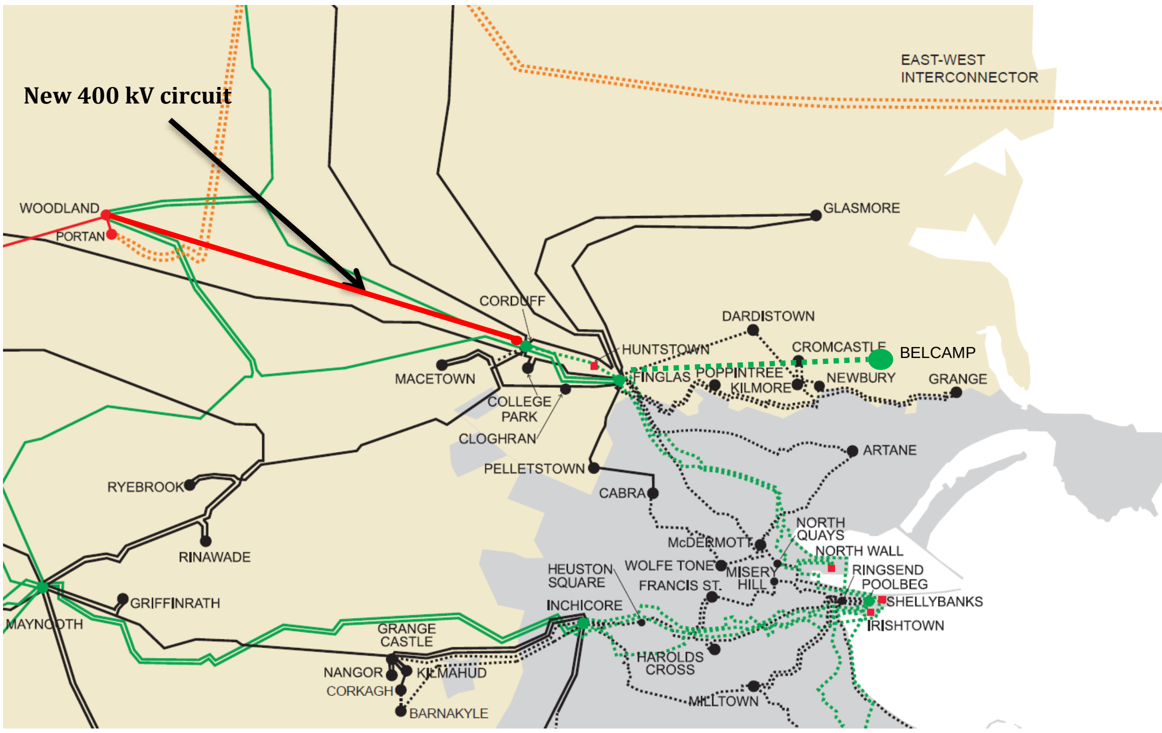

Figure 3 *New 400 kV overhead line circuit connecting the Woodland and Corduff substations.*

7.1.2 Technical Performance

7.1.2.1 Thermal overload

In comparison to the alternative options, the New Corduff - Woodland 400 kV OHL option performs poorly in terms of remaining thermal overloads that are required to be resolved to fulfil a fully compliant solution with the Transmission System Security and Planning Standards (TSSPS). (**Dark Blue**).

This option removes the overload of Clonee – Woodland 220 kV circuit seen when the system is intact. It is reduced to a post contingent overload of 107% following the unplanned loss of the Corduff – Woodland 220 kV circuit. The post contingent overload on the existing Corduff – Woodland 220 kV circuit following the unplanned loss of the Clonee – Woodland 220 kV circuit identified in Step 1, is reduced from 172% to 103%. However overloads of 131% remain on one Corduff – Finglas 220 kV circuit following the unplanned loss of the other Corduff – Finglas 220 kV circuit. This option has no influence on reducing power flows in those circuits. These circuits would require uprating to prevent overloads.

Dependence on generation in the North Dublin area is reduced by this option as the option will better manage power flows on the existing 220 kV circuits between Woodland, Corduff, and Finglas 220 kV substations. In particularly the dependence on the generators at Huntstown generation station is reduced. Generation at Poolbeg generation station can be used to alleviate thermal problems, but its effect is limited by the capacity of the circuits between Poolbeg, North Wall, and Shellybanks and Finglas substations.

To further reduce dependence on generation in North Dublin and manage the power flows better, additional reinforcement will be required. For example, the existing Corduff – Finglas 1 & 2, Corduff – Woodland, Clonee – Woodland and Clonee – Corduff 220 kV circuits may need thermal uprating in the future, depending on the rate of demand increases and generation portfolio changes. Other potential solutions include new additional circuits in the area to add further network capacity, for example a new circuit between Corduff, Finglas or Belcamp substations in North Dublin and Poolbeg or Irishtown substations in the city centre.

7.1.2.2 Voltage

The management of voltage in the Dublin and Mid East[2] area is a known operational challenge.

This option is an overhead line option and so will not be expected to have a significant influence on increasing the voltage in the area. The analysis carried out has confirmed this. This option performs well in terms of voltage and has a low influence on the need for additional reactive power controlling equipment (**Cream**)

7.1.2.3 Short Circuit Analysis

The transmission network in North Dublin has relatively high short circuit current levels, but still with standards and Grid code levels. This option contributes to a moderate increase of short circuit current levels in the North Dublin area. All increases in short circuit level remain within Grid Code levels, but represent a reduction in available headroom. The results of the short circuit analysis can be found in Appendix 2. This option is considered to have a moderate impact in terms short circuit current levels (**Dark Green**).

7.1.2.4 Reinforcements to cater for maintenance conditions

This option will require additional reinforcements to keep the network within standards following a subsequent loss of plant and equipment whilst another is out for planned maintenance. In particular, a maintenance and trip combination that includes the new Corduff - Woodland 400 kV OHL and one of the existing 220 kV circuits between Corduff, Clonee, Finglas, and Woodland, result in overloads on remaining circuits in that corridor which is the same as the unplanned loss of a single piece of transmission equipment before the new circuit is added. This issue is common to all the options evaluated. These overloads can be managed using dispatch of existing thermal generation in North Dublin. To reduce dependence on these generators additional reinforcements will be required. The additional reinforcements range from thermal uprates of the existing 220 kV circuits, or new circuits to add further capacity to the network in the area.

This option is considered to have a moderate performance in terms of possible future reinforcements (**Dark Green**).

7.1.2.5 Conclusion of technical performance

The ability of each option to reduce thermal overloads in the network corridor is a key consideration for technical performance, and when combined with the other technical aspects this option is considered to have moderate to poor performance (**Blue)**.

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[2] NUTS Level 3 Region made up of counties Kildare, Wicklow, Meath, and Louth. https://ec.europa.eu/eurostat/web/nuts/background

Technical performance Corduff – Woodland 400 kV OHL	Thermal overloads	Voltage	Short circuit	Maintenance conditions	Combined Technical Performance

Table 2 *Summary of technical performance for the Corduff – Woodland 400 kV OHL option*

7.1.3 Economic Performance

The estimated capital costs for the full solution for the Corduff – Woodland 400 kV OHL option is approximately €38.8m. This includes new circuit bays, new 400 kV equipment at the existing substation, and new 400/220 kV transformer required. The estimated cost for the transmission system operator to develop the Corduff – Woodland 400 kV OHL option is approximately €22.8m. This option is considered to have low impact in terms of the cost (**Cream**).

7.1.4 Environmental

Having considered the potential environmental impacts of a 400kV OHL it is concluded that this option will have moderate environmental impact (**Dark Green**) – this is relative to the other options being considered and in particular the UGC options. The construction and operation of a 400kV or 220kV OHL would be similar. The introduction of new overhead infrastructure into the study area will change the baseline environment and while it may be possible to mitigate impacts, they may be significant. The determination of the significance of which would require more detailed assessment as the options move through the various steps in the Framework for Grid Development.

7.1.5 Deliverability

Having assessed high level deliverability aspects for a new 400 kV overhead line circuit it is concluded that this option could be associated with high planning risks. Based on experience on other similar OHL projects, permitting would be expected to be very challenging due to societal acceptance of such a development. This means that overall, the option could very likely experience delays in its development compared to the other options.

Furthermore, a high level assessment showed limited options for the development of a new 400 kV busbar adjacent to the existing Corduff 220 kV substation. An appropriate site may be located in the vicinity, however this would introduce additional project complexity and risk associated with new circuits required to connect the new 400 kV busbar to the existing 220 kV busbar.

It is considered that this option will have a low to moderate impact in terms of potential outages required as it is mostly a new build with only outages required for energisation.

All options presented in this paper will be new infrastructure and will require permits and wayleaves to some extent or another – this elevates the deliverability criteria for all options. Significant engagement with landowners and communities would be required in the delivery of a new overhead circuit, for such purposes as surveying, siting and construction. These parties may be new to accommodating electricity infrastructure on their landholdings and within their communities. New wayleaves would be required to facilitate construction of the new circuit. Based on recent precedent in terms of the provision of new 400 kV transmission infrastructure, there is the potential for significant landowner, community and public concerns with this option, with the likely consequence of project delays or difficulties in gaining access to land.

Overall, given the nature of this option the planning risks are considered difficult to mitigate and more dominant in delivering the project. Combining this with the wayleaving required for a new 400 kV OHL circuit, this option is considered to have an overall high to moderate impact on deliverability (**Blue**)

7.1.6 Socio-economic

Having considered the potential impacts of a 400 kV OHL it is concluded that this option will have moderate socio-economic impact (**Dark Green**) – this is relative to the other options being considered and in particular the UGC. The construction and operation of a 400 kV or 220 kV OHL would be similar. The introduction of new overhead infrastructure into the study area will change the baseline environment and while it may be possible to mitigate impacts they may be significant. The determination of the significance of which would require more detailed assessment as the options move through the various steps in the Framework for Grid Development. It performs better than the other OHL option to Belcamp as it only travels to the substations on the western fringes of Dublin City and avoids more constrained areas.

7.1.7 Summary of option

Overall performance Corduff – Woodland 400 kV OHL	Technical Performance	Economic Performance	Environmental	Deliverability	Socio-economic	Overall Performance
	(Blue)	(Light Yellow)	(Green)	(Blue)	(Green)	(Blue)

Table 3 *Summary of performance of all criteria for Corduff – Woodland 400 kV OHL option*

7.2 New Corduff - Woodland 400 kV UGC circuit

7.2.1 Description of option

This option involves a transmission network reinforcement to strengthen the network between the existing Woodland 400 kV substation in County Meath and the Corduff 220 kV substation in North County Dublin. The reinforcement consists of a new 400 kV underground cable linking the Woodland 400 kV substation to the Corduff 220 kV substation, and a new 400 kV busbar and 400/220 kV transformer at Corduff.

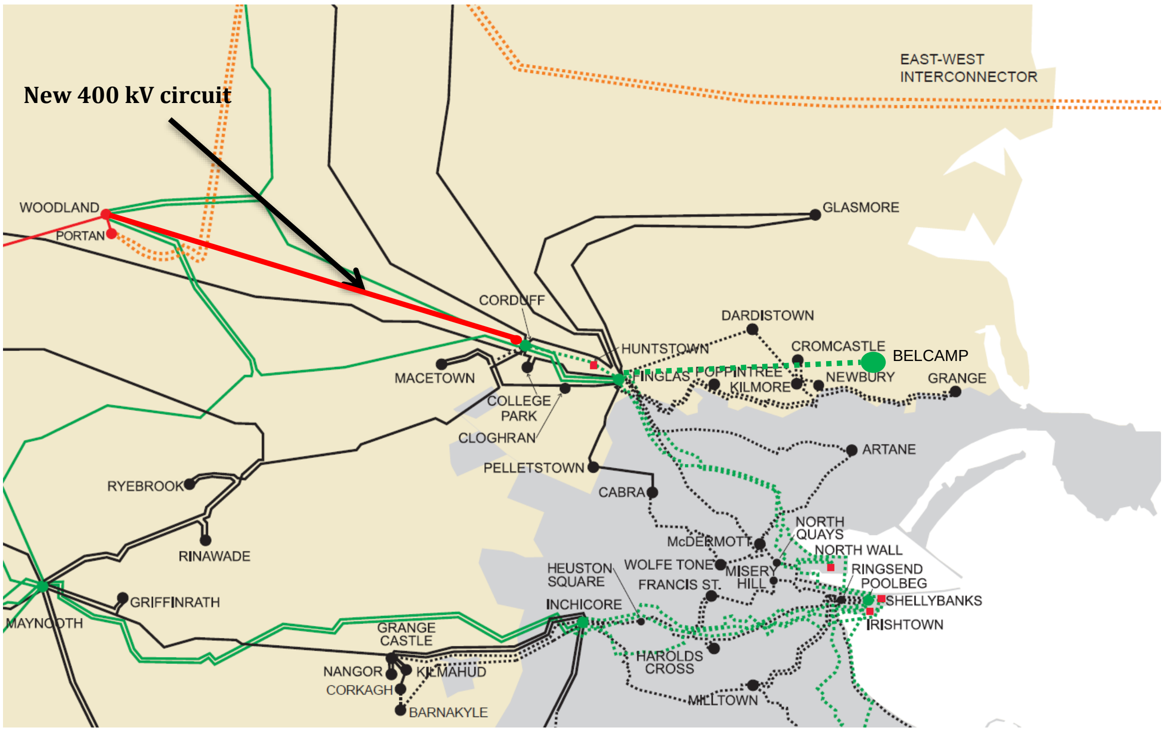


Figure 4: *New 400 kV underground cable circuit connecting the Woodland and Corduff substations.*

7.2.2 Technical Performance

7.2.2.1 Thermal overloads

In comparison to the alternative options, the New Corduff - Woodland 400 kV UGC option performs poorly in terms of remaining thermal overloads that are required to be resolved to fulfil a fully compliant solution with the Transmission System Security and Planning Standards (TSSPS). (**Dark Blue**).

This option removes the overload of Clonee – Woodland 220 kV circuit seen when the system is intact. It is reduced to a post contingent overload of 105% following the unplanned loss of the new circuit. The post contingent overload on the existing Corduff – Woodland 220 kV circuit following the unplanned loss of the Clonee – Woodland 220 kV circuit identified in Step 1, is reduced from 172% to below 100%. However overloads of

132% remain on one Corduff – Finglas 220 kV circuit following the unplanned loss of the other Corduff – Finglas 220 kV circuit. This option has no influence on reducing power flows in those circuits. These circuits would require uprating to prevent overloads.

Dependence on generation in the North Dublin area, particularly the generators at Huntstown, to manage power flows on the existing 220 kV circuits between Woodland, Corduff, and Finglas 220 kV substations is reduced by this option, but some dependence remains.

The new 400/220 kV transformer at Corduff can be seen to be loaded above its continuous rating, but within its emergency rating, when one Huntstown generator trips while the other is unavailable. Additional 400/220 kV transformer capacity may be required at Corduff to accommodate these power flows. These power flows are higher than those shown for the 400 kV OHL options due to the lower impedance of the cable circuit between Woodland and Corduff.

Dependence on generation in the North Dublin area is reduced by this option as the option will better manage power flows on the existing 220 kV circuits between Woodland, Corduff, and Finglas 220 kV substations. In particularly the dependence on the generators at Huntstown generation station is reduced. Generation at Poolbeg generation station can be used to alleviate thermal problems, but its effect is limited by the capacity of the circuits between Poolbeg, North Wall, and Shellybanks and Finglas substations.

To further reduce dependence on generation in North Dublin additional reinforcement will be required. For example, the existing Corduff – Finglas 1 & 2, Corduff – Woodland, Clonee – Woodland and Clonee – Corduff 220 kV circuits may need thermal uprating in the future, depending on the rate of demand increases and generation portfolio changes. Other potential solutions include new additional circuits in the area to add further network capacity, for example a new circuit between Corduff, Finglas or Belcamp substations in North Dublin and Poolbeg or Irishtown substations in the city centre.

7.2.2.2 Voltage

The management of voltage in the Dublin and Mid East area is a known operational challenge.

This option is an underground cable option and so will be expected to have a significant influence on increasing the voltage in the area. The analysis carried out has confirmed this identifying night time voltages above allowable limits that will require mitigation. If this option progresses to Step 3, further analysis will be undertaken to determine the mitigation required. This option has a moderate influence on the need for additional reactive power controlling equipment (**Green**)

7.2.2.3 Short Circuit analysis

The transmission network in North Dublin has relatively high short circuit current levels, but still with standards and Grid code levels. This option contributes to a moderate increase of short circuit current levels in the North Dublin area. All increases in short circuit level remain within Grid Code levels, but represent a reduction in available headroom. The results of the short circuit analysis can be found in Appendix 4. This option is considered to have a moderate impact in terms short circuit current levels (**Dark Green**).

7.2.2.4 Reinforcements to cater for maintenance conditions

This option will require additional reinforcements to keep the network within standards following a subsequent loss of plant and equipment whilst another is out for planned maintenance. In particular, a maintenance and trip combination that includes the new Corduff - Woodland 400 kV UGC and one of the existing 220 kV circuits between Corduff, Clonee, Finglas, and Woodland, result in overloads on remaining circuits in that corridor which are the same as the unplanned loss of a single piece of transmission equipment before the new circuit is added. This issue is common to all the options evaluated. These overloads can be managed using dispatch of existing thermal generation in North Dublin. To reduce dependence on these generators additional reinforcements will be required. The additional reinforcements range from thermal uprates of the existing 220 kV circuits, or new circuits to add further capacity to the network in the area.

This option is considered to have a moderate performance in terms possible future reinforcements (**Dark Green**).

7.2.2.5 Conclusion of technical performance

The ability of each option to reduce thermal overloads in the network corridor is a key consideration for technical performance, and when combined with the other technical aspects this option is considered to have moderate to poor performance (**Blue)**.

Technical performance Corduff – Woodland 400 kV UGC	Thermal overloads	Voltage	Short circuit	Maintenance conditions	Combined Technical Performance

Table 4 *Summary of technical performance for the Corduff – Woodland 400 kV UGC option*

7.2.3 Economic Performance

The estimated capital costs for the full solution for the Corduff – Woodland 400 kV UGC option is approximately €130.7m. This includes new circuit bays, new 400 kV equipment at the existing substation, and new 400/220 kV transformer required. The estimated cost for the transmission system operator to develop the Corduff – Woodland 400 kV UGC option is approximately €16.6m. This option is considered to have high impact in terms of the cost (**Dark Blue**).

7.2.4 Environmental

Having considered the potential environmental impacts of a 400 kV UGC it is concluded that this option will have low-moderate environmental impact (**Green**) – this is relative to the other options being considered and in particular the OHL. The construction of UGC however is not without its impacts and requires careful consideration of impacts on sensitive receptors. It should be possible to mitigate significant impacts. The determination of the significance of which would require more detailed assessment as the options move through the various steps in the Framework for Grid Development.

7.2.5 Deliverability

An UGC option may reduce the risk in attaining permits. This is largely due to the elimination of visual impacts and preference from the public for EirGrid to pursue UGC options generally. It is currently considered that the UGC options in this project, due to their size, scale and likely impact, are likely to require planning permission. While there is precedent for 220 kV UGC within the public road to comprise exempted development, it is considered that the scale of the overall UGC development, combined with the new associated infrastructure likely to be required as outlined above, will result in the overall development not comprising exempted development.

Additionally, some other elements of the option may require planning, such as reactive support requirements if required, so the option will still have moderate planning risks associated.

An UGC option would preferably be accommodated in the public road network. However with regards to permits and wayleaving, it should be recognised that it may not be possible to lay a 400 kV underground cable along existing roads due to the cable trench width required. If this is the case, a 400 kV underground cable option may have to be laid across open fields.

This brings its own significant challenges in terms of landowner engagement and concerns, environmental and land use impacts – in particular the inability to undertake certain types of agricultural activity thereon. It is assumed that significant engagement with landowners with properties along public roads would be required in the delivery of a new 400 kV UGC, for such purposes as surveying, siting and construction.

A high level assessment showed limited options for the development of a new 400 kV busbar adjacent to the existing Corduff 220 kV substation. An appropriate site may be located in the vicinity, however this would introduce additional project complexity and risk associated with new circuits required to connect the new 400 kV busbar to the existing 220 kV busbar.

It is considered that this option will have a low to moderate impact in terms of potential outages required as it is mostly a new build with only outages required for energisation.

Overall, this option is considered to have an overall mid-level/moderate impact on deliverability (**Dark Green**).

7.2.6 Socio-economic

Having considered the potential impacts of a UGC it is concluded that this option will have low-moderate socio-economic impact (**Green**) – this is relative to the other options being considered and in particular the OHL. The introduction of new overhead infrastructure into the study area will change the baseline environment and while it may be possible to mitigate impacts they may be significant. The determination of the significance of which would require more detailed assessment as the options move through the various steps in the Framework for Grid Development.

7.2.7 Summary of option

Overall performance Corduff – Woodland 400 kV UGC	Technical Performance	Economic Performance	Environmental	Deliverability	Socio-economic	Overall Performance

Table 5 *Summary of performance of all criteria for the Corduff – Woodland 400 kV UGC option*

7.3 New Corduff – Woodland 220 kV OHL circuit

7.3.1 Description of option

This option involves a transmission network reinforcement to strengthen the network between the existing Woodland 400 kV substation in County Meath and the Corduff 220 kV substation in North County Dublin. The reinforcement consists of a new 220 kV overhead line linking the Woodland 400 kV substation to the Corduff 220 kV substation.

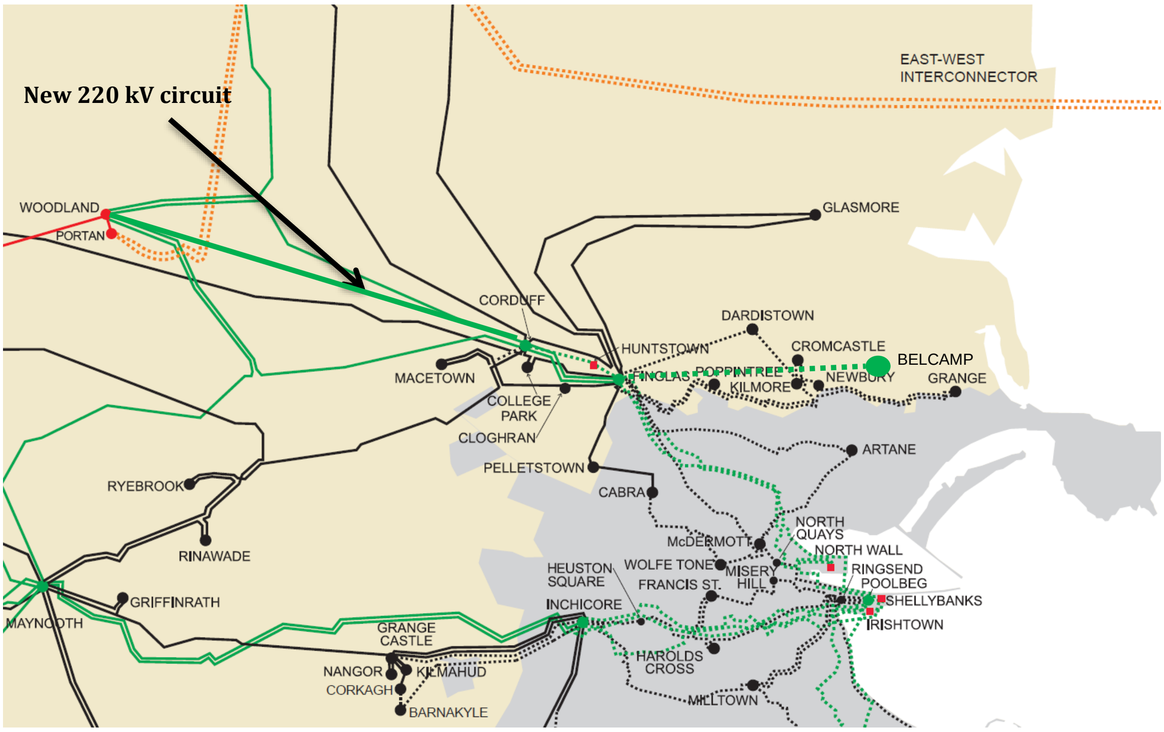


Figure 5: *New 220 kV overhead line circuit connecting the Woodland and Corduff substations.*

7.3.2 Technical Performance

7.3.2.1 Thermal overloads

In comparison to the alternative options, the New Corduff - Woodland 220 kV OHL option performs poorly in terms of remaining thermal overloads that are required to be resolved to fulfil a fully compliant solution with the Transmission System Security and Planning Standards (TSSPS) (**Dark Blue**).

This option removes the overload of Clonee – Woodland 220 kV circuit seen when the system is intact. It is reduced to a post contingent overload of 107% following the unplanned loss of the new circuit. The post contingent overload on the existing Corduff – Woodland 220 kV circuit following the unplanned loss of the Clonee – Woodland 220 kV circuit identified in Step 1, is reduced from 172% to 101%. However overloads of 123% remain on one Corduff – Finglas 220 kV circuit following the unplanned loss of the other

Corduff – Finglas 220 kV circuit. This option has no influence on reducing power flows in those circuits. These circuits would require uprating to prevent overloads.

Dependence on generation in the North Dublin area is reduced by this option as the option will better manage power flows on the existing 220 kV circuits between Woodland, Corduff, and Finglas 220 kV substations. In particularly the dependence on the generators at Huntstown generation station is reduced. Generation at Poolbeg generation station can be used to alleviate thermal problems, but its effect is limited by the capacity of the circuits between Poolbeg, North Wall, and Shellybanks and Finglas substations.

This option increases the flows on the 400/220 kV transformers at Woodland. The thermal ratings of the transformers are not breached, however remaining capacity headroom is eroded.

To further reduce dependence on generation in North Dublin additional reinforcement will be required. For example, the existing Corduff – Finglas 1 & 2, Corduff – Woodland, Clonee – Woodland and Clonee – Corduff 220 kV circuits may need thermal uprating in the future, depending on the rate of demand increases and generation portfolio changes. Other potential solutions include new additional circuits in the area to add further network capacity, for example a new circuit between Corduff, Finglas or Belcamp substations in North Dublin and Poolbeg or Irishtown substations in the city centre.

7.3.2.2 Voltage

The management of voltage in the Dublin and Mid East area is a known operational challenge.

This option is an overhead line option and so will not be expected to have a significant influence on increasing the voltage in the area. The analysis carried out has confirmed this. This option performs well in terms of voltage and has a low influence on the need for additional reactive power controlling equipment (**Cream**)

7.3.2.3 Short Circuit Analysis

The transmission network in North Dublin has relatively high short circuit current levels, but still with standards and Grid code levels. This option contributes to a moderate to low increase of short circuit current levels in the North Dublin area. All increases in short circuit level remain within Grid Code levels, but represent a reduction in available headroom. The results of the short circuit analysis can be found in Appendix 4. This option is considered to have a moderate to low impact in terms short circuit current levels (**Green**).

7.3.2.4 Reinforcements to cater for maintenance conditions

This option will require additional reinforcements to keep the network within standards following a subsequent loss of plant and equipment whilst another is out for planned maintenance. In particular, a maintenance and trip combination that includes the new Corduff - Woodland 220 kV OHL and one of the existing 220 kV circuits between Corduff, Clonee, Finglas, and Woodland, result in overloads on remaining circuits in that corridor which are the same as the unplanned loss of a single piece of transmission equipment before the new circuit is added. This issue is common to all the options evaluated. These overloads can be managed using dispatch of existing thermal generation in North Dublin. To reduce dependence on these generators additional reinforcements will be required. The additional reinforcements range from thermal uprates of the existing 220 kV circuits, or new circuits to add further capacity to the network in the area.

This option is considered to have a high to moderate performance in terms possible future reinforcements (**Blue**).

7.3.2.5 Conclusion of technical performance

The ability of each option to reduce thermal overloads in the network corridor is a key consideration for technical performance, and when combined with the other technical aspects this option is considered to have moderate to poor performance (**Blue)**.

Technical performance Corduff – Woodland 220 kV OHL	Thermal overloads	Voltage	Short circuit	Maintenance conditions	Combined Technical Performance

Table 6 *Summary of the* technical performance for *220 kV OHL option*

7.3.3 Economic Performance

The estimated capital costs for the full solution for the Corduff – Woodland 220 kV OHL option is approximately €17.4m. This includes new circuit bays required. The estimated cost for the transmission system operator to develop the Corduff – Woodland 220 kV OHL option is approximately €23.2m. This option is considered to have low impact in terms of the cost (**Cream**).

7.3.4 Environmental

Having considered the potential environmental impacts of a 220kV OHL it is concluded that this option will have moderate environmental impact (**Dark Green**) – this is relative to the other options being considered and in particular the UGC. The construction and operation of a 400kV or 220kV OHL would be similar. The introduction of new overhead infrastructure into the study area will change the baseline environment and while it may be possible to mitigate impacts they may be significant. The determination of the significance of which would require more detailed assessment as the options move through the various steps in the Framework for Grid Development.

7.3.5 Deliverability

Having assessed high level deliverability aspects for a new 220 kV overhead line circuit it is concluded that this option could be associated with high planning risks.

A new OHL circuit will require permits and wayleaves – this elevates the deliverability risks. There is a public participation facet requiring extensive relationship building with individual landowners, the risk to the option is often in the time required to achieve wayleaving.

It is considered that this option will have a low to moderate impact in terms of potential outages required as it is mostly a new build with only outages required for energisation.

Given the nature of the project the planning risks are considered to more difficult to mitigate and more dominant in delivering the project. Combining the planning risks with the risks around permits and wayleaving, this option is considered to have an overall high to moderate impact on deliverability (**Blue).**

7.3.6 Socio-economic

Having considered the potential impacts of a 220 kV OHL it is concluded that this option will have moderate socio-economic impact (**Dark Green**) – this is relative to the other options being considered and in particular the UGC. The construction and operation of a 400 kV or 220 kV OHL would be similar. The introduction of new overhead infrastructure into the study area will change the baseline environment and while it may be possible to mitigate impacts they may be significant. The determination of the significance of which would require more detailed assessment as the options move through the various steps in the Framework for Grid Development. It performs better than the other OHL option to Belcamp as it only travels to the substations on the western fringes of Dublin City and avoids more constrained areas.

7.3.7 Summary of option

Overall performance Corduff – Woodland 220 kV OHL	Technical Performance	Economic Performance	Environmental	Deliverability	Socio-economic	Overall Performance

Table 7 *Summary of performance of all criteria for the Corduff – Woodland 220 kV OHL option*

7.4 New Finglas - Woodland 220 kV OHL circuit

7.4.1 Description of option

This option involves a transmission network reinforcement to strengthen the network between the existing Woodland 400 kV substation in County Meath and the Finglas 220 kV substation in North County Dublin. The reinforcement consists of a new 220 kV overhead line linking the Woodland 400 kV substation to the Finglas 220 kV substation.

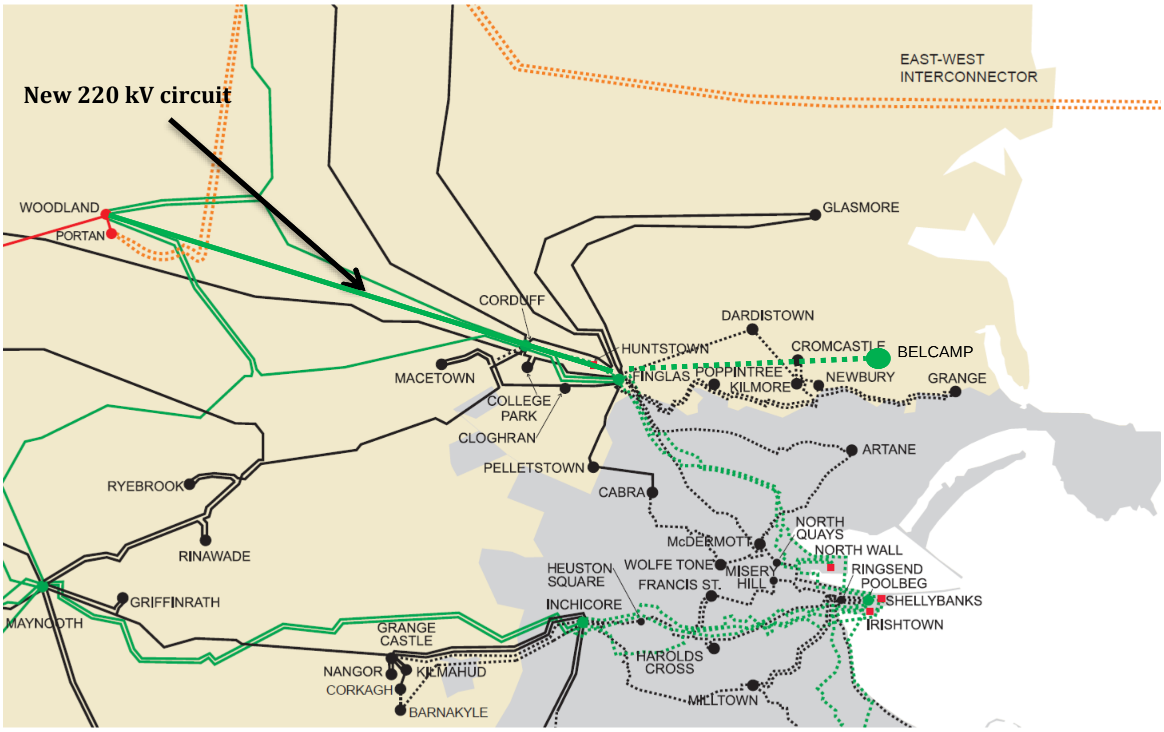


Figure 6: *New 220 kV overhead line circuit connecting the Woodland and Finglas substations.*

7.4.2 Technical Performance

7.4.2.1 Thermal overloads

In comparison to the alternative options, the New Finglas - Woodland 220 kV OHL option performs poorly in terms of remaining thermal overloads that are required to be resolved to fulfil a fully compliant solution with the Transmission System Security and Planning Standards (TSSPS) (**Dark Blue**).

This option removes the overload of Clonee – Woodland 220 kV circuit seen when the system is intact. It is reduced to a post contingent overload of 114% following the unplanned loss of the Corduff – Woodland 220 kV circuit. The post contingent overload on the existing Corduff – Woodland 220 kV circuit following the unplanned loss of the Clonee – Woodland 220 kV circuit identified in Step 1, is reduced from 172% to 109%. The unplanned loss of the new Finglas – Woodland 220 kV circuit has a similar result.

Dependence on generation in the North Dublin area is reduced by this option as the option will better manage power flows on the existing 220 kV circuits between Woodland, Corduff, and Finglas 220 kV substations. In particularly the dependence on the generators at Huntstown generation station is reduced. Generation at Poolbeg generation station can be used to alleviate thermal problems, but its effect is limited by the capacity of the circuits between Poolbeg, North Wall, and Shellybanks and Finglas substations.

This option increases the flows on the 400/220 kV transformers at Woodland. The thermal ratings of the transformers are not breached, however remaining capacity headroom is eroded.

To further reduce dependence on generation in North Dublin additional reinforcement will be required. For example, the existing Corduff – Finglas 1 & 2, Corduff – Woodland, Clonee – Woodland and Clonee – Corduff 220 kV circuits may need thermal uprating in the future, depending on the rate of demand increases and generation portfolio changes. Other potential solutions include new additional circuits in the area to add further network capacity, for example a new circuit between Corduff, Finglas or Belcamp substations in North Dublin and Poolbeg or Irishtown substations in the city centre.

7.4.2.2 Voltage

The management of voltage in the Dublin and Mid East area is a known operational challenge.

This option is an overhead line option and so will not be expected to have a significant influence on increasing the voltage in the area. The analysis carried out has confirmed this. This option performs well in terms of voltage and has a low influence on the need for additional reactive power controlling equipment (**Cream**)

7.4.2.3 Short Circuit Analysis

The transmission network in North Dublin has relatively high short circuit current levels, but still with standards and Grid code levels. This option contributes to a moderate to low increase of short circuit current levels in the North Dublin area. All increases in short circuit level remain within Grid Code levels, but represent a reduction in available headroom. The results of the short circuit analysis can be found in Appendix 4. This option is considered to have a moderate to low impact in terms short circuit current levels (**Green**).

7.4.2.4 Reinforcements to cater for maintenance conditions

This option will require additional reinforcements to keep the network within standards following a subsequent loss of plant and equipment whilst another is out for planned maintenance. In particular, a maintenance and trip combination that includes the new Finglas - Woodland 220 kV OHL and one of the existing 220 kV circuits between Corduff, Clonee, Finglas, and Woodland, result in overloads on remaining circuits in that corridor which are the same as the unplanned loss of a single piece of transmission equipment before the new circuit is added. This issue is common to all the options evaluated. These overloads can be managed using dispatch of existing thermal generation in North Dublin. To reduce dependence on these generators additional reinforcements will be required. The additional reinforcements range from thermal uprates of the existing 220 kV circuits, or new circuits to add further capacity to the network in the area.

This option is considered to have a high to moderate performance in terms possible future reinforcements. (**Blue**).

7.4.2.5 Conclusion of technical performance

The ability of each option to reduce thermal overloads in the network corridor is a key consideration for technical performance, and when combined with the other technical aspects this option is considered to have moderate to poor performance (**Blue)**.

Technical performance Finglas – Woodland 220 kV OHL	Thermal overloads	Voltage	Short circuit	Maintenance conditions	Combined Technical Performance

Table 8 *Summary of technical performance for the Finglas – Woodland 220 kV OHL option*

7.4.3 Economic Performance

The estimated capital costs for the full solution for the Finglas – Woodland 220 kV OHL option is approximately €20.3m. This includes new circuit bays required. The estimated cost for the transmission system operator to develop the Finglas – Woodland 220 kV OHL option is approximately €23.3m. This option is considered to have low impact in terms of the cost (**Cream**).

7.4.4 Environmental

Having considered the potential environmental impacts of a 220 kV OHL it is concluded that this option will have moderate environmental impact (**Dark Green**) – this is relative to the other options being considered and in particular the UGC. The construction and operation of a 400kV or 220kV OHL would be similar. The introduction of new overhead infrastructure into the study area will change the baseline environment and while it may be possible to mitigate impacts, they may be significant. The determination of the significance of which would require more detailed assessment as the options move through the various steps in the Framework for Grid Development.

7.4.5 Deliverability

Having assessed high level deliverability aspects for a new 220 kV overhead line circuit it is concluded that this option could be associated with high planning risks.

A new OHL circuit will require permits and wayleaves – this elevates the deliverability risks. There is a public participation facet requiring extensive relationship building with individual landowners, the risk to the option is often in the time required to achieve wayleaving.

It is considered that this option will have a low to moderate impact in terms of potential outages required as it is mostly a new build with only outages required for energisation.

Given the nature of the project the planning risks are considered to more difficult to mitigate and more dominant in delivering the project. Combining the planning risks with the risks around permits and wayleaving, this option is considered to have an overall high to moderate impact on deliverability (**Blue**)

7.4.6 Socio-economic

Having considered the potential impacts of a 220 kV OHL it is concluded that this option will have moderate socio-economic impact (**Dark Green**) – this is relative to the other options being considered and in particular the UGC. The construction and operation of a 400 kV or 220 kV OHL would be similar. The introduction of new overhead infrastructure into the study area will change the baseline environment and while it may be possible to mitigate impacts they may be significant. The determination of the significance of which would require more detailed assessment as the options move through the various steps in the Framework for Grid Development. It performs better than the other OHL option to Belcamp as it only travels to the substations on the western fringes of Dublin City and avoids more constrained areas.

7.4.7 Summary of option

Overall performance Finglas – Woodland 220 kV OHL	Technical Performance	Economic Performance	Environmental	Deliverability	Socio-economic	Overall Performance
	(Blue)	(Light Yellow)	(Dark Green)	(Blue)	(Dark Green)	(Blue)

Table 9 *Summary of performance of all criteria for the Finglas - Woodland 220 kV OHL option*

7.5 New Finglas – Woodland 400 kV UGC circuit

This option involves a transmission network reinforcement to strengthen the network between the existing Woodland 400 kV substation in County Meath and the Finglas 220 kV substation in North County Dublin. The reinforcement consists of a new 400 kV underground cable linking the Woodland 400 kV substation to the Finglas 220 kV substation, and a new 400 kV busbar and 400/220 kV transformer at Finglas.

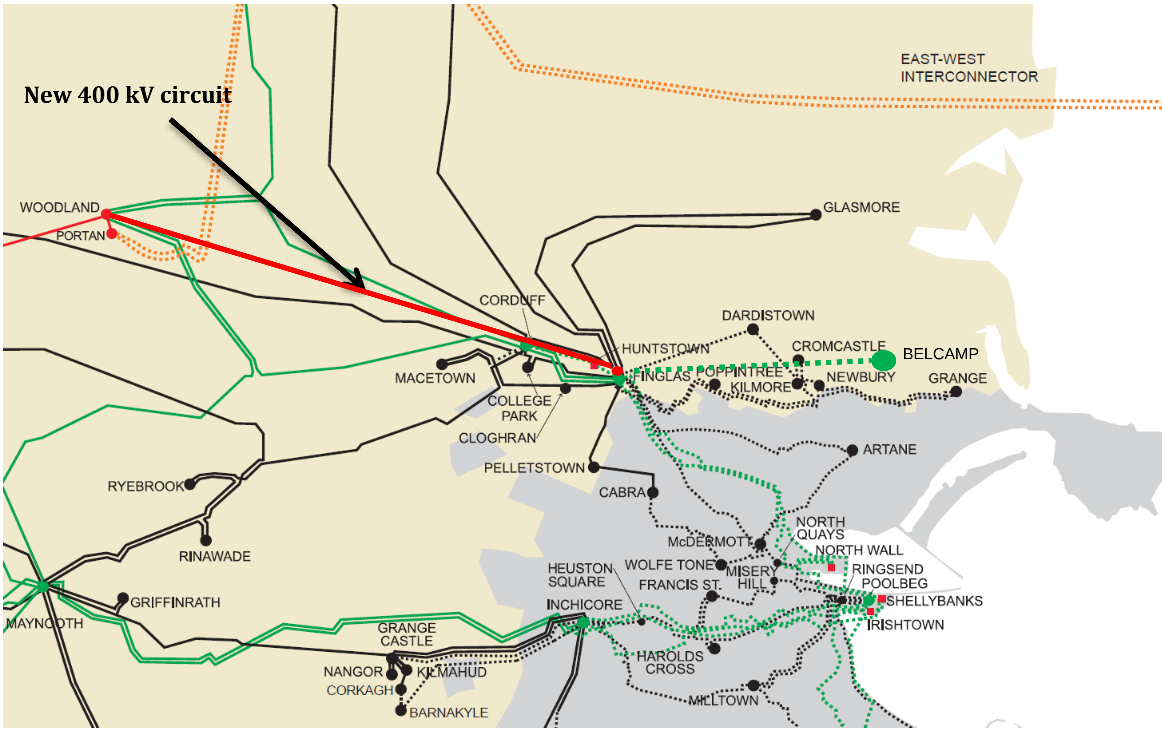


Figure 7: *New 400 kV underground cable circuit connecting the Woodland and Finglas substations.*

7.5.1 Technical Performance

7.5.1.1 Thermal overloads

In comparison to the alternative options, the New Finglas - Woodland 400 kV UGC option performs well in terms of remaining thermal overloads that are required to be resolved to fulfil a fully compliant solution with the Transmission System Security and Planning Standards (TSSPS). (**Green**).

This option removes the overload of Clonee – Woodland 220 kV circuit seen when the system is intact. It is reduced to a post contingent overload of 105% following the unplanned loss of the new circuit. The post contingent overload on the existing Corduff – Woodland 220 kV circuit following the unplanned loss of the Clonee – Woodland 220 kV circuit identified in Step 1, is reduced from 172% to 100%.

Dependence on generation in the North Dublin area, particularly the generators at Huntstown, to manage power flows on the existing 220 kV circuits between Woodland, Corduff, and Finglas 220 kV substations is reduced by this option, but some dependence remains.

The new 400/220 kV transformer at Finglas can be seen to be loaded above its continuous rating, but within its emergency rating, when one Huntstown generator trips while the other is unavailable. Additional 400/220 kV transformer capacity may be required at Finglas to accommodate these power flows. These power flows are higher than those shown for the 400 kV OHL options due to the lower impedance of the cable circuit between Woodland and Finglas.

Dependence on generation in the North Dublin area is reduced by this option as the option will better manage power flows on the existing 220 kV circuits between Woodland, Corduff, and Finglas 220 kV substations. In particularly the dependence on the generators at Huntstown generation station is reduced. Generation at Poolbeg generation station can be used to alleviate thermal problems, but its effect is limited by the capacity of the circuits between Poolbeg, North Wall, and Shellybanks and Finglas substations.

To further reduce dependence on generation in North Dublin additional reinforcement will be required. For example, the existing Corduff – Finglas 1 & 2, Corduff – Woodland, Clonee – Woodland and Clonee – Corduff 220 kV circuits may need thermal uprating in the future, depending on the rate of demand increases and generation portfolio changes. Other potential solutions include new additional circuits in the area to add further network capacity, for example a new circuit between Corduff, Finglas or Belcamp substations in North Dublin and Poolbeg or Irishtown substations in the city centre.

7.5.1.2 Voltage

The management of voltage in the Dublin and Mid East area is a known operational challenge.

This option is an underground cable option and so will be expected to have a significant influence on increasing the voltage in the area. The analysis carried out has confirmed this identifying night time voltages above allowable limits that will require mitigation. If this option progresses to Step 3, further analysis will be undertaken to determine the mitigation required. This option has a moderate influence on the need for additional reactive power controlling equipment (**Green**)

7.5.1.3 Short Circuit Analysis

The transmission network in North Dublin has relatively high short circuit current levels, but still with standards and Grid code levels. This option contributes to a moderate to high increase of short circuit current levels in the North Dublin area. All increases in short circuit level remain within Grid Code levels, but represent a reduction in available headroom. The results of the short circuit analysis can be found in Appendix 4. This option is considered to have a moderate to high impact in terms short circuit current levels (**Blue**).

7.5.1.4 Reinforcements to cater for maintenance conditions

This option will require additional reinforcements to keep the network within standards following a subsequent loss of plant and equipment whilst another is out for planned maintenance. In particular, a maintenance and trip combination that includes the new Finglas - Woodland 400 kV UGC and one of the existing 220 kV circuits between Corduff, Clonee, Finglas, and Woodland, result in overloads on remaining circuits in that corridor which are the same as the unplanned loss of a single piece of transmission equipment before the new circuit is added. This issue is common to all the options evaluated. These overloads can be managed using dispatch of existing thermal generation in North Dublin. To reduce dependence on these generators additional reinforcements will be required. The additional reinforcements range from thermal uprates of the existing 220 kV circuits, or new circuits to add further capacity to the network in the area. Details of the criteria are found in section 3.2

This option is considered to have a moderate performance in terms possible future reinforcements (**Dark Green**).

7.5.1.5 Conclusion of technical performance

This option is considered to have good performance from a technical point of view (**Green**) when all technical aspects were considered.

Technical performance Finglas – Woodland 400 kV UGC	Thermal overloads	Voltage	Short circuit	Maintenance conditions	Combined Technical Performance

Table 10 *Summary of technical performance for the Finglas – Woodland 400 kV UGC option*

7.5.2 Economic Performance

The estimated capital costs for the full solution for the Finglas – Woodland 400 kV UGC option is approximately €154.6m. This includes new circuit bays, new 400 kV equipment at the existing substation, and new 400/220 kV transformer required. The estimated cost for the transmission system operator to develop the Finglas – Woodland 400 kV UGC option is approximately €17.0m. This option is considered to have high impact in terms of the cost (**Dark Blue**).

7.5.3 Environmental

Having considered the potential environmental impacts of a 400kkV UGC it is concluded that this option will have low-moderate environmental impact (**Green**) – this is relative to the other options being considered and in particular the OHL. The construction of UGC however is not without its impacts and requires careful consideration of impacts on sensitive receptors. It should be possible to mitigate significant impacts. The determination of the significance of which would require more detailed assessment as the options move through the various steps in the Framework for Grid Development.

7.5.4 Deliverability

An UGC option may reduce the risk in attaining permits. This is largely due to the elimination of visual impacts and preference from the public for EirGrid to pursue UGC options generally. It is currently considered that the UGC options in this project, due to their size, scale and likely impact, are likely to require planning permission. While there is precedent for 220 kV UGC within the public road to comprise exempted development, it is considered that the scale of the overall UGC development, combined with the new associated infrastructure likely to be required as outlined above, will result in the overall development not comprising exempted development.

Additionally, some other elements of the option may require planning, such as reactive support requirements if required, so the option will still have moderate planning risks associated.

An UGC option would preferably be accommodated in the public road network. However with regards to permits and wayleaving, it should be recognised that it may not be possible to lay a 400 kV underground cable along existing roads due to the cable trench width required. If this is the case, a 400 kV underground cable option may have to be laid across open fields.

This brings its own significant challenges in terms of landowner engagement and concerns, environmental and land use impacts – in particular the inability to undertake certain types of agricultural activity thereon. It is assumed that significant engagement with landowners with properties along public roads would be required in the delivery of a new 400 kV UGC, for such purposes as surveying, siting and construction.

A high level assessment showed limited options for the development of a new 400 kV busbar adjacent to the existing Finglas 220 kV substation. An appropriate site may be located in the vicinity, however this would introduce additional project complexity and risk associated with new circuits required to connect the new 400 kV busbar to the existing 220 kV busbar.

It is considered that this option will have a low to moderate impact in terms of potential outages required as it is mostly a new build with only outages required for energisation.

Overall, this option is considered to have an overall mid-level/moderate impact on deliverability (**Dark Green**).

7.5.5 Socio-economic

Having considered the potential impacts of a UGC it is concluded that this option will have low-moderate socio-economic impact (**Green**) – this is relative to the other options being considered and in particular the OHL. The introduction of new overhead infrastructure into the study area will change the baseline environment and while it may be possible to mitigate impacts they may be significant. The determination of the significance of which would require more detailed assessment as the options move through the various steps in the Framework for Grid Development.

7.5.6 Summary of option

Overall performance Finglas – Woodland 400 kV UGC	Technical Performance	Economic Performance	Environmental	Deliverability	Socio-economic	Overall Performance

Table 11 *Summary of performance of all criteria for the Finglas – Woodland 400 kV UGC option*

7.6 New Finglas - Woodland 400 kV OHL circuit

7.6.1 Description of option

This option involves a transmission network reinforcement to strengthen the network between the existing Woodland 400 kV substation in County Meath and the Finglas 220 kV substation in North County Dublin. The reinforcement consists of a new 400 kV overhead line linking the Woodland 400 kV substation to the Finglas 220 kV substation, and a new 400 kV busbar and 400/220 kV transformer at Finglas.

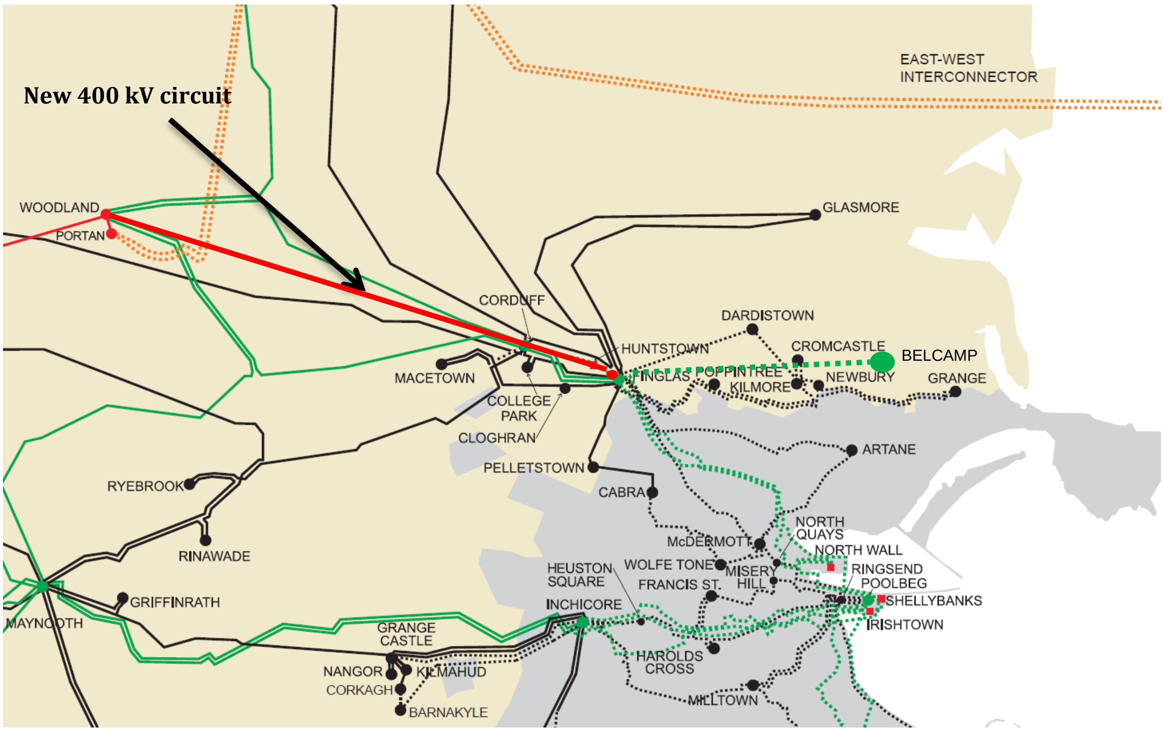


Figure 8: *New 400 kV overhead line circuit connecting the Woodland and Finglas substations.*

7.6.2 Technical Performance

7.6.2.1 Thermal overloads

In comparison to the alternative options, the New Finglas - Woodland 400 kV OHL option performs well in terms of remaining thermal overloads that are required to be resolved to fulfil a fully compliant solution with the Transmission System Security and Planning Standards (TSSPS).

This option removes the overload of Clonee – Woodland 220 kV circuit seen when the system is intact. It is reduced to a post contingent overload of 109% following the unplanned loss of the Corduff – Woodland 220 kV circuit. The post contingent overload on the existing Corduff – Woodland 220 kV circuit following the unplanned loss of the Clonee – Woodland 220 kV circuit identified in Step 1, is reduced from 172% to 105%.

Dependence on generation in the North Dublin area is reduced by this option as the option will better manage power flows on the existing 220 kV circuits between Woodland, Corduff, and Finglas 220 kV substations. In particularly the dependence on the generators at Huntstown generation station is reduced. Generation at Poolbeg generation station can be used to alleviate thermal problems, but its effect is limited by the capacity of the circuits between Poolbeg, North Wall, and Shellybanks and Finglas substations.

To further reduce dependence on generation in North Dublin additional reinforcement will be required. For example, the existing Corduff – Finglas 1 & 2, Corduff – Woodland, Clonee – Woodland and Clonee – Corduff 220 kV circuits may need thermal uprating in the future, depending on the rate of demand increases and generation portfolio changes. Other potential solutions include new additional circuits in the area to add further network capacity, for example a new circuit between Corduff, Finglas or Belcamp substations in North Dublin and Poolbeg or Irishtown substations in the city centre.(**Green**).

7.6.2.2 Voltage

The management of voltage in the Dublin and Mid East area is a known operational challenge.

This option is an overhead line option and so will not be expected to have a significant influence on increasing the voltage in the area. The analysis carried out has confirmed this. This option performs well in terms of voltage and has a low influence on the need for additional reactive power controlling equipment (**Cream**)

7.6.2.3 Short Circuit Analysis

The transmission network in North Dublin has relatively high short circuit current levels, but still with standards and Grid code levels. This option contributes to a moderate to high increase of short circuit current levels in the North Dublin area. All increases in short circuit level remain within Grid Code levels, but represent a reduction in available headroom. The results of the short circuit analysis can be found in Appendix 4. This option is considered to have a moderate to high impact in terms short circuit current levels (**Blue**).

7.6.2.4 Reinforcements to cater for maintenance conditions

This option will require additional reinforcements to keep the network within standards following a subsequent loss of plant and equipment whilst another is out for planned maintenance. In particular, a maintenance and trip combination that includes the new Finglas - Woodland 400 kV OHL and one of the existing 220 kV circuits between Corduff, Clonee, Finglas, and Woodland, result in overloads on remaining circuits in that corridor which are the same as the unplanned loss of a single piece of transmission equipment before the new circuit is added. This issue is common to all the options evaluated. These overloads can be managed using dispatch of existing thermal generation in North Dublin. To reduce dependence on these generators additional reinforcements will be required. The additional reinforcements range from thermal uprates of the existing 220 kV circuits, or new circuits to add further capacity to the network in the area.

This option is considered to have a moderate performance in terms possible future reinforcements (**Dark Green**).

7.6.2.5 Conclusion of technical performance

This option is considered to have good performance from a technical point of view (**Green**) when all technical aspects were considered.

Technical performance Finglas – Woodland 400 kV OHL	Thermal overloads	Voltage	Short circuit	Maintenance conditions	Combined Technical Performance

Table 12 *Summary of technical performance for Finglas – Woodland 400 kV OHL option*

7.6.3 Economic Performance

The estimated capital costs for the full solution for the Finglas – Woodland 400 kV OHL option is approximately €44.7m. This includes new circuit bays, new 400 kV equipment at the existing substation, and new 400/220 kV transformer required. The estimated cost for the transmission system operator to develop the Finglas – Woodland 400 kV OHL option is approximately €23.8m. This option is considered to have low to moderate impact in terms of the cost (**Green**).

7.6.4 Environmental

Having considered the potential environmental impacts of a 400kV OHL it is concluded that this option will have moderate environmental impact (**Dark Green**) – this is relative to the other options being considered and in particular the UGC. The construction and operation of a 400kV or 220kV OHL would be similar.The introduction of new overhead infrastructure into the study area will change the baseline environment and while it may be possible to mitigate impacts they may be significant. The determination of the significance of which would require more detailed assessment as the options move through the various steps in the Framework for Grid Development.

7.6.5 Deliverability

Having assessed high level deliverability aspects for a new 400 kV overhead line circuit it is concluded that this option could be associated with high planning risks.

Based on experience on other similar OHL projects, permitting would be expected to be very challenging due to societal acceptance of such a development. This means that overall, the option could very likely experience delays in its development compared to the other options.

Furthermore, a high level assessment showed limited options for the development of a new 400 kV busbar adjacent to the existing Finglas 220 kV substation. An appropriate site may be located in the vicinity, however this would introduce additional project complexity and risk associated with new circuits required to connect the new 400 kV busbar to the existing 220 kV busbar.

It is considered that this option will have a low to moderate impact in terms of potential outages required as it is mostly a new build with only outages required for energisation.

Significant engagement with landowners and communities would be required in the delivery of a new overhead circuit, for such purposes as surveying, siting and construction. These parties may be new to accommodating electricity infrastructure on their landholdings and within their communities. New wayleaves would be required to facilitate construction of the new circuit. Based on recent precedent in terms of the provision of new 400 kV transmission infrastructure, there is the potential for significant landowner, community and public concerns with this option, with the likely consequence of project delays or difficulties in gaining access to land.

Overall, given the nature of the project the planning risks are considered difficult to mitigate and more dominant in delivering the project. Combining the planning risks with the risks around permits and wayleaving, this option is considered to have an overall high to moderate impact on deliverability (**Blue).**

7.6.6 Socio-economic

Having considered the potential impacts of a 400 kV OHL it is concluded that this option will have moderate socio-economic impact (**Dark Green**) – this is relative to the other options being considered and in particular the UGC. The construction and operation of a 400 kV or 220 kV OHL would be similar. The introduction of new overhead infrastructure into the study area will change the baseline environment and while it may be possible to mitigate impacts they may be significant. The determination of the significance of which would require more detailed assessment as the options move through the various steps in the Framework for Grid Development. It performs better than the other OHL option to

Belcamp as it only travels to the substations on the western fringes of Dublin City and avoids more constrained areas.

7.6.7 Summary of option

Overall performance Finglas – Woodland 400 kV OHL	Technical Performance	Economic Performance	Environmental	Deliverability	Socio-economic	Overall Performance

Table 13 *Summary of performance of all criteria for the Finglas – Woodland 400 kV OHL option*

7.7 New Belcamp – Woodland 400 kV OHL circuit

This option involves a transmission network reinforcement to strengthen the network between the existing Woodland 400 kV substation in County Meath and the Belcamp 220 kV substation in North County Dublin. The reinforcement consists of a new 400 kV overhead line linking the Woodland 400 kV substation to the Belcamp 220 kV substation, and a new 400 kV busbar and 400/220 kV transformer at Belcamp.

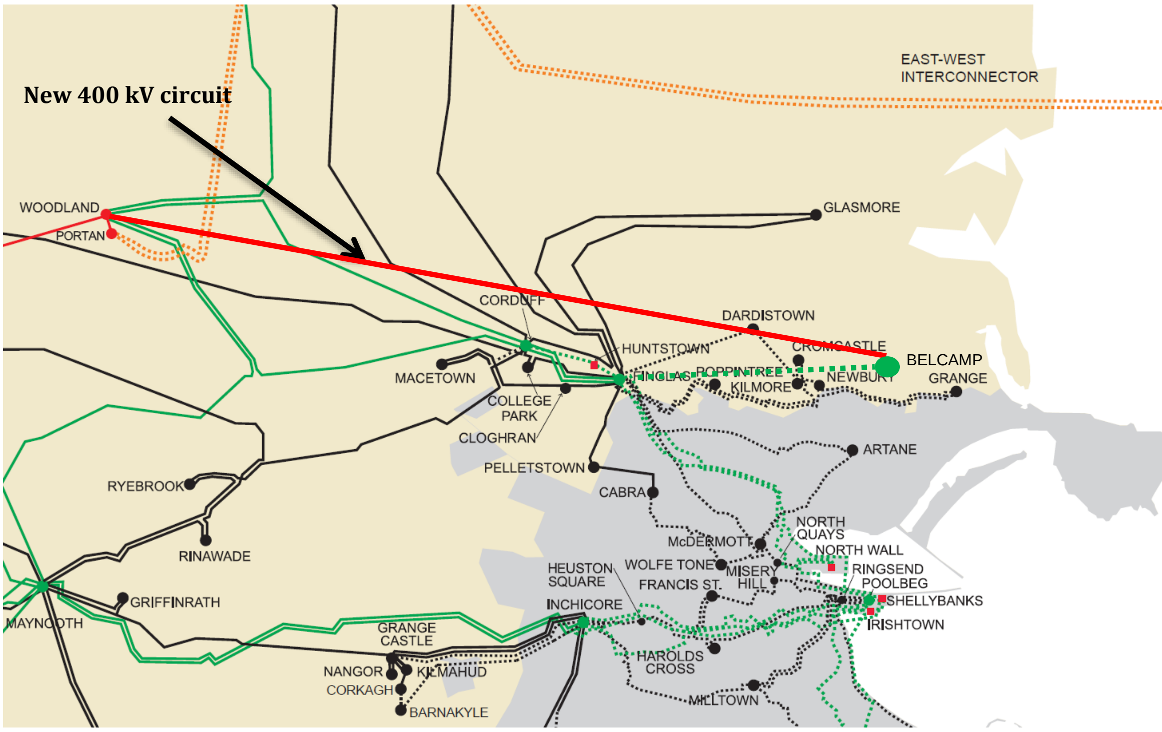


Figure 9: *New 400 kV overhead line circuit connecting the Woodland and Belcamp substations.*

7.7.1 Technical Performance

7.7.1.1 Thermal overloads

In comparison to the alternative options, the New Belcamp - Woodland 400 kV OHL option performs well in terms of remaining thermal overloads that are required to be resolved to fulfil a fully compliant solution with the Transmission System Security and Planning Standards (TSSPS). (**Green**).

This option removes the overload of Clonee – Woodland 220 kV circuit seen when the system is intact. It is reduced to a post contingent overload of 110% following the unplanned loss of the Corduff – Woodland 220 kV circuit. The post contingent overload on the existing Corduff – Woodland 220 kV circuit following the unplanned loss of the Clonee – Woodland 220 kV circuit identified in Step 1, is reduced from 172% to 107%.

Dependence on generation in the North Dublin area is reduced by this option as the option will better manage power flows on the existing 220 kV circuits between Woodland, Corduff, and Finglas 220 kV substations. In particularly the dependence on the generators at Huntstown generation station is reduced. Generation at Poolbeg generation station can be used to alleviate thermal problems, but its effect is limited by the capacity of the circuits between Poolbeg, North Wall, and Shellybanks and Finglas substations.

To further reduce dependence on generation in North Dublin additional reinforcement will be required. For example, the existing Corduff – Finglas 1 & 2, Corduff – Woodland, Clonee – Woodland and Clonee – Corduff 220 kV circuits may need thermal uprating in the future, depending on the rate of demand increases and generation portfolio changes. Other potential solutions include new additional circuits in the area to add further network capacity, for example a new circuit between Corduff, Finglas or Belcamp substations in North Dublin and Poolbeg or Irishtown substations in the city centre.

7.7.1.2 Voltage

The management of voltage in the Dublin and Mid East area is a known operational challenge.

This option is an overhead line option and so will not be expected to have a significant influence on increasing the voltage in the area. The analysis carried out has confirmed this. This option performs well in terms of voltage and has a low influence on the need for additional reactive power controlling equipment (**Cream**)

7.7.1.3 Short Circuit Analysis

The transmission network in North Dublin has relatively high short circuit current levels, but still with standards and Grid code levels. This option contributes to a moderate to high increase of short circuit current levels in the North Dublin area. All increases in short circuit level remain within Grid Code levels, but represent a reduction in available headroom. The results of the short circuit analysis can be found in Appendix 4. This option is considered to have a moderate to high impact in terms short circuit current levels (**Blue**).

7.7.1.4 Reinforcements to cater for maintenance conditions

This option will require additional reinforcements to keep the network within standards following a subsequent loss of plant and equipment whilst another is out for planned maintenance. In particular, a maintenance and trip combination that includes the new Belcamp - Woodland 400 kV OHL and one of the existing 220 kV circuits between Corduff, Clonee, Finglas, and Woodland, result in overloads on remaining circuits in that corridor which are the same as the unplanned loss of a single item of transmission equipment before the new circuit is added. This issue is common to all the options evaluated. These overloads can be managed using dispatch of existing thermal generation in North Dublin. To reduce dependence on these generators additional reinforcements will be required. The additional reinforcements range from thermal uprates of the existing 220 kV circuits, or new circuits to add further capacity to the network in the area. Details of the criteria are found in section 3.2

This option is considered to have a moderate performance in terms possible future reinforcements (**Dark Green**).

7.7.1.5 Conclusion of technical performance

This option is considered to have good performance from a technical point of view (**Green**) when all technical aspects were considered.

Technical performance Belcamp – Woodland 400 kV OHL	Thermal overloads	Voltage	Short circuit	Maintenance conditions	Combined Technical Performance

Table 14 *Summary of technical performance for the Belcamp – Woodland 400 kV OHL option*

7.7.2 Economic Performance

The estimated capital costs for the full solution for the Belcamp – Woodland 400 kV OHL option is approximately €58.2m. This includes new circuit bays, new 400 kV equipment at the existing substation, and new 400/220 kV transformer required. The estimated cost for the transmission system operator to develop the Belcamp – Woodland 400 kV OHL option is approximately €24.6m. This option is considered to have low to moderate impact in terms of the cost (**Green**).

7.7.3 Environmental

Having considered the potential environmental impacts of a 220kV OHL it is concluded that this option will have moderate environmental impact (**Dark Green**) – this is relative to the other options being considered and in particular the UGC. The construction and operation of a 400kV or 220kV OHL would be similar.The introduction of new overhead infrastructure into the study area will change the baseline environment and while it may be possible to mitigate impacts they may be significant. The determination of the significance of which would require more detailed assessment as the options move through the various steps in the Framework for Grid Development.

7.7.4 Deliverability

Having assessed high level deliverability aspects for a new 400 kV overhead line circuit it is concluded that this option could be associated with high planning risks.

Based on experience on other similar OHL projects, permitting would be expected to be very challenging due to societal acceptance of such a development. This means that overall, the option could very likely experience delays in its development compared to the other options.

On the other hand, a high level assessment showed suitable options for the development of a new 400 kV busbar adjacent to the existing Belcamp 220 kV substation. This would minimise project complexity and risk associated with connections between the new 400 kV busbar to the existing 220 kV busbar.

It is considered that this option will have a low to moderate impact in terms of potential outages required as it is mostly a new build with only outages required for energisation.

Significant engagement with landowners and communities would be required in the delivery of a new overhead circuit, for such purposes as surveying, siting and construction. These parties may be new to accommodating electricity infrastructure on their landholdings and within their communities. New wayleaves would be required to facilitate construction of the new circuit. Based on recent precedent in terms of the provision of new 400 kV transmission infrastructure, there is the potential for significant landowner, community and public concerns with this option, with the likely consequence of project delays or difficulties in gaining access to land.

Given the nature of the project the planning risks are considered difficult to mitigate and more dominant in delivering the project. Combining the planning risks with the risks around permits and wayleaving, this option is considered to have an overall moderate to high impact on deliverability (**Blue**)

7.7.5 *Socio-economic*

Having considered the potential impacts of a 400 kV OHL it is concluded that this option will have moderate-high socio-economic impact (**Dark Green**) – this is relative to the other options being considered and in particular the UGC. The introduction of new overhead infrastructure into the study area will change the baseline environment and while it may be possible to mitigate impacts they may be significant. The determination of the significance of which would require more detailed assessment as the options move through the various steps in the Framework for Grid Development. It performs worse than the other OHL options as it travels to the substations with additional constrained areas like including north Dublin City, Dublin Airport Environs, Swords.

7.7.6 Summary of option

Overall performance Belcamp – Woodland 400 kV OHL	Technical Performance	Economic Performance	Environmental	Deliverability	Socio-economic	Overall Performance

Table 15 *Summary of performance of all criteria for the Belcamp – Woodland 400 kV OHL option.*

7.8 Summary of the performance of options

7.8.1 Technical Performance

The technical performance of each option was assessed to achieve Transmission System Security and Planning Standards (TSSPS) compliant solutions. In addition, certain aspects were looked at in detail to distinguish between the options such as the difference in thermal overloads, improvements in phase angles, difference in reactive support requirements, changes in short circuit levels and how the options performed under maintenance conditions. It should be noted that the relative performance between the options may change in Step 3 when further analysis is carried out.

Estimated Technical performance for options	Corduff - Woodland 400 kV OHL	Corduff – Woodland 400 kV UGC	Corduff - Woodland 220 kV OHL	Finglas - Woodland 220 kV OHL	Finglas - Woodland 400 kV UGC	Finglas - Woodland 400 kV OHL	Belcamp - Woodland 400 kV OHL

Table 16 *Summary of technical performance for all options*

7.8.2 Economic Performance

The economic performance of the options is based on capital costs for each option. Each option is fully assessed to achieve a Transmission System Security and Planning Standards (TSSPS) compliant solution. The capital costs for the five options range between €86m – €173m.   Each option is also assessed on estimated cost for the transmission system operator to develop. These costs range between €13-20m for the five options.

Estimated economic performance for options	Corduff - Woodland 400 kV OHL	Corduff – Woodland 400 kV UGC	Corduff - Woodland 220 kV OHL	Finglas - Woodland 220 kV OHL	Finglas - Woodland 400 kV UGC	Finglas - Woodland 400 kV OHL	Belcamp - Woodland 400 kV OHL

Table 17 *Summary of economic performance for all options*

7.8.3 Environmental

The options were assessed, at a high level, for potential environmental impacts. The construction of any new transmission infrastructure will compare poorly against other options using existing infrastructure. It is also recognised that the installation of an underground option is not without environmental impacts. An underground option will have a slightly better environmental performance in comparison with an above ground solution on a high level general comparison.

Estimated environmental aspects	Corduff - Woodland 400 kV OHL	Corduff – Woodland 400 kV UGC	Corduff - Woodland 220 kV OHL	Finglas - Woodland 220 kV OHL	Finglas - Woodland 400 kV UGC	Finglas - Woodland 400 kV OHL	Belcamp - Woodland 400 kV OHL

Table 18 *Summary of environmental aspects for all options*

7.8.4 Deliverability

The deliverability aspects in regards to timelines, planning risks, permits and wayleaving and outages were assessed on a high level for the options. All the options involve new infrastructure and so were associated with low outages as is assumed that they will be constructed off-line with minimal outages required to connect to the transmission system. All options could have a range of different planning, permitting, wayleaving and construction risks and other aspects associated with their technology and this was reflected in the assessment at a high level. Further investigations and assessments will be undertaken in Step 3.

Estimated deliverability aspects	Corduff - Woodland 400 kV OHL	Corduff – Woodland 400 kV UGC	Corduff - Woodland 220 kV OHL	Finglas - Woodland 220 kV OHL	Finglas - Woodland 400 kV UGC	Finglas - Woodland 400 kV OHL	Belcamp - Woodland 400 kV OHL

Table 19 *Summary of deliverability aspects for all options*

7.8.5 Socio-economic

A new asset in a socio-economic environment will, in general, always perform poorly relative to other options which may use existing infrastructure. The introduction of new infrastructure into the study area will change the baseline environment and while it may be possible to mitigate impacts they may be significant. The determination of the significance of which would require more detailed assessment as the options move through the various steps in the Framework for Grid Development.

Estimated socio-economic aspects	Corduff - Woodland 400 kV OHL	Corduff – Woodland 400 kV UGC	Corduff - Woodland 220 kV OHL	Finglas - Woodland 220 kV OHL	Finglas - Woodland 400 kV UGC	Finglas - Woodland 400 kV OHL	Belcamp - Woodland 400 kV OHL

Table 20 *Summary of socio-economic performance for all options*

8 Conclusions

EirGrid follow a six step approach when we develop and implement the best performing solution option to any identified transmission network problem. The transmission network problem for Capital Project 1021 was identified and described in previous Step 1 and was documented in the Need Report.

The need, in this case, involves a transmission network problem relating to the transfer of power across the existing 220 kV transmission network from the Woodland 400 kV substation to the north Dublin area. The issues encountered involve the capacity of the transmission system in the area.

Capital Project 1021 has now gone through Step 2 of the framework for grid development. Step 2 was carried out in two parts. Part A covered the aspects that were considered when the long list of options was created and the first refinement of this list. This is documented in Options Report Part A. The outcome of the second part of refinement of the list has been presented in this report, Options Report Part B (this document).

The outcome from the Part B in Step 2 is that four solution options will be brought forward for further analysis in Step 3. The four options are:

1. New Finglas – Woodland 400 kV overhead line (OHL)
2. New Finglas – Woodland 400 kV underground cable (UGC)
3. New Belcamp – Woodland 400 kV overhead line (OHL)
4. New Belcamp – Woodland 400 kV underground cable (UGC)

Appendix 1 – Analysis Result

Appendix 1A – New Corduff – Woodland 400 kV OHL Circuit

Loss of single piece of transmission equipment Results

Contingency	Monitored line	Pre-cnt MVA	Post-cnt MVA	Rating MVA	% Loading	Demand Level
Corduff - Finglas 1 220 kV circuit	Corduff - Finglas 2 220 kV circuit	291.5	569.5	434	131.2	Summer Peak
Corduff - Finglas 2 220 kV circuit	Corduff - Finglas 1 220 kV circuit	291.5	569.5	434	131.2	Summer Peak

Loss of single piece of transmission equipment while generation is out of service Results

Generator Outage	Contingency	Monitored line	Pre-cnt MVA	Post-cnt MVA	Rating MVA	% Loading	Demand Level
Huntstown 2	Corduff - Woodland 1 220 kV circuit	Clonee - Woodland 1 220 kV circuit	407	624.7	434	143.9	Summer Peak
Huntstown 2	Clonee - Woodland 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	355.3	608.8	434	140.3	Summer Peak
Huntstown 2	New Corduff - Woodland 400 kV circuit	Clonee - Woodland 1 220 kV circuit	407	585.1	434	134.8	Summer Peak
Huntstown 2	New Corduff 400/220 kV transformer	Clonee - Woodland 1 220 kV circuit	407	585.2	434	134.8	Summer Peak
Huntstown 2	New Corduff - Woodland 400 kV circuit	Corduff - Woodland 1 220 kV circuit	355.3	538.2	434	124	Summer Peak
Huntstown 2	New Corduff 400/220 kV transformer	Corduff - Woodland 1 220 kV circuit	355.3	538.3	434	124	Summer Peak
Huntstown 2	Clonee - Corduff 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	355.3	528.8	434	121.8	Summer Peak
Huntstown 2	Corduff - Finglas 1 220 kV circuit	Corduff - Finglas 2 220 kV circuit	257.5	502.5	434	115.8	Summer Peak
Huntstown 2	Corduff - Finglas 2 220 kV circuit	Corduff - Finglas 1 220 kV circuit	257.5	502.5	434	115.8	Summer Peak
Huntstown 2	Corduff - Woodland 1 220 kV circuit	Clonee - Corduff 1 220 kV circuit	279.4	491.1	434	113.2	Summer Peak
Huntstown 2	Corduff - Woodland 1 220 kV circuit	Clonee - Woodland 1 220 kV circuit	392.7	600.6	534	112.5	Winter Peak

Maintenance and trip combination Results

Maintenance	Contingency	Monitored Bus	Pre-cnt MVA	Post-cnt MVA	Rating MVA	% Loading	Demand Level
Clonee - Woodland 1 220 kV circuit	New Corduff 400 / 220 kV transformer	Corduff - Woodland 2 220 kV circuit	430	748.4	434	172.5	Summer Peak
Clonee - Woodland 1 220 kV circuit	New Corduff - Woodland 400 kV circuit	Corduff - Woodland 2 220 kV circuit	430	746.8	434	172.1	Summer Peak
Clonee - Corduff 1 220 kV circuit	New Corduff - Woodland 400 kV circuit	Corduff - Woodland 1 220 kV circuit	373.8	653.6	434	150.6	Summer Peak
Clonee - Corduff 1 220 kV circuit	New Corduff 400/220 kV transformer	Corduff - Woodland 1 220 kV circuit	373.8	653.8	434	150.6	Summer Peak
Corduff - Woodland 1 220 kV circuit	New Corduff - Woodland 400 kV circuit	Clonee - Corduff 1 220 kV circuit	344.8	622.8	434	143.5	Summer Peak
Corduff - Woodland 1 220 kV circuit	New Corduff 400/220 kV transformer	Clonee - Corduff 1 220 kV circuit	344.8	622.9	434	143.5	Summer Peak
Dunstown - Carrickmines 1 220 kV circuit	Corduff - Finglas 1 220 kV circuit	Corduff - Finglas 2 220 kV circuit	303.6	593.5	434	136.8	Summer Peak
Dunstown - Carrickmines 1 220 kV circuit	Corduff - Finglas 2 220 kV circuit	Corduff - Finglas 1 220 kV circuit	303.6	593.5	434	136.8	Summer Peak
Clonee - Woodland 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	New Corduff 400/220 kV transformer	468.2	682.9	500	136.6	Summer Peak
Corduff - Woodland 1 220 kV circuit	Clonee - Woodland 1 220 kV circuit	New Corduff 400/220 kV transformer	458.9	682.9	500	136.6	Summer Peak
Belcamp - Shellybanks 1 220 kV circuit	Corduff - Finglas 1 220 kV circuit	Corduff - Finglas 2 220 kV circuit	299	585	434	134.8	Summer Peak
Belcamp - Shellybanks 1 220 kV circuit	Corduff - Finglas 2 220 kV circuit	Corduff - Finglas 1 220 kV circuit	299	585	434	134.8	Summer Peak
Finglas - North Wall 1 220 kV circuit	Corduff - Finglas 1 220 kV circuit	Corduff - Finglas 2 220 kV circuit	293.9	575.1	434	132.5	Summer Peak
Finglas - North Wall 1 220 kV circuit	Corduff - Finglas 2 220 kV circuit	Corduff - Finglas 1 220 kV circuit	293.9	575.1	434	132.5	Summer Peak
Poolbeg - Shellybanks 1 220 kV circuit	Corduff - Finglas 1 220 kV circuit	Corduff - Finglas 2 220 kV circuit	293	572.9	434	132	Summer Peak
Poolbeg - Shellybanks 1 220 kV circuit	Corduff - Finglas 2 220 kV circuit	Corduff - Finglas 1 220 kV circuit	293	572.9	434	132	Summer Peak
Belcamp - Finglas 1 220 kV circuit	Corduff - Finglas 1 220 kV circuit	Corduff - Finglas 2 220 kV circuit	284.6	556.5	434	128.2	Summer Peak
Belcamp - Finglas 1 220 kV circuit	Corduff - Finglas 2 220 kV circuit	Corduff - Finglas 1 220 kV circuit	284.6	556.5	434	128.2	Summer Peak
Clonee - Corduff 1 220 kV circuit	Corduff - Finglas 1 220 kV circuit	Corduff - Finglas 2 220 kV circuit	279.6	546.8	434	126	Summer Peak
Clonee - Corduff 1 220 kV circuit	Corduff - Finglas 2 220 kV circuit	Corduff - Finglas 1 220 kV circuit	279.6	546.8	434	126	Summer Peak
Dunstown - Woodland 1 400 kV circuit	Corduff - Finglas 1 220 kV circuit	Corduff - Finglas 2 220 kV circuit	277.3	542.5	434	125	Summer Peak
Dunstown - Woodland 1 400 kV circuit	Corduff - Finglas 2 220 kV circuit	Corduff - Finglas 1 220 kV circuit	277.3	542.5	434	125	Summer Peak
Clonee - Corduff 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	New Corduff 400/220 kV transformer	444.7	621.6	500	124.3	Summer Peak
Corduff - Woodland 1 220 kV circuit	Clonee - Corduff 1 220 kV circuit	New Corduff 400/220 kV transformer	458.9	621.6	500	124.3	Summer Peak
Corduff - Woodland 1 220 kV circuit	Corduff - Finglas 1 220 kV circuit	Corduff - Finglas 2 220 kV circuit	275.1	538	434	124	Summer Peak
Corduff - Woodland 1 220 kV circuit	Corduff - Finglas 2 220 kV circuit	Corduff - Finglas 1 220 kV circuit	275.1	538	434	124	Summer Peak
Clonee - Woodland 1 220 kV circuit	Corduff - Finglas 1 220 kV circuit	Corduff - Finglas 2 220 kV circuit	272.4	532.5	434	122.7	Summer Peak
Clonee - Woodland 1 220 kV circuit	Corduff - Finglas 2 220 kV circuit	Corduff - Finglas 1 220 kV circuit	272.4	532.5	434	122.7	Summer Peak
Oldstreet - Woodland 1 400 kV circuit	Corduff - Finglas 1 220 kV circuit	Corduff - Finglas 2 220 kV circuit	268.5	524.4	434	120.8	Summer Peak
Oldstreet - Woodland 1 400 kV circuit	Corduff - Finglas 2 220 kV circuit	Corduff - Finglas 1 220 kV circuit	268.5	524.4	434	120.8	Summer Peak
Belcamp - Shellybanks 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	Clonee - Woodland 1 220 kV circuit	317.9	478.9	434	110.3	Summer Peak

Appendix 1B – New Corduff – Woodland 400 kV UGC Circuit,

N, intact system issues

Monitored Bus	kV	V (pu)	Voltage condition	Demand Level
Louth	110	1.0937	BUSES WITH VOLTAGE GREATER THAN 1.0900:	Summer Night Valley
Mullagharlin	110	1.0904	BUSES WITH VOLTAGE GREATER THAN 1.0900:	Summer Night Valley

Loss of single piece of transmission equipment Results

Contingency	Monitored line	Pre-cnt MVA	Post-cnt MVA	Rating MVA	% Loading	Demand Level
Corduff - Finglas 1 220 kV circuit	Corduff - Finglas 2 220 kV circuit	293.8	574.1	434	132.3	Summer Peak
Corduff - Finglas 2 220 kV circuit	Corduff - Finglas 1 220 kV circuit	293.8	574.1	434	132.3	Summer Peak

Loss of single piece of transmission equipment while generation is out of service Results

Generator Outage	Contingency	Monitored line	Pre-cnt MVA	Post-cnt MVA	Rating MVA	% Loading	Demand Level
Huntstown 2	none	New Corduff 400/220 kV transformer	550.1	550.1	500	110	Summer Peak
Huntstown 2	Corduff - Woodland 1 220 kV circuit	Clonee - Woodland 220 kV circuit	394.8	601.8	434	138.7	Summer Peak
Huntstown 2	New Corduff 400 / 220 kV transformer	Clonee - Woodland 220 kV circuit	394.8	588.4	434	135.6	Summer Peak
Huntstown 2	Clonee - Woodland 220 kV circuit	Corduff - Woodland 1 220 kV circuit	343.1	585.5	434	134.9	Summer Peak
Huntstown 2	New Corduff - Woodland 400 kV circuit	Clonee - Woodland 220 kV circuit	394.8	584.7	434	134.7	Summer Peak
Huntstown 2	New Corduff 400 / 220 kV transformer	Corduff - Woodland 1 220 kV circuit	343.1	541.5	434	124.8	Summer Peak
Huntstown 2	New Corduff - Woodland 400 kV circuit	Corduff - Woodland 1 220 kV circuit	343.1	537.7	434	123.9	Summer Peak
Huntstown 2	Clonee - Corduff 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	343.1	507.2	434	116.9	Summer Peak
Huntstown 2	Corduff - Finglas 1 220 kV circuit	Corduff - Fingls 2 220 kV circuit	259.2	506.1	434	116.6	Summer Peak
Huntstown 2	Corduff - Fingls 2 220 kV circuit	Corduff - Finglas 1 220 kV circuit	259.2	506.1	434	116.6	Summer Peak

Maintenance and trip combination Results

Maintenance	Contingency	Monitored Bus	Pre-cnt MVA	Post-cnt MVA	Rating (MVA)	% Loading	Demand Level
Clonee - Woodland 1 220 kV circuit	New Corduff 400 / 220 kV transformer	Corduff - Woodland 1 220 kV circuit	430	748.4	434	172.5	Summer Peak
Clonee - Woodland 1 220 kV circuit	New Corduff - Woodland 400 kV circuit	Corduff - Woodland 1 220 kV circuit	430	746.8	434	172.1	Summer Peak
Clonee - Corduff 1 220 kV circuit	New Corduff 400 / 220 kV transformer	Corduff - Woodland 1 220 kV circuit	356.9	655.2	434	151	Summer Peak
Clonee - Corduff 1 220 kV circuit	New Corduff - Woodland 400 kV circuit	Corduff - Woodland 1 220 kV circuit	356.9	653.8	434	150.6	Summer Peak
Corduff - Woodland 1 220 kV circuit	Clonee - Woodland 220 kV circuit	New Corduff 400 / 220 kV transformer	494.8	722.7	500	144.5	Summer Peak
Corduff - Woodland 1 220 kV circuit	New Corduff 400 / 220 kV transformer	Clonee - Corduff 1 220 kV circuit	328.3	624.1	434	143.8	Summer Peak
Corduff - Woodland 1 220 kV circuit	New Corduff - Woodland 400 kV circuit	Clonee - Corduff 1 220 kV circuit	328.3	623	434	143.5	Summer Peak
Dunstown - Carrickmines 1 220 kV circuit	Corduff - Finglas 1 220 kV circuit	Corduff - Fingls 2 220 kV circuit	305.8	598	434	137.8	Summer Peak
Dunstown - Carrickmines 1 220 kV circuit	Corduff - Fingls 2 220 kV circuit	Corduff - Finglas 1 220 kV circuit	305.8	598	434	137.8	Summer Peak
Belcamp - Shellybanks 1 220 kV circuit	Corduff - Finglas 1 220 kV circuit	Corduff - Fingls 2 220 kV circuit	302	591.1	434	136.2	Summer Peak
Belcamp - Shellybanks 1 220 kV circuit	Corduff - Fingls 2 220 kV circuit	Corduff - Finglas 1 220 kV circuit	302	591.1	434	136.2	Summer Peak
Finglas - North Wall 1 220 kV circuit	Corduff - Finglas 1 220 kV circuit	Corduff - Fingls 2 220 kV circuit	296.9	580.9	434	133.9	Summer Peak
Finglas - North Wall 1 220 kV circuit	Corduff - Fingls 2 220 kV circuit	Corduff - Finglas 1 220 kV circuit	296.9	580.9	434	133.9	Summer Peak
Poolbeg - Shellybanks 1 220 kV circuit	Corduff - Finglas 1 220 kV circuit	Corduff - Fingls 2 220 kV circuit	295.2	577.4	434	133	Summer Peak
Poolbeg - Shellybanks 1 220 kV circuit	Corduff - Fingls 2 220 kV circuit	Corduff - Finglas 1 220 kV circuit	295.2	577.4	434	133	Summer Peak
Clonee - Corduff 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	New Corduff 400 / 220 kV transformer	479.6	656.5	500	131.3	Summer Peak
Corduff - Woodland 1 220 kV circuit	Clonee - Corduff 1 220 kV circuit	New Corduff 400 / 220 kV transformer	494.8	656.5	500	131.3	Summer Peak
Belcamp - Finglas 1 220 kV circuit	Corduff - Finglas 1 220 kV circuit	Corduff - Fingls 2 220 kV circuit	287.1	561.4	434	129.4	Summer Peak
Belcamp - Finglas 1 220 kV circuit	Corduff - Fingls 2 220 kV circuit	Corduff - Finglas 1 220 kV circuit	287.1	561.4	434	129.4	Summer Peak
Clonee - Corduff 1 220 kV circuit	Corduff - Finglas 1 220 kV circuit	Corduff - Fingls 2 220 kV circuit	282.8	553.1	434	127.4	Summer Peak
Clonee - Corduff 1 220 kV circuit	Corduff - Fingls 2 220 kV circuit	Corduff - Finglas 1 220 kV circuit	282.8	553.1	434	127.4	Summer Peak
Dunstown - Woodland 1 400 kV circuit	Corduff - Finglas 1 220 kV circuit	Corduff - Fingls 2 220 kV circuit	279.4	546.8	434	126	Summer Peak
Dunstown - Woodland 1 400 kV circuit	Corduff - Fingls 2 220 kV circuit	Corduff - Finglas 1 220 kV circuit	279.4	546.8	434	126	Summer Peak
Corduff - Woodland 1 220 kV circuit	Corduff - Finglas 1 220 kV circuit	Corduff - Fingls 2 220 kV circuit	278.4	544.4	434	125.4	Summer Peak
Corduff - Woodland 1 220 kV circuit	Corduff - Fingls 2 220 kV circuit	Corduff - Finglas 1 220 kV circuit	278.4	544.4	434	125.4	Summer Peak
Clonee - Woodland 1 220 kV circuit	Corduff - Finglas 1 220 kV circuit	Corduff - Fingls 2 220 kV circuit	275.6	538.8	434	124.2	Summer Peak
Clonee - Woodland 1 220 kV circuit	Corduff - Fingls 2 220 kV circuit	Corduff - Finglas 1 220 kV circuit	275.6	538.8	434	124.2	Summer Peak
Woodland - Oldstreet 1 400 kV circuit	Corduff - Finglas 1 220 kV circuit	Corduff - Fingls 2 220 kV circuit	270.3	528.4	434	121.8	Summer Peak
Woodland - Oldstreet 1 400 kV circuit	Corduff - Fingls 2 220 kV circuit	Corduff - Finglas 1 220 kV circuit	270.3	528.4	434	121.8	Summer Peak
Corduff - Woodland 1 220 kV circuit	New Corduff 400 / 220 kV transformer	Clonee - Woodland 220 kV circuit	329.7	491.5	434	113.2	Summer Night Valley

Appendix 1C – New Corduff – Woodland 220 kV OHL Circuit

Loss of single piece of transmission equipment Results

Contingency	Monitored line	Pre-cnt MVA	Post-cnt MVA	Rating MVA	% Loading	Demand Level
Corduff - Finglas 1 220 kV circuit	Corduff - Finglas 2 220 kV circuit	273.1	533.5	434	122.9	Summer Peak
Corduff - Finglas 2 220 kV circuit	Corduff - Finglas 1 220 kV circuit	273.1	533.5	434	122.9	Summer Peak

Loss of single piece of transmission equipment while generation is out of service Results

Generator Outage	Contingency	Monitored line	Pre-cnt MVA	Post-cnt MVA	Rating MVA	% Loading	Demand Level
Huntstown 2	New New Corduff - Woodland 2 220 kV circuit	Clonee - Woodland 2 220 kV circuit	430.2	593.9	434	136.8	Summer Peak
Huntstown 2	Corduff - Woodland 1 220 kV circuit	Clonee - Woodland 2 220 kV circuit	430.2	580.8	434	133.8	Summer Peak
Huntstown 2	Clonee - Woodland 2 220 kV circuit	New Corduff - Woodland 2 220 kV circuit	378.6	568.9	434	131.1	Summer Peak
Huntstown 2	Clonee - Woodland 2 220 kV circuit	Corduff - Woodland 1 220 kV circuit	356.7	536	434	123.5	Summer Peak
Huntstown 2	Corduff - Woodland 1 220 kV circuit	New Corduff - Woodland 2 220 kV circuit	378.6	533.7	434	123	Summer Peak
Huntstown 2	New Corduff - Woodland 2 220 kV circuit	Corduff - Woodland 1 220 kV circuit	356.7	515.5	434	118.8	Summer Peak
Huntstown 2	Clonee - Corduff 1 220 kV circuit	New Corduff - Woodland 2 220 kV circuit	378.6	511.6	434	117.9	Summer Peak
Huntstown 2	Poolbeg 220 kV Bus Tie Reactor	Clonee - Woodland 2 220 kV circuit	430.2	492.3	434	113.4	Summer Peak
Huntstown 2	Clonee - Corduff 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	356.7	482	434	111.1	Summer Peak

Maintenance and trip combination Results

Maintenance	Contingency	Monitored Bus	Pre-cnt MVA	Post-cnt MVA	Rating (MVA)	% Loading	Demand Level
Clonee - Woodland 2 220 kV circuit	New Corduff - Woodland 2 220 kV circuit	Corduff - Woodland 1 220 kV circuit	414.8	734.8	434	169.3	Summer Peak
New Corduff - Woodland 2 220 kV circuit	Clonee - Woodland 2 220 kV circuit	Corduff - Woodland 1 220 kV circuit	394.7	734.8	434	169.3	Summer Peak
Clonee - Corduff 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	New Corduff - Woodland 2 220 kV circuit	386.4	653.6	434	150.6	Summer Peak
Clonee - Corduff 1 220 kV circuit	New Corduff - Woodland 2 220 kV circuit	Corduff - Woodland 1 220 kV circuit	364.1	643.1	434	148.2	Summer Peak
New Corduff - Woodland 2 220 kV circuit	Clonee - Corduff 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	394.7	643.1	434	148.2	Summer Peak
New Corduff - Woodland 2 220 kV circuit	Corduff - Woodland 1 220 kV circuit	Clonee - Corduff 1 220 kV circuit	342.1	622.8	434	143.5	Summer Peak
Dunstown - Carrickmines 1 220 kV circuit	Corduff - Finglas 1 220 kV circuit	Corduff - Finglas 2 220 kV circuit	286.3	559.6	434	128.9	Summer Peak
Dunstown - Carrickmines 1 220 kV circuit	Corduff - Finglas 2 220 kV circuit	Corduff - Finglas 1 220 kV circuit	286.3	559.6	434	128.9	Summer Peak
Belcamp - Shellybanks 1 220 kV circuit	Corduff - Finglas 1 220 kV circuit	Corduff - Finglas 2 220 kV circuit	280.1	547.9	434	126.3	Summer Peak
Belcamp - Shellybanks 1 220 kV circuit	Corduff - Finglas 2 220 kV circuit	Corduff - Finglas 1 220 kV circuit	280.1	547.9	434	126.3	Summer Peak
Finglas - North Wall 1 220 kV circuit	Corduff - Finglas 1 220 kV circuit	Corduff - Finglas 2 220 kV circuit	275.1	538.1	434	124	Summer Peak
Finglas - North Wall 1 220 kV circuit	Corduff - Finglas 2 220 kV circuit	Corduff - Finglas 1 220 kV circuit	275.1	538.1	434	124	Summer Peak
Poolbeg - Shellybanks 1 220 kV circuit	Corduff - Finglas 1 220 kV circuit	Corduff - Finglas 2 220 kV circuit	275.3	538.2	434	124	Summer Peak
Poolbeg - Shellybanks 1 220 kV circuit	Corduff - Finglas 2 220 kV circuit	Corduff - Finglas 1 220 kV circuit	275.3	538.2	434	124	Summer Peak
Belcamp - Finglas 1 220 kV circuit	Corduff - Finglas 1 220 kV circuit	Corduff - Finglas 2 220 kV circuit	266.4	520.8	434	120	Summer Peak
Belcamp - Finglas 1 220 kV circuit	Corduff - Finglas 2 220 kV circuit	Corduff - Finglas 1 220 kV circuit	266.4	520.8	434	120	Summer Peak
Dunstown - Woodland 1 400 kV circuit	Corduff - Finglas 1 220 kV circuit	Corduff - Finglas 2 220 kV circuit	264.8	517.6	434	119.3	Summer Peak
Dunstown - Woodland 1 400 kV circuit	Corduff - Finglas 2 220 kV circuit	Corduff - Finglas 1 220 kV circuit	264.8	517.6	434	119.3	Summer Peak
Clonee - Corduff 1 220 kV circuit	Corduff - Finglas 1 220 kV circuit	Corduff - Finglas 2 220 kV circuit	262.3	512.6	434	118.1	Summer Peak
Clonee - Corduff 1 220 kV circuit	Corduff - Finglas 2 220 kV circuit	Corduff - Finglas 1 220 kV circuit	262.3	512.6	434	118.1	Summer Peak
New Corduff - Woodland 2 220 kV circuit	Corduff - Finglas 1 220 kV circuit	Corduff - Finglas 2 220 kV circuit	259	506	434	116.6	Summer Peak
New Corduff - Woodland 2 220 kV circuit	Corduff - Finglas 2 220 kV circuit	Corduff - Finglas 1 220 kV circuit	259	506	434	116.6	Summer Peak
Clonee - Woodland 2 220 kV circuit	Corduff - Finglas 1 220 kV circuit	Corduff - Finglas 2 220 kV circuit	256.9	501.9	434	115.7	Summer Peak
Clonee - Woodland 2 220 kV circuit	Corduff - Finglas 2 220 kV circuit	Corduff - Finglas 1 220 kV circuit	256.9	501.9	434	115.7	Summer Peak
Woodland - Oldstreet 1 400 kV circuit	Corduff - Finglas 1 220 kV circuit	Corduff - Finglas 2 220 kV circuit	255.6	499.1	434	115	Summer Peak
Woodland - Oldstreet 1 400 kV circuit	Corduff - Finglas 2 220 kV circuit	Corduff - Finglas 1 220 kV circuit	255.6	499.1	434	115	Summer Peak
Dunstown - Carrickmines 1 220 kV circuit	New Corduff - Woodland 2 220 kV circuit	Clonee - Woodland 2 220 kV circuit	351.1	479.2	434	110.4	Summer Peak
Belcamp - Shellybanks 1 220 kV circuit	New Corduff - Woodland 2 220 kV circuit	Clonee - Woodland 2 220 kV circuit	350.4	478.2	434	110.2	Summer Peak

Appendix 1D – New Finglas – Woodland 220 kV OHL Circuit

Loss of single piece of transmission equipment Results

Contingency	Monitored line	Pre-cnt MVA	Post-cnt MVA	Rating MVA	% Loading	Demand Level
Corduff - Woodland 1 220 kV circuit	Clonee - Woodland 1 220 kV circuit	352.8	497.8	434	114.7	Summer Peak
Clonee - Woodland 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	300.8	474.1	434	109.2	Summer Peak

Loss of single piece of transmission equipment while generation is out of service Results

Generator Outage	Contingency	Monitored line	Pre-cnt MVA	Post-cnt MVA	Rating MVA	% Loading	Demand Level
Huntstown 2	none	Clonee - Woodland 1 220 kV circuit	452.9	452.9	434	104.4	Summer Peak
Huntstown 2	Clonee - Woodland 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	401.9	628.4	434	144.8	Summer Peak
Huntstown 2	Clonee - Corduff 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	401.9	562.6	434	129.6	Summer Peak
Huntstown 2	New Finglas - Woodland 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	401.9	538.5	434	124.1	Summer Peak
Huntstown 2	Corduff - Woodland 1 220 kV circuit	Clonee - Corduff 1 220 kV circuit	322.3	511.9	434	118	Summer Peak
Huntstown 2	Corduff - Woodland 1 220 kV circuit	Clonee - Woodland 1 220 kV circuit	440.5	630.3	534	118	Winter Peak
Huntstown 2	Clonee - Woodland 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	389.9	608.5	534	114	Winter Peak
Huntstown 2	Clonee - Woodland 1 220 kV circuit	New Finglas - Woodland 1 220 kV circuit	322.1	480.1	434	110.6	Summer Peak

Maintenance and trip combination Results

Maintenance	Contingency	Monitored Bus	Pre-cnt MVA	Post-cnt MVA	Rating MVA	% Loading	Demand Level
Clonee - Woodland 1 220 kV circuit	New Finglas - Woodland 1 220 kV circuit	Corduff - Woodland 2 220 kV circuit	430	748.4	434	172.5	Summer Peak
Clonee - Woodland 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	New Finglas - Woodland 1 220 kV circuit	377.4	696.9	434	160.6	Summer Peak
Corduff - Woodland 1 220 kV circuit	Clonee - Woodland 1 220 kV circuit	New Finglas - Woodland 1 220 kV circuit	361	696.9	434	160.6	Summer Peak
Clonee - Corduff 1 220 kV circuit	New Finglas - Woodland 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	413.3	653.6	434	150.6	Summer Peak
Corduff - Woodland 1 220 kV circuit	New Finglas - Woodland 1 220 kV circuit	Clonee - Corduff 1 220 kV circuit	371.9	622.8	434	143.5	Summer Peak
Clonee - Corduff 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	New Finglas - Woodland 1 220 kV circuit	335	611.2	434	140.8	Summer Peak
Corduff - Woodland 1 220 kV circuit	Clonee - Corduff 1 220 kV circuit	New Finglas - Woodland 1 220 kV circuit	361	611.2	434	140.8	Summer Peak
Dunstown - Carrickmines 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	Clonee - Woodland 1 220 kV circuit	360.8	510.3	434	117.6	Summer Peak
Belcamp - Shellybanks 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	Clonee - Woodland 1 220 kV circuit	360.2	509.3	434	117.3	Summer Peak
Corduff - Finglas 1 220 kV circuit	New Finglas - Woodland 1 220 kV circuit	Corduff - Finglas 2 220 kV circuit	279.2	508.2	434	117.1	Summer Peak
Corduff - Finglas 2 220 kV circuit	New Finglas - Woodland 1 220 kV circuit	Corduff - Finglas 1 220 kV circuit	279.2	508.2	434	117.1	Summer Peak
Finglas - North Wall 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	Clonee - Woodland 1 220 kV circuit	356.8	504.2	434	116.2	Summer Peak
Poolbeg - Shellybanks 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	Clonee - Woodland 1 220 kV circuit	354	500.2	434	115.3	Summer Peak
Belcamp - Finglas 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	Clonee - Woodland 1 220 kV circuit	350.2	494.2	434	113.9	Summer Peak
Corduff - Finglas 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	Clonee - Woodland 1 220 kV circuit	344.4	490.9	434	113.1	Summer Peak
Corduff - Finglas 2 220 kV circuit	Corduff - Woodland 1 220 kV circuit	Clonee - Woodland 1 220 kV circuit	344.4	490.9	434	113.1	Summer Peak
Dunstown - Woodland 1 400 kV circuit	Corduff - Woodland 1 220 kV circuit	Clonee - Woodland 1 220 kV circuit	346.7	489.5	434	112.8	Summer Peak
Dunstown - Carrickmines 1 220 kV circuit	Clonee - Woodland 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	309.1	486.9	434	112.2	Summer Peak
Belcamp - Shellybanks 1 220 kV circuit	Clonee - Woodland 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	307	485.3	434	111.8	Summer Peak
Finglas - North Wall 1 220 kV circuit	Clonee - Woodland 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	303.8	480.2	434	110.6	Summer Peak
Corduff - Finglas 1 220 kV circuit	Corduff - Finglas 2 220 kV circuit	New Finglas - Woodland 1 220 kV circuit	271	479.4	434	110.5	Summer Peak
Corduff - Finglas 2 220 kV circuit	Corduff - Finglas 1 220 kV circuit	New Finglas - Woodland 1 220 kV circuit	271	479.4	434	110.5	Summer Peak

Appendix 1E – New Finglas – Woodland 400 kV UGC Circuit

N, intact system issues

Monitored Bus	kV	V (pu)	Voltage condition	Demand Level
Artane	110	1.0904	BUSES WITH VOLTAGE GREATER THAN 1.0900:	Summer Night Valley
Cabra	110	1.0902	BUSES WITH VOLTAGE GREATER THAN 1.0900:	Summer Night Valley
Finglas	110	1.0901	BUSES WITH VOLTAGE GREATER THAN 1.0900:	Summer Night Valley
Gorman	110	1.0902	BUSES WITH VOLTAGE GREATER THAN 1.0900:	Summer Night Valley
Gorman	220	1.0929	BUSES WITH VOLTAGE GREATER THAN 1.0900:	Summer Night Valley
Louth A	110	1.111	BUSES WITH VOLTAGE GREATER THAN 1.0900:	Summer Night Valley
Louth	220	1.0944	BUSES WITH VOLTAGE GREATER THAN 1.0900:	Summer Night Valley
Lisdrum	110	1.0946	BUSES WITH VOLTAGE GREATER THAN 1.0900:	Summer Night Valley
McDermott St	110	1.0903	BUSES WITH VOLTAGE GREATER THAN 1.0900:	Summer Night Valley
Meath Hill	110	1.0971	BUSES WITH VOLTAGE GREATER THAN 1.0900:	Summer Night Valley
Mullagharlin	110	1.1079	BUSES WITH VOLTAGE GREATER THAN 1.0900:	Summer Night Valley
Pelletstown	110	1.0901	BUSES WITH VOLTAGE GREATER THAN 1.0900:	Summer Night Valley
Ratrussan	110	1.0936	BUSES WITH VOLTAGE GREATER THAN 1.0900:	Summer Night Valley
Woodland	220	1.0924	BUSES WITH VOLTAGE GREATER THAN 1.0900:	Summer Night Valley
Wolfe Tone St	110	1.0903	BUSES WITH VOLTAGE GREATER THAN 1.0900:	Summer Night Valley
Louth B	110	1.1065	BUSES WITH VOLTAGE GREATER THAN 1.0900:	Summer Night Valley

Loss of single piece of transmission equipment Results

Contingency	Monitored line	Pre-cnt MVA	Post-cnt MVA	Rating MVA	% Loading	Demand Level
Corduff - Woodland 1 220 kV circuit	Clonee - Woodland 1 220 kV circuit	301.9	452.8	434	104.3	Summer Peak
Clonee - Woodland 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	250	435.6	434	100.4	Summer Peak

Loss of single piece of transmission equipment while generation is out of service Results

Generator Outage	Contingency	Monitored line	Pre-cnt MVA	Post-cnt MVA	Rating MVA	% Loading	Demand Level
Huntstown 2	none	New Finglas 400/220 kV transformer	551.2	551.2	500	110.2	Summer Peak
Huntstown 2	none	New Finglas 400/220 kV transformer	540.7	540.7	500	108.1	Winter Peak
Huntstown 2	Corduff - Woodland 1 220 kV circuit	Clonee - Woodland 1 220 kV circuit	399.4	612.5	434	141.1	Summer Peak
Huntstown 2	Clonee - Woodland 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	347.7	596.8	434	137.5	Summer Peak
Huntstown 2	New Finglas 400/220 kV transformer	Clonee - Woodland 1 220 kV circuit	399.4	588.8	434	135.7	Summer Peak
Huntstown 2	New Finglas - Woodland 400 kV circuit	Clonee - Woodland 1 220 kV circuit	399.4	585.1	434	134.8	Summer Peak
Huntstown 2	New Finglas 400/220 kV transformer	Corduff - Woodland 1 220 kV circuit	347.7	542	434	124.9	Summer Peak
Huntstown 2	New Finglas - Woodland 400 kV circuit	Corduff - Woodland 1 220 kV circuit	347.7	538.2	434	124	Summer Peak
Huntstown 2	Clonee - Corduff 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	347.7	516.9	434	119.1	Summer Peak
Huntstown 2	Corduff - Woodland 1 220 kV circuit	Clonee - Corduff 1 220 kV circuit	272.4	480.2	434	110.6	Summer Peak
Huntstown 2	Corduff - Woodland 1 220 kV circuit	Clonee - Woodland 1 220 kV circuit	385.6	589.6	534	110.4	Winter Peak

Maintenance and trip combination Results

Maintenance	Contingency	Monitored Bus	Pre-cnt MVA	Post-cnt MVA	Rating MVA	% Loading	Demand Level
Clonee - Woodland 1 220 kV circuit	New Finglas - Woodland 400 kV circuit	Corduff - Woodland 2 220 kV circuit	430	748.4	434	172.5	Summer Peak
Clonee - Woodland 1 220 kV circuit	New Finglas 400/220 kV transformer	Corduff - Woodland 2 220 kV circuit	430	746.8	434	172.1	Summer Peak
Clonee - Corduff 1 220 kV circuit	New Finglas 400/220 kV transformer	Corduff - Woodland 1 220 kV circuit	361.3	656.9	434	151.4	Summer Peak
Clonee - Corduff 1 220 kV circuit	New Finglas - Woodland 400 kV circuit	Corduff - Woodland 1 220 kV circuit	361.3	653.9	434	150.7	Summer Peak
Corduff - Woodland 1 220 kV circuit	New Finglas 400/220 kV transformer	Clonee - Corduff 1 220 kV circuit	333.1	625.5	434	144.1	Summer Peak
Corduff - Woodland 1 220 kV circuit	New Finglas - Woodland 400 kV circuit	Clonee - Corduff 1 220 kV circuit	333.1	623	434	143.5	Summer Peak
Clonee - Corduff 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	New Finglas 400/220 kV transformer	488.1	662.6	500	132.5	Summer Peak
Corduff - Finglas 1 220 kV circuit	New Finglas 400/220 kV transformer	Corduff - Finglas 2 220 kV circuit	186.8	508.8	434	117.2	Summer Peak
Corduff - Finglas 2 220 kV circuit	New Finglas 400/220 kV transformer	Corduff - Finglas 1 220 kV circuit	186.8	508.8	434	117.2	Summer Peak
Corduff - Finglas 1 220 kV circuit	New Finglas - Woodland 400 kV circuit	Corduff - Finglas 2 220 kV circuit	186.8	508.3	434	117.1	Summer Peak
Corduff - Finglas 2 220 kV circuit	New Finglas - Woodland 400 kV circuit	Corduff - Finglas 1 220 kV circuit	186.8	508.3	434	117.1	Summer Peak

Appendix 1F – New Finglas – Woodland 400 kV OHL Circuit

Loss of single piece of transmission equipment Results

Contingency	Monitored line	Pre-cnt MVA	Post-cnt MVA	Rating MVA	% Loading	Demand Level
Corduff - Woodland 1 220 kV circuit	Clonee - Woodland 1 220 kV circuit	313.5	473.8	434	109.2	Summer Peak
Clonee - Woodland 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	261.4	457	434	105.3	Summer Peak

Loss of single piece of transmission equipment while generation is out of service Results

Generator Outage	Contingency	Monitored line	Pre-cnt MVA	Post-cnt MVA	Rating MVA	% Loading	Demand Level
Huntstown 2	Corduff - Woodland 1 220 kV circuit	Clonee - Woodland 1 220 kV circuit	413.4	638.5	434	147.1	Summer Peak
Huntstown 2	Clonee - Woodland 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	361.7	623.2	434	143.6	Summer Peak
Huntstown 2	New Finglas - Woodland 400 kV circuit	Clonee - Woodland 1 220 kV circuit	413.4	585.1	434	134.8	Summer Peak
Huntstown 2	New Finglas 400/220 kV transformer	Clonee - Woodland 1 220 kV circuit	413.4	585.2	434	134.8	Summer Peak
Huntstown 2	Clonee - Corduff 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	361.7	541.7	434	124.8	Summer Peak
Huntstown 2	New Finglas - Woodland 400 kV circuit	Corduff - Woodland 1 220 kV circuit	361.7	538.1	434	124	Summer Peak
Huntstown 2	New Finglas 400/220 kV transformer	Corduff - Woodland 1 220 kV circuit	361.7	538.2	434	124	Summer Peak
Huntstown 2	Corduff - Woodland 1 220 kV circuit	Clonee - Corduff 1 220 kV circuit	285.2	504	434	116.1	Summer Peak
Huntstown 2	Corduff - Woodland 1 220 kV circuit	Clonee - Woodland 1 220 kV circuit	399.4	614	534	115	Winter Peak
Huntstown 2	Clonee - Woodland 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	348.2	598.8	534	112.1	Winter Peak
Huntstown 2	Corduff - Woodland 1 220 kV circuit	Clonee - Woodland 1 220 kV circuit	315.1	476.5	434	109.8	Summer Night Valley

Maintenance and trip combination Results

Maintenance	Contingency	Monitored Bus	Pre-cnt MVA	Post-cnt MVA	Rating MVA	% Loading	Demand Level
Clonee - Woodland 1 220 kV circuit	New Finglas 400/220 kV transformer	Corduff - Woodland 2 220 kV circuit	430	748.4	434	172.5	Summer Peak
Clonee - Woodland 1 220 kV circuit	New Finglas - Woodland 400 kV circuit	Corduff - Woodland 2 220 kV circuit	430	746.8	434	172.1	Summer Peak
Clonee - Corduff 1 220 kV circuit	New Finglas - Woodland 400 kV circuit	Corduff - Woodland 1 220 kV circuit	381	653.6	434	150.6	Summer Peak
Clonee - Corduff 1 220 kV circuit	New Finglas 400/220 kV transformer	Corduff - Woodland 1 220 kV circuit	381	653.8	434	150.6	Summer Peak
Corduff - Woodland 1 220 kV circuit	New Finglas - Woodland 400 kV circuit	Clonee - Corduff 1 220 kV circuit	352.2	622.8	434	143.5	Summer Peak
Corduff - Woodland 1 220 kV circuit	New Finglas 400/220 kV transformer	Clonee - Corduff 1 220 kV circuit	352.2	622.9	434	143.5	Summer Peak
Clonee - Woodland 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	New Finglas 400/220 kV transformer	465.3	676.5	500	135.3	Summer Peak
Corduff - Woodland 1 220 kV circuit	Clonee - Woodland 1 220 kV circuit	New Finglas 400/220 kV transformer	456.6	676.5	500	135.3	Summer Peak
Clonee - Corduff 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	New Finglas 400/220 kV transformer	443.2	617.3	500	123.5	Summer Peak
Corduff - Woodland 1 220 kV circuit	Clonee - Corduff 1 220 kV circuit	New Finglas 400/220 kV transformer	456.6	617.3	500	123.5	Summer Peak
Corduff - Finglas 1 220 kV circuit	New Finglas - Woodland 400 kV circuit	Corduff - Finglas 2 220 kV circuit	204.8	508.3	434	117.1	Summer Peak
Corduff - Finglas 1 220 kV circuit	New Finglas 400/220 kV transformer	Corduff - Finglas 2 220 kV circuit	204.8	508.3	434	117.1	Summer Peak
Corduff - Finglas 2 220 kV circuit	New Finglas - Woodland 400 kV circuit	Corduff - Finglas 1 220 kV circuit	204.8	508.3	434	117.1	Summer Peak
Corduff - Finglas 2 220 kV circuit	New Finglas 400/220 kV transformer	Corduff - Finglas 1 220 kV circuit	204.8	508.3	434	117.1	Summer Peak
Belcamp - Shellybanks 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	Clonee - Woodland 1 220 kV circuit	321.1	486.8	434	112.2	Summer Peak
Dunstown - Carrickmines 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	Clonee - Woodland 1 220 kV circuit	318.9	482.9	434	111.3	Summer Peak
Finglas - North Wall 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	Clonee - Woodland 1 220 kV circuit	317.4	480.7	434	110.8	Summer Peak

Appendix 1G – New Belcamp – Woodland 400 kV OHL Circuit.

Loss of single piece of transmission equipment Results

Contingency	Monitored line	Pre-cnt MVA	Post-cnt MVA	Rating MVA	% Loading	Demand Level
Corduff - Woodland 1 220 kV circuit	Clonee - Woodland 1 220 kV circuit	317	481	434	110.8	Summer Peak
Clonee - Woodland 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	265	464.5	434	107	Summer Peak

Loss of single piece of transmission equipment while generation is out of service Results

Generator Outage	Contingency	Monitored line	Pre-cnt MVA	Post-cnt MVA	Rating MVA	% Loading	Demand Level
Huntstown 2	Corduff - Woodland 1 220 kV circuit	Clonee - Woodland 1 220 kV circuit	418.2	648.9	434	149.5	Summer Peak
Huntstown 2	Clonee - Woodland 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	366.6	633.9	434	146.1	Summer Peak
Huntstown 2	New Belcamp - Woodland 400 kV circuit	Clonee - Woodland 1 220 kV circuit	418.2	585.1	434	134.8	Summer Peak
Huntstown 2	New Belcamp 400/220 kV transformer	Clonee - Woodland 1 220 kV circuit	418.2	585.2	434	134.8	Summer Peak
Huntstown 2	Clonee - Corduff 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	366.6	551.6	434	127.1	Summer Peak
Huntstown 2	New Belcamp - Woodland 400 kV circuit	Corduff - Woodland 1 220 kV circuit	366.6	538.2	434	124	Summer Peak
Huntstown 2	New Belcamp 400/220 kV transformer	Corduff - Woodland 1 220 kV circuit	366.6	538.3	434	124	Summer Peak
Huntstown 2	Corduff - Woodland 1 220 kV circuit	Clonee - Corduff 1 220 kV circuit	289.8	513.7	434	118.4	Summer Peak
Huntstown 2	Corduff - Woodland 1 220 kV circuit	Clonee - Woodland 1 220 kV circuit	403.9	624.5	534	116.9	Winter Peak
Huntstown 2	Clonee - Woodland 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	352.9	609.4	534	114.1	Winter Peak
Huntstown 2	Corduff - Woodland 1 220 kV circuit	Clonee - Woodland 1 220 kV circuit	317.8	482.4	434	111.2	Summer Night Valley

Maintenance and trip combination Results

Maintenance	Contingency	Monitored Bus	Pre-cnt MVA	Post-cnt MVA	Rating MVA	% Loading	Demand Level
Clonee - Woodland 1 220 kV circuit	New Belcamp 400 / 220 kV transformer	Corduff - Woodland 2 220 kV circuit	430	748.4	434	172.5	Summer Peak
Clonee - Woodland 1 220 kV circuit	New Belcamp - Woodland 400 kV circuit	Corduff - Woodland 2 220 kV circuit	430	746.8	434	172.1	Summer Peak
Clonee - Corduff 1 220 kV circuit	New Belcamp - Woodland 400 kV circuit	Corduff - Woodland 1 220 kV circuit	387.8	653.6	434	150.6	Summer Peak
Clonee - Corduff 1 220 kV circuit	New Belcamp 400/220 kV transformer	Corduff - Woodland 1 220 kV circuit	387.8	653.8	434	150.6	Summer Peak
Corduff - Woodland 1 220 kV circuit	New Belcamp - Woodland 400 kV circuit	Clonee - Corduff 1 220 kV circuit	359.1	622.8	434	143.5	Summer Peak
Corduff - Woodland 1 220 kV circuit	New Belcamp 400/220 kV transformer	Clonee - Corduff 1 220 kV circuit	359.1	623	434	143.5	Summer Peak
Corduff - Finglas 1 220 kV circuit	New Belcamp - Woodland 400 kV circuit	Corduff - Finglas 2 220 kV circuit	211.5	508.3	434	117.1	Summer Peak
Corduff - Finglas 1 220 kV circuit	New Belcamp 400/220 kV transformer	Corduff - Finglas 2 220 kV circuit	211.5	508.3	434	117.1	Summer Peak
Corduff - Finglas 2 220 kV circuit	New Belcamp - Woodland 400 kV circuit	Corduff - Finglas 1 220 kV circuit	211.5	508.3	434	117.1	Summer Peak
Corduff - Finglas 2 220 kV circuit	New Belcamp 400/220 kV transformer	Corduff - Finglas 1 220 kV circuit	211.5	508.3	434	117.1	Summer Peak
Belcamp - Finglas 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	Clonee - Woodland 1 220 kV circuit	323.2	496.9	434	114.5	Summer Peak
Finglas - North Wall 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	Clonee - Woodland 1 220 kV circuit	323.1	492	434	113.4	Summer Peak
Dunstown - Carrickmines 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	Clonee - Woodland 1 220 kV circuit	322.5	490.3	434	113	Summer Peak
Belcamp - Shellybanks 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	Clonee - Woodland 1 220 kV circuit	322.5	490	434	112.9	Summer Peak
Belcamp - Finglas 1 220 kV circuit	Clonee - Woodland 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	270.6	481.2	434	110.9	Summer Peak
Poolbeg - Shellybanks 1 220 kV circuit	Corduff - Woodland 1 220 kV circuit	Clonee - Woodland 1 220 kV circuit	316.8	480.9	434	110.8	Summer Peak

Appendix 2 – Short Circuit Results

The following tables give the short circuit results for the options in the refined long list.

3ph Peak Make		% of rating	Change in % of rating comapred to no reinforcement case						
Node	Rating (kA)	No Reinforcment	Corduff - Woodland 400 kV OHL	Corduff - Woodland 400 kV UGC	Corduff - Woodland 220 kV OHL	Finglas - Woodland 220 kV OHL	Finglas - Woodland 400 kV UGC	Finglas - Woodland 400 kV OHL	Belcamp - Woodland 400 kV OHL
BELCAMP 110 kV	62.5	57%	2%	2%	1%	1%	2%	2%	3%
BELCAMP 220 kV	100	59%	6%	6%	4%	5%	7%	7%	9%
CORDUFF 110 kV	78.75	73%	2%	2%	1%	1%	2%	2%	2%
CORDUFF 220 kV	100	64%	9%	9%	6%	3%	7%	6%	6%
FIN_URBAN 110 kV	78.75	50%	2%	2%	1%	1%	2%	2%	2%
FINGLAS 220 kV	100	64%	7%	7%	5%	6%	9%	9%	8%
FIN_RURAL 110 kV	78.75	50%	2%	2%	1%	1%	2%	2%	2%
POOLBEG NORTH	78.75	74%	6%	6%	4%	5%	8%	7%	8%
POOLBEG SOUTH	78.75	81%	1%	1%	0%	0%	1%	1%	1%
SHELLYBANKS	100	58%	5%	5%	3%	4%	6%	6%	7%
WOODLAND 220 kV	100	72%	0%	0%	4%	5%	0%	0%	0%
WOODLAND 400 kV	100	44%	4%	4%	1%	1%	4%	5%	4%

3ph RMS AC Break		% of rating	Change in % of rating comapred to no reinforcement case						
Node	Rating (kA)	No Reinforcment	Corduff - Woodland 400 kV OHL	Corduff - Woodland 400 kV UGC	Corduff - Woodland 220 kV OHL	Finglas - Woodland 220 kV OHL	Finglas - Woodland 400 kV UGC	Finglas - Woodland 400 kV OHL	Belcamp - Woodland 400 kV OHL
BELCAMP 110 kV	25	48%	2%	2%	1%	1%	2%	2%	2%
BELCAMP 220 kV	40	50%	5%	5%	4%	5%	7%	6%	8%
CORDUFF 110 kV	31.5	68%	2%	2%	1%	1%	2%	2%	2%
CORDUFF 220 kV	40	54%	7%	7%	5%	3%	6%	6%	5%
FIN_URBAN 110 kV	31.5	42%	2%	2%	1%	1%	2%	2%	2%
FINGLAS 220 kV	40	54%	6%	6%	5%	5%	8%	7%	7%
FIN_RURAL 110 kV	31.5	40%	2%	2%	1%	1%	2%	2%	2%
POOLBEG NORTH	31.5	63%	6%	6%	4%	5%	7%	7%	8%
POOLBEG SOUTH	31.5	70%	1%	1%	0%	0%	1%	1%	1%
SHELLYBANKS	40	50%	5%	5%	3%	4%	6%	5%	6%
WOODLAND 220 kV	40	65%	1%	0%	3%	3%	0%	0%	0%
WOODLAND 400 kV	40	41%	3%	3%	0%	0%	3%	3%	3%

3ph TOT RMS Break		% of rating	Change in % of rating comapred to no reinforcement case						
Node	Rating (kA)	No Reinforcment	Corduff - Woodland 400 kV OHL	Corduff - Woodland 400 kV UGC	Corduff - Woodland 220 kV OHL	Finglas - Woodland 220 kV OHL	Finglas - Woodland 400 kV UGC	Finglas - Woodland 400 kV OHL	Belcamp - Woodland 400 kV OHL
BELCAMP 110 kV	25	58%	3%	3%	1%	2%	3%	3%	5%
BELCAMP 220 kV	40	55%	6%	6%	4%	4%	7%	7%	10%
CORDUFF 110 kV	31.5	68%	2%	2%	1%	1%	2%	2%	2%
CORDUFF 220 kV	40	60%	9%	9%	6%	3%	7%	6%	6%
FIN_URBAN 110 kV	31.5	51%	3%	3%	1%	2%	3%	3%	3%
FINGLAS 220 kV	40	61%	7%	7%	5%	6%	9%	9%	8%
FIN_RURAL 110 kV	31.5	50%	2%	3%	1%	2%	3%	3%	3%
POOLBEG NORTH	31.5	70%	6%	6%	4%	5%	7%	7%	8%
POOLBEG SOUTH	31.5	76%	1%	1%	0%	0%	1%	1%	1%
SHELLYBANKS	40	55%	5%	5%	3%	4%	6%	6%	6%
WOODLAND 220 kV	40	70%	0%	0%	4%	4%	0%	0%	0%
WOODLAND 400 kV	40	44%	4%	4%	1%	1%	4%	4%	4%

1 ph Peak Make		% of rating	Change in % of rating comapred to no reinforcement case						
Node	Rating (kA)	No Reinforcment	Corduff - Woodland 400 kV OHL	Corduff - Woodland 400 kV UGC	Corduff - Woodland 220 kV OHL	Finglas - Woodland 220 kV OHL	Finglas - Woodland 400 kV UGC	Finglas - Woodland 400 kV OHL	Belcamp - Woodland 400 kV OHL
BELCAMP 110 kV	62.5	45%	1%	1%	1%	1%	1%	1%	1%
BELCAMP 220 kV	100	65%	5%	5%	4%	4%	6%	6%	8%
CORDUFF 110 kV	78.75	76%	2%	2%	1%	1%	2%	2%	2%
CORDUFF 220 kV	100	71%	7%	7%	6%	3%	6%	5%	5%
FIN_URBAN 110 kV	78.75	60%	2%	2%	1%	1%	2%	2%	2%
FINGLAS 220 kV	100	74%	7%	7%	5%	6%	8%	8%	7%
FIN_RURAL 110 kV	78.75	53%	2%	2%	1%	1%	2%	2%	2%
POOLBEG NORTH	78.75	66%	3%	4%	2%	3%	4%	4%	5%
POOLBEG SOUTH	78.75	82%	1%	1%	0%	0%	1%	1%	1%
SHELLYBANKS	100	57%	3%	3%	2%	3%	4%	4%	4%
WOODLAND 220 kV	100	72%	0%	0%	5%	5%	0%	0%	0%
WOODLAND 400 kV	100	44%	3%	3%	1%	1%	3%	3%	3%

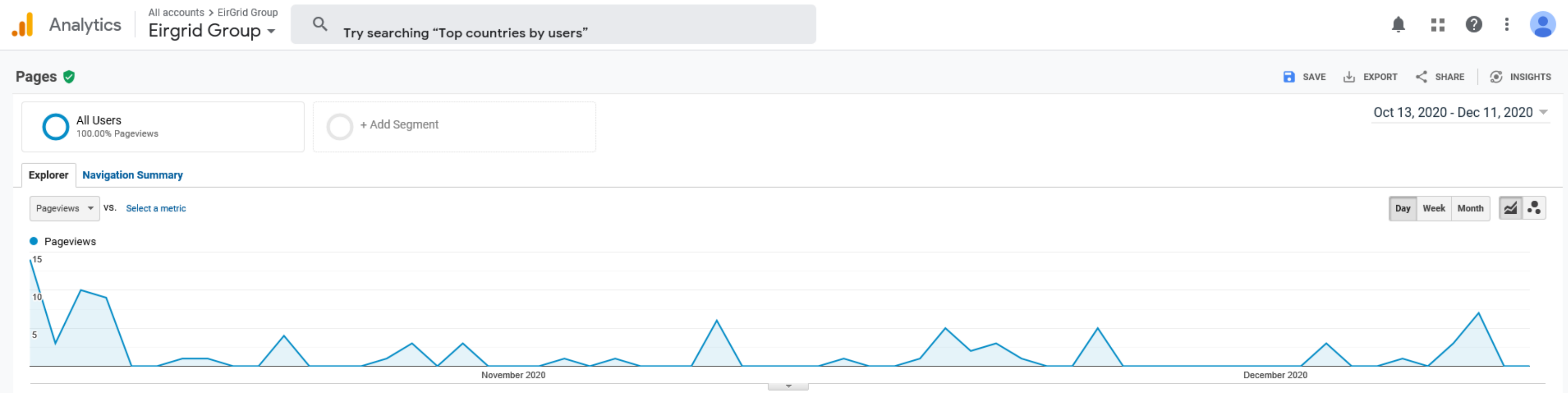
1ph RMS AC Break		% of rating	Change in % of rating comapred to no reinforcement case						
Node	Rating (kA)	No Reinforcment	Corduff - Woodland 400 kV OHL	Corduff - Woodland 400 kV UGC	Corduff - Woodland 220 kV OHL	Finglas - Woodland 220 kV OHL	Finglas - Woodland 400 kV UGC	Finglas - Woodland 400 kV OHL	Belcamp - Woodland 400 kV OHL
BELCAMP 110 kV	25	41%	1%	1%	1%	1%	1%	1%	1%
BELCAMP 220 kV	40	62%	5%	5%	4%	5%	6%	6%	7%
CORDUFF 110 kV	31.5	74%	2%	2%	1%	1%	2%	1%	1%
CORDUFF 220 kV	40	66%	7%	7%	6%	3%	6%	5%	5%
FIN_URBAN 110 kV	31.5	54%	2%	2%	1%	1%	2%	2%	2%
FINGLAS 220 kV	40	68%	6%	6%	5%	6%	8%	7%	7%
FIN_RURAL 110 kV	31.5	47%	1%	1%	1%	1%	2%	2%	1%
POOLBEG NORTH	31.5	67%	4%	4%	3%	4%	5%	5%	5%
POOLBEG SOUTH	31.5	81%	1%	1%	0%	0%	1%	1%	1%
SHELLYBANKS	40	56%	4%	4%	3%	3%	5%	4%	5%
WOODLAND 220 kV	40	69%	1%	0%	5%	5%	0%	0%	0%
WOODLAND 400 kV	40	43%	3%	3%	1%	1%	3%	3%	3%

1 ph TOT RMS Break		% of rating	Change in % of rating comapred to no reinforcement case						
Node	Rating (kA)	No Reinforcment	Corduff - Woodland 400 kV OHL	Corduff - Woodland 400 kV UGC	Corduff - Woodland 220 kV OHL	Finglas - Woodland 220 kV OHL	Finglas - Woodland 400 kV UGC	Finglas - Woodland 400 kV OHL	Belcamp - Woodland 400 kV OHL
BELCAMP 110 kV	25	47%	1%	1%	1%	1%	2%	2%	2%
BELCAMP 220 kV	40	65%	5%	5%	4%	5%	6%	6%	8%
CORDUFF 110 kV	31.5	74%	2%	2%	1%	1%	2%	2%	2%
CORDUFF 220 kV	40	71%	7%	8%	6%	3%	6%	6%	5%
FIN_URBAN 110 kV	31.5	63%	3%	3%	1%	2%	3%	3%	3%
FINGLAS 220 kV	40	75%	7%	7%	5%	6%	9%	9%	8%
FIN_RURAL 110 kV	31.5	54%	2%	2%	1%	1%	2%	2%	2%
POOLBEG NORTH	31.5	68%	4%	4%	3%	4%	5%	5%	5%
POOLBEG SOUTH	31.5	83%	1%	1%	0%	0%	1%	1%	1%
SHELLYBANKS	40	57%	4%	4%	3%	3%	4%	4%	5%
WOODLAND 220 kV	40	73%	0%	0%	5%	5%	0%	0%	0%
WOODLAND 400 kV	40	46%	3%	3%	1%	1%	3%	3%	3%

Appendix 3 Stakeholder Engagement

Project Website Visitor Statistics

The image below is taken from the analytics of the project website and the pages within the site. The chart shows the number of pageviews per day for the duration of the consultation period. The most visits recorded in one day was at the start of the consultation period, when 15 pageviews were recorded. This is not matched again for the duration of the period with a total of 89 views from 77 unique users.



	Page	Pageviews	Unique Pageviews	Avg. Time on Page	Entrances	Bounce Rate	% Exit	Page Value
		89 % of Total: 0.12% (73,353)	77 % of Total: 0.14% (56,803)	00:00:49 Avg for View: 00:02:02 (-60.23%)	11 % of Total: 0.03% (32,725)	25.00% Avg for View: 52.26% (-52.16%)	28.09% Avg for View: 44.61% (-37.04%)	€0.00 % of Total: 0.00% (€0.00)
1.	/the-grid/projects/cp1021/related-documents/	34 (38.20%)	31 (40.26%)	00:01:48	1 (9.09%)	0.00%	44.12%	€0.00 (0.00%)
2.	/the-grid/projects/cp1021/whats-happening-now/	32 (35.96%)	26 (33.77%)	00:00:19	2 (18.18%)	0.00%	12.50%	€0.00 (0.00%)
3.	/the-grid/projects/cp1021/the-project/	18 (20.22%)	15 (19.48%)	00:00:42	8 (72.73%)	37.50%	33.33%	€0.00 (0.00%)
4.	/the-grid/projects/cp1021/contact/	5 (5.62%)	5 (6.49%)	00:00:04	0 (0.00%)	0.00%	0.00%	€0.00 (0.00%)

Show rows: 10 Go to: 1 1 - 4 of 4

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