Methodology for Connecting Groups of Generators to the Northern Ireland Distribution System using Cluster Substations

A Consultation Paper

10 August 2012
TABLE OF CONTENTS

1. Introduction 1
2. Collation of Information on Generation 3
3. Assessment Process 4
4. Technical Assessment 5
5. Further Assessment 9
6. Cluster Approval and Pre-Construction 14
7. Responses 15

Appendix 1 Process Flow Chart 16
Appendix 2 Worked Examples 17
1. **INTRODUCTION**

To facilitate the connection of renewable generation to the electricity grid whilst respecting Northern Ireland’s landscape and cultural heritage, NIE intends, in appropriate circumstances, to group or “cluster” generators (generally on shore wind farms) so that they will share network infrastructure. Where there is insufficient potential generation in an area to justify a cluster, then generators would continue to be connected on an individual basis to the 33kV system.

Clustering large wind farm generators also offers advantages in managing information and control related to that part of the system and could permit single point rather than distributed solutions to other engineering problems arising from high levels of renewable energy penetration. It is not yet clear how voltage stability, fast response and inertia response will be managed in future, but grouping of generators is likely to facilitate more efficient solutions.

In March 2010 Northern Ireland Electricity (NIE) consulted on the principle of clustering generators and the associated charging mechanism\(^1\). The consultation process concluded that:

- Clustering provided a suitable method of connecting groups of generators that are located in the same vicinity.
- The charge for a generator to connect into a cluster substation should be based on a proportion of the cost of the cluster, plus the full cost of its unique connection assets.
- The Least Cost Technical Acceptable (LCTA) method of connection must still be considered for generators not associated with a group.

Following the consultation process the Utility Regulator (UR) issued a decision paper\(^2\) on 21 April 2011, which agreed with the above conclusions and directed NIE to proceed with the updating of NIE’s Charging Statement to give effect to this methodology.

The above consultation and decision paper focused on the principles of adopting a clustering approach and the options for the charging of costs. It did not consider the precise criteria that should be considered or the methodology that should be applied when concluding that a group of generators should be connected as a cluster. Also, it did not evaluate the construction options for cluster infrastructure. This paper therefore considers these issues. Specifically it:

- Proposes criteria to be used to determine when a clustered approach should be applied by NIE and
- Outlines the process to evaluate options for the establishment of a cluster.

---

\(^1\) Charges for Connecting Groups of Generators to the Northern Ireland Distribution System
http://www.nie.co.uk/Network/Major-projects/Renewable-investment

\(^2\) Decision Paper on the Charges for Connecting Groups of Generators (Clustering) to the Northern Ireland Distribution System.
In terms of process the following is proposed for each situation where clustering is to be considered:

1. Collation of information on generation
2. Assessment Process
   - Assessment of the extent of generation that requires to be planned for
   - Consideration of the case for a cluster taking account of adjacent network
   - Assessment of options for delivering the cluster
3. Development of conclusions and preparation of a report related to each cluster for submission as an approval to UR

Views from the relevant stakeholders are invited on these proposals.
2. **COLLATION OF INFORMATION ON GENERATION**

Table 1 below shows the information relating to existing and proposed generators that NIE will collate and update on a 3 monthly basis. Whilst the majority of the information is in the public domain, certain details are sourced from one to one interactions with developers. This latter information will only be shared with the UR and will be treated as confidential.

<table>
<thead>
<tr>
<th>Generator Stage</th>
<th>Information</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commissioned</td>
<td>Name Developer Size (MW) Location (x,y co-ordinates) Commissioning Date</td>
<td>NIE Records Developers</td>
</tr>
<tr>
<td>Consented (Planning Approved)</td>
<td>Name Developer Financial Stage (if available) Size Location Requested Commissioning Month Likelihood of completion</td>
<td>NIE Records Planning Service Developers</td>
</tr>
<tr>
<td>Awaiting Planning Approval</td>
<td>Name Developer Size Location Estimated Commissioning Year Likelihood of completion</td>
<td>Planning Service Developers</td>
</tr>
<tr>
<td>Environmental Impact Assessment (EIA)</td>
<td>Name <strong>Confidential</strong> Developer Size Location Estimated Commissioning Year Likelihood of completion</td>
<td>Developers</td>
</tr>
<tr>
<td>Withdrawn from Planning or Rejected by Planning</td>
<td>Name Developer Size Location Likelihood of completion</td>
<td>Planning Service Developers</td>
</tr>
<tr>
<td>Early Stage e.g. landowner option negotiations</td>
<td>Name <strong>Confidential</strong> Developer Size Location Estimated Commissioning Year Likelihood of completion</td>
<td>Developers</td>
</tr>
</tbody>
</table>

Table 1  Generator Information
3. ASSESSMENT PROCESS

The proposed assessment process has two stages.

1. A technical assessment of the various network connection options for the expected level of generation.
2. A non-technical assessment covering environmental considerations, access restrictions and opportunities, timing issues and costing. This will seek to refine the output of the technical assessment, reducing the available connection options to one preferred scheme.

Generally this assessment will entail the consideration of 33kV connections compared to options for establishing a shared 110kV infrastructure (i.e. a cluster).
4. TECHNICAL ASSESSMENT

4.1 Extent of Generator Capacity to be Accommodated

The primary consideration in this analysis is the level of generation capacity that is likely to connect to a potential cluster substation.

Geographical Extent of a Cluster

An assessment is made of all generation anticipated in an area of about 310 km$^2$ or a 10km radius. This radius is based on a 12km maximum length of 33kV 200mm$^2$ aluminium overhead line that, when fully loaded, maintains the 33kV voltage at the generator within statutory limits. The radius is reduced to 10km to allow for the route length being generally around 20% greater than the direct distance from the source to the generator. The radius is based upon average conditions and engineering principles and judgement are to be applied to refine any particular case. E.g. It might be possible to use a 15km 33kV overhead line to connect a generator where the voltage rise at the generator remains within the upper statutory limit.

Anticipated Extent of Generation - Weighted to Take Account of Uncertainty

Many developers and NI Planning Service inform NIE about potential future developments. Some developments are however more certain than others and this needs to be taken into account. NIE’s proposal is that all known generators within the defined area will be listed with their Maximum Export Capacity (MEC) and each MEC will then be weighted to reflect its development status.

Six development stages that have been identified are Early Stage, EIA Commenced, EIA Commenced (with generator in an AONB), Submitted to Planning, Withdrawn from Planning and Consented. We have considered the inclusion of a stage related to project financial closure and we are open to comments on this matter. Our thinking however is that if a developer is unable to secure the required funding to develop a project it could be developed by another party.

It is proposed to apply weighting factors to each of the six stages. This enables a probabilistic calculation to be made of the total projected MEC in the area. The proposed weightings are based as far as possible on historical data and information from ongoing discussions NIE have with developers and NI Planning Service. The following factors were considered in refining the proposed weightings.

- To date all large scale generation projects that have received planning consent have subsequently been constructed and connected or are currently proceeding within the NIE connections process, hence a weighting factor of 1.0 has been proposed.
- Since 1993, when the first large scale wind farms were commissioned in NI, approximately 80% of the aggregated capacity$^3$ of all wind farms submitted for

---

$^3$ Also 80% of individual large scale generations that have applied for planning permission have obtained approval.
planning approval have obtained consent. Based on this historical data a weighting factor of 0.8 is proposed for generators submitted to planning.

- A 0.4 weighting factor is proposed for generators that have commenced work on an EIA, in recognition of the significant financial commitment made by the developer. Discussions with developers have indicated that a high proportion (estimated 70-80%) of projects that start work on an EIA are subsequently submitted for planning approval. The 0.4 is arrived at by NIE assuming that each project has a 50% chance of making it through to submitting a planning application.

- Where a generator is to be located in an Area of Outstanding Natural Beauty (AONB) or similar designation then it is proposed to reduce the weighting factor to 0.3. This is in recognition of the fact that these developments face more challenging environmental scrutiny and are less likely to progress to a full planning application. NIE would accept that this weighting is particularly judgemental and subject changes in Planning Service policies.

- Developers often inform NIE of new generator projects in the early stages of development. Although this information is very useful, a weighting factor of zero is proposed due to the high level of uncertainty associated with the projects. Similarly projects that have been withdrawn from planning will also have a zero weighting applied; although such projects may be resubmitted there is no certainty of this.

All weightings will be kept under review with the benefit of experience. The proposed weighting factors are therefore as follows.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Weighting Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consented</td>
<td>1.0</td>
</tr>
<tr>
<td>Submitted to Planning</td>
<td>0.8</td>
</tr>
<tr>
<td>EIA Commenced</td>
<td>0.4</td>
</tr>
<tr>
<td>EIA Commenced with Generator in an AONB or similar</td>
<td>0.3</td>
</tr>
<tr>
<td>Withdrawn from Planning</td>
<td>0.0</td>
</tr>
<tr>
<td>Early Stage</td>
<td>0.0</td>
</tr>
</tbody>
</table>

**Table 2  Weighting Factors**

The above weighting factors will be applied to the individual wind farm capacities to establish an overall ‘weighted’ potential cluster capacity.

Where an individual generator is located such that connection is possible to more than one cluster then the following would apply in terms of allocation of capacity.
Methodology for Connecting Groups of Generators to the Northern Ireland Distribution System using Cluster Substations

- One cluster substation must be selected as the preferred method of connection for each generator.
- The cluster selected should generally be the closest to the generator.
- In special circumstances a cluster substation other than the closest may be selected. This could be the case if the closest substation is already fully subscribed (with generations that have already made application), or where the closest substation’s estimated commissioning date will unreasonably delay the connection, or where environmental limitations prevent building the connection asset to the nearest cluster.

We need to be clear that inclusion of a generator in any category is only for the purpose of decision making about the viability of a cluster. It does not infer any greater connection right to any particular generator over any other generator in the area.

**Views Requested**

*The risk of succeeding in financial closure may in future be as great for a development as the risk of obtaining planning permission. We would specifically like to seek views on how we account for this, so that we are robust in not developing excessive infrastructure. We could, for example, downgrade the weightings for each stage so that only projects with both planning permission and financial closure can be considered as being 100% certain. If this approach is to be taken we would welcome views on the new ratings or stages. NIE would also welcome views on the general system of weightings.*

### 4.2 Weighted Capacity Threshold for Consideration of a Cluster Substation

In rural areas NIE generally seek to use overhead lines as the preferred construction method. An overhead line usually provides the least cost method of connection with a good level of reliability. NIE will typically provide connection to a single wind farm using one 33kV overhead line, the line currently used has a rating of 28MVA. A single 110kV overhead line can provide a capacity of up to 190MVA.

It is proposed to use 56MVA as the minimum combined weighted MEC needed to justify a wind farm cluster. This figure is based on a view that generally two 33kV overhead lines (each rated at 28MVA) into a given area would be acceptable, whilst three would not be acceptable when compared with a single 110kV circuit.

Where the combined MEC of generators located within a designated area is less than 56MVA then their connection(s) will generally be designed using one or two 33kV overhead lines connected to a suitable point on the network. In some cases a joint connection scheme may be applied to ensure that connection to more than two generators can be provided using a maximum of two 33kV lines.

Where the combined weighted MEC for the designated area is greater than 56MVA then further consideration will be given to establishing a 110/33kV cluster substation located within the designated area.

---

4 200mm² AAAC conductor 33kV overhead line. This is currently specified as a draft NIE document.
For combined weighted MEC’s below 56MVA it is not guaranteed that NIE will be able to obtain two 33kV line routes, in which case either 33kV cabling or a 110kV cluster solution may be considered.

**Views Requested**
Consultees are requested to consider whether any modification would improve the approach taken.
5. **FURTHER ASSESSMENT**

When the steps described in Sections 3 and 4 conclude that a cluster substation should be considered then NIE will carry out further analysis. This is described in 5.1. The LCTA method of connection should also be considered further, as described in 5.2.

In both cases the information detailed in Table 3 will be required.

<table>
<thead>
<tr>
<th>Information</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity available on the local distribution network</td>
<td>NIE Electrical Studies</td>
</tr>
<tr>
<td>Capacity available at the local grid substation</td>
<td>NIE Electrical Studies</td>
</tr>
<tr>
<td>Distance to the local grid substation</td>
<td>NIE Mapping System</td>
</tr>
<tr>
<td>Required connection dates for generators</td>
<td>Developers</td>
</tr>
<tr>
<td>Estimated approval dates generator in planning</td>
<td>Developers</td>
</tr>
<tr>
<td>Estimated time to provide a cluster connection</td>
<td>NIE</td>
</tr>
<tr>
<td>Estimated time to provide individual connections</td>
<td>NIE</td>
</tr>
<tr>
<td>Estimated cost to establish a cluster</td>
<td>NIE</td>
</tr>
<tr>
<td>Estimated cost of individual connections</td>
<td>NIE</td>
</tr>
<tr>
<td>Any known routing restrictions or opportunities e.g. access, environmental, land owner, terrain</td>
<td>NIE</td>
</tr>
</tbody>
</table>

**Table 3 Site Specific Information**

5.1 **Further Assessment of a Cluster Substation**

Based on a consideration of the information in Table 3, NIE will conclude whether the establishment of a cluster substation represents the optimal method of connection. The following criteria must be considered and an overall conclusion drawn.

**Use of Three or More Overhead Lines**

Whilst the case for a cluster approach is based on avoiding multiple 33kV overhead lines, this will need to be validated on a case by case basis. Apart from environmental considerations, the costs associated with a multiple 33kV line option may escalate when reinforcement work at the existing grid substation is included.
Use of Underground Cable

The use of underground cabling can reduce the time to complete the connection of a generator to the network. This can be an important factor for developers. The issue of timing is dealt with in further detail later in this section.

Where the use of multiple 33kV lines is not considered practical (due to visual impact considerations or when suitable routes and/or planning approval cannot be obtained) the option of using multiple 33kV underground cables may be considered as an alternative to the cluster solution.

The use of multiple underground cables must be carefully considered against the following criteria.

- Cost - The main drawback of using underground cable is that it is considerably more expensive per unit length than overhead line. A cable circuit route length will also typically be greater than an overhead circuit because it must follow roadways or pre-defined boundaries, further increasing the cost. The overall cost may also escalate when reinforcements at the existing grid substation are included. This approach may need the agreement of all the developers involved as connection costs could exceed that of the clustered option.

- Future Connections - The use of all available underground cable routes may jeopardise the connection of future generators in the area. Future connections may become much more expensive as a result of forcing underground cabling and substation reinforcement on to later generators.

- Efficiency - The use of long 33kV cables transporting high power flows may result in an inefficient network in terms of total capital expenditure and network losses.

- Environmental Impact - Whilst the use of underground cabling provides benefits in terms of visual impact, the effect on the landscape and wildlife during the construction phase can be significant. In addition underground cables can have a permanent environmental impact.

Environmental Assessment

NIE has considered the potential for carrying out a detailed environmental assessment of the range of connection options. In particular to assess the feasibility of and enable the comparison of cluster options with those based on multiple 33kV lines. A number of environmental criteria would be considered during this assessment. It would then become a judgement by environmental and planning specialists to consider the various options against these criteria.

The methodology applied by such specialists is to score environmental cost on the basis of trusted databases of environmental information. Where opportunities are present parts of the route can have a negative environmental cost element e.g. by the route corridor following existing infrastructure corridors.

The environmental process will have two outcomes. The first is a set of recommendations as to whether each or any option is environmentally feasible. The second is the estimated environmental "cost" of each option. The absolute numbers
associated with environmental “cost” have no meaning other than for option comparison / weighting.

The environmental report will provide details of the following:

- The general nature of the environment and any special features.
- The options studied.
- The model used for the study.
- The infrastructure weightings used.
- The findings.
- The recommended option.
- The lowest environmental impact route corridor and all corridors within 5% and 10% of that corridor.

The report will also list information supplied for the study and will be accompanied by maps. The report will be provided by environmental experts and is to be a resource for information to be provided to the Planning Service.

NIE considers that defensible judgements can often be made on these matters, without the need for lengthy and costly consultant input. It is proposed that an environmental assessment will be carried out only where it is needed to support a decision.

**Cost Assessment**

Option costing is only to be applied to solutions which are deemed technically acceptable and environmentally feasible.

Dealing first with the simple case where the environmentally preferred option is also the cost preferred option, the decision is straight-forward.

Where the environmentally preferred and cost preferred options do not align, then NIE will investigate the matter further and report on the issue to the UR with a recommendation. Within a set of feasible solutions, NIE generally seek to minimise cost, however there could be occasions where the environmental “cost” difference is great and this may influence the outcome.

Where an otherwise acceptable option carries excessive cost but is preferred by a developer for reasons of say timing or constraints minimisation, then NIE may offer that option to the developer in exchange for the developer funding the excess cost.

There are two aspects to cost within the decision making framework. There is the initial or construction cost and there is an all-of-life cost. For network issues, all-of-life cost mostly concerns initial cost plus electrical losses. Although all-of-life costs will be considered as part of the “cost” assessment it does not affect developer contributions.
The costing report will indicate:

- The basis of costing.
- The options costed and their details.
- The expected option cost and any further assumptions made in the costing of options.
- The expected accuracy of the cost estimates.
- Whether a clearly preferred connection scheme can be recommended or whether additional investigation is required.

**Timing**

NIE recognise that the lead time for delivery of an individual 33kV connection is generally less than that of a cluster substation. A new 33kV overhead line requires a ground survey and the acquisition of wayleaves and planning approval prior to the construction phase. An Environmental Impact Assessment (EIA) may be requested by the planning authority if the line passes through an AONB or similar designation. An EIA for a 33kV line has not been requested to date.

In general, a clustered approach will require the establishment of a new 110/33kV substation in the vicinity of the proposed generators, and a 110kV line or lines will connect to the existing grid. Generally, the Planning Service will require that an EIA is completed for both the 110kV substation and line(s). Depending on the requirements of the EIA, the data collection phase alone can take up to a year. The analysis of the data and production of the EIA report will add 3-6 months to this. The substation design, line surveys, legalities and procurement of the equipment are also significant with a clustered arrangement.

The construction phase for establishing a cluster substation is also considerably longer than that of a single 33kV overhead line. As a result the grid connection of the first generator to connect to a new cluster substation may be significantly delayed. When the cluster substation is established subsequent generators may benefit from shortened lead times.

One solution to avoid delays for the first generator would be for NIE to develop cluster substations ahead of generators requesting connection. With this approach there would however be an unacceptable level of risk that the predicted generators do not obtain planning approval and subsequently the investment in the cluster is nugatory.

A second solution would be to offer the first generator an individual 33kV connection. The difficulty with this solution is that removing one generator may reduce the justification of the cluster. The connection of future generators in the area using individual connections could also be jeopardised in terms of line route availability and securing planning approval. Also the use of multiple 33kV overhead lines transporting high power flows may result in an inefficient network in terms of total capital expenditure (albeit funded by developers) and network losses.

Clearly a balanced position is needed where no generator’s connection is unduly delayed and also where NIE can continue to successfully connect generators to the grid.
It is proposed that where the implementation of a clustered approach will severely delay an individual generator's connection then consideration may need to be given to providing the generator with an individual connection. In terms of this assessment it is considered that, preferably, any single generator should not be delayed by more than 18 months by the implementation of a cluster approach than would have been the case with an individual 33kV connection. Where an individual 33kV connection is proposed then a second iteration of the analysis described in this paper must be completed to determine the optimum method of connection for the remaining generators. It is recognised that, historically, some generators not yet connected may have experienced delays in excess of this. This proposal is aimed at managing this consideration into the future.

5.2 Further Assessment of the LCTA Method of Connection

In the same way that the requirement for a cluster approach needs to be challenged fully, as detailed in section 5.1, the alternative conclusion that individual LCTA 33kV connections are appropriate also needs detailed investigation. The following sets out the criteria that must be considered.

Access or Planning Restrictions

When NIE has identified specific restrictions on the overhead line routes available, then a clustered approach may be deemed appropriate for generators even with a combined capacity less than 56MVA. Examples of restrictions would be when the local council or planning authority have advised that approval for new lines will not be granted or when NIE ground surveys have identified that line routes are limited. NIE must be able to demonstrate any restrictions to developers.

Cost

Where the combined output of generators in a designated area is less that 56MVA then generally one or two 33kV overhead lines will be used to provide the connection(s). However when it can be demonstrated that it would be more cost effective to use a cluster approach, then a shared 110/33kV substation should be developed. It is envisaged that this will only apply in exceptional circumstances.

A possible example could be where major reinforcements are needed at the existing 110/33kV substation to facilitate the generation capacity at 33kV. These reinforcements may increase the total cost of individual connections to above that of the clustered solution.

Views Requested

Consultees are asked to consider the methodology and criteria proposed at the Further Assessment stage.
6. CLUSTER APPROVAL AND PRE-CONSTRUCTION

The UR’s approval is required for the capital expenditure associated with each cluster. This is because electricity customers may contribute initially to the cost of the cluster.

As discussed in 5.1 the time taken to deliver cluster substations is critical to meeting developer’s expectations for grid connections. To allow NIE to construct cluster substations in a timely manner, whilst ensuring that the risk of under-recovery of customer funding is minimised, the following process is proposed.

- The cluster substation is justified as described in Sections 3 to 5.
- An approval for the capital expenditure for the pre-construction work for each cluster is then sought from the UR. The justification for the cluster described in this document will be detailed in the approval paper.
- Following consideration, and subject to UR agreeing with the case for the cluster, UR will grant NIE approval to proceed with the pre-construction work.
- NIE complete the pre-construction work and submit the proposal to the Planning Service for their approval.
- NIE then re-assess the justification for the cluster substation. i.e. check if any of the conditions have changed.
- Based on the outputs of the pre-construction work NIE will calculate a cost estimate for the construction work.
- NIE then re-assess the justification for the cluster substation. i.e. check if any of the conditions have changed.
- NIE will then submit an approval paper to the UR for the construction phase of the project.
- Following consideration, and subject to UR agreeing again with the case for the cluster, UR will grant NIE approval to proceed with the construction work. When planning approval has been obtained the construction phase can proceed.

To assist developers in prioritising their projects, details of the cluster plan will be published on the NIE website. This will include the location of each cluster and the achieved and expected dates for key milestones. NIE will also publish the estimated per MW charge associated with accessing each cluster. This information will be regularly updated by NIE.
7. RESPONSES

NIE would be pleased to receive your views on the methodology set out in this consultation paper by 7 September 2012.

Your responses should be in writing and addressed to:

Gerry Hodgkinson
Northern Ireland Electricity Ltd
Fortwilliam House
Edgewater Office Park
Edgewater Road
Belfast
BT3 9JQ

or sent by email to:
denzil.conn@nie.co.uk

NIE propose to hold a consultation presentation and discussion at Fortwilliam House on 24 August 2012 at 10.00am for interested parties. Further details can be obtained by contacting Gerry Hodgkinson or Denzil Conn.

Gerry Hodgkinson 028 9095 4353 gerry.hodgkinson@nie.co.uk
Denzil Conn 028 9095 4340 denzil.conn@nie.co.uk

NIE will also be happy to arrange bilateral meetings during the consultation period for further discussions or clarifications.

Additional copies of this paper can be downloaded at:
http://www.nie.co.uk/Network/Major-projects/Renewable-investment
Appendix 1 - Process Flow Chart

Collate and maintain a database of large scale generation projects.

Technical Assessment of Generators in Designated Area. Produce Connection Options.

Is the combined weighted MEC over 56MW?

Yes

Consideration of Clustered Approach.

Further analysis of:
- Using 3 or more 33kV OH lines.
- Using 33kV underground cables.
- Environmental.
- Cost.
- Timing.

No

Consideration of 33kV connections to the existing distribution network.

Further analysis of:
- Access or planning restrictions.
- Cost.

Is a cluster more appropriate?

Yes

Is a cluster still justified?

No

Yes

Produce Summary Report based on clustered connections.

Produce Summary Report based on 33kV connections.

Request pre-construction approval from the Utility Regulator.
Appendix 2 – Worked Examples

The following four worked examples are based on cluster substations that have been submitted to the UR for pre-construction approval. The information provided for each cluster is a summary of a more detailed report.

1. Magherakeel

Generators within a 10km radius of Magherakeel (approximately 11km south-west of Castlederg, Co. Tyrone) were collated and weighted according to their stage.

<table>
<thead>
<tr>
<th>Generator</th>
<th>Stage</th>
<th>Weighting</th>
<th>MEC MW</th>
<th>Weighted MEC MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Church Hill</td>
<td>Approved</td>
<td>1.0</td>
<td>18.4</td>
<td>18.4</td>
</tr>
<tr>
<td>Crighshane</td>
<td>Approved</td>
<td>1.0</td>
<td>32.2</td>
<td>32.2</td>
</tr>
<tr>
<td>Thornog</td>
<td>Approved</td>
<td>1.0</td>
<td>10.0</td>
<td>10.0</td>
</tr>
<tr>
<td>Tievenameenta</td>
<td>Approved</td>
<td>1.0</td>
<td>34.5</td>
<td>34.5</td>
</tr>
<tr>
<td>Seegronan</td>
<td>Approved</td>
<td>1.0</td>
<td>21.0</td>
<td>21.0</td>
</tr>
<tr>
<td>Altgolan</td>
<td>Awaiting Planning</td>
<td>0.8</td>
<td>18.0</td>
<td>14.4</td>
</tr>
<tr>
<td>Meenakeenan</td>
<td>Awaiting Planning</td>
<td>0.8</td>
<td>12.0</td>
<td>9.6</td>
</tr>
<tr>
<td>Gronan</td>
<td>Awaiting Planning</td>
<td>0.8</td>
<td>15.0</td>
<td>12.0</td>
</tr>
<tr>
<td>Aghamore</td>
<td>Awaiting Planning</td>
<td>0.8</td>
<td>15.0</td>
<td>12.0</td>
</tr>
<tr>
<td>Thornog ext</td>
<td>Awaiting Planning</td>
<td>0.8</td>
<td>9.0</td>
<td>7.2</td>
</tr>
<tr>
<td>Crighshane ext</td>
<td>Awaiting Planning</td>
<td>0.8</td>
<td>20.7</td>
<td>16.6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td>205.8</td>
<td>187.9</td>
</tr>
</tbody>
</table>

The total weighted MEC for a cluster substation at Magherakeel is 187.9MW

The closest existing transmission nodes to the Magherakeel area are Omagh Main (30km) and Strabane Main (36km). Installing 33kV circuits from Omagh and/or Strabane to the Magherakeel area have not been considered because 7 to 9 circuits would be required. This would give rise to environmental and planning difficulties, an unacceptable voltage rise at the generators and considerable works and Omagh and/or Strabane.

Without any further analysis NIE concluded that a cluster substation in the Magherakeel area would be required. Following a desktop route select the following is proposed:

- Establish a 110/33kV substation in the Magherakeel area with two 90MVA transformers.
- Construct a new 110kV overhead line from Omagh Main to Magherakeel.

Developers associated with the first wind farms to connect to Magherakeel have agreed to the proposal and the associated timescale.
2. Killymallaght

Generators within a 10km radius of Killymallaght (approximately 7km south of Derry city) were collated and weighted according to their stage.

<table>
<thead>
<tr>
<th>Generator</th>
<th>Stage</th>
<th>Weighting</th>
<th>MEC MW</th>
<th>Weighted MEC MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carrickatane</td>
<td>Approved</td>
<td>1.0</td>
<td>22.5</td>
<td>22.5</td>
</tr>
<tr>
<td>Eglish</td>
<td>Awaiting Planning</td>
<td>0.8</td>
<td>27.0</td>
<td>21.6</td>
</tr>
<tr>
<td>Proposed Wind Farm</td>
<td>EIA Commenced</td>
<td>0.4</td>
<td>12.5</td>
<td>5.0</td>
</tr>
<tr>
<td>Gortmonly</td>
<td>Withdrawn</td>
<td>0</td>
<td>18.0</td>
<td>0.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>80.0</strong></td>
<td></td>
<td><strong>49.1</strong></td>
</tr>
</tbody>
</table>

The total weighted MEC for a cluster substation at Killymallaght is 49.1MW. This is less than the 56MW required to initially justify a cluster.

Further analysis of the access restrictions and costs associated with the following two options was completed.

Option 1    Install two 33kV circuits from Lisaghmore Main
Option 2    Establish a cluster substation

Access Restrictions

A basic ‘route select’ type line survey and a substation visit were carried out. The following was concluded:

- The last 2-3km of the 33kV circuits into Lisaghmore Main would need to be underground cable due its urban location.
- The 33kV lines would need to be diverted around high ground located between Killymallaght and Lisaghmore.
- A river running along a similar route to the route of the overhead lines would present difficulties. Thrust boring work may be required to cross the river.
- There were already three 110kV circuits and one 33kV circuit following a similar route. Finding two additional route corridors would be difficult.
- There is a high rock content in the area between Killymallaght and Lisaghmore which could make trenching difficult and expensive.
Cost Analysis

Slieve Kirk wind farm, also located in the same area, was recently connected to the 110kV network by establishing a switching site adjacent to an existing 110kV overhead line. The 110kV switching site has sufficient space to accommodate a single 110/33kV transformer and the associated switchgear. Eglish and Carrickatane wind farms are both in close proximity to the existing switching site.

The cost analysis compared the following two options:

1. Establish a single transformer cluster site at the existing 110kV switching site. Install two 33kV circuits from the new cluster site to Eglish and Carrickatane.
2. Install two 33kV circuits from Lisaghmore Main to Eglish and Carrickatane.

The cost analysis showed that option 1 was the least expensive.

Selected Option

Option 1 is selected as the method of connection and a construction approval paper has been submitted to the UR.
3. **Altahullion**

Generators within a 10km radius of the Altahullion area (approximately 7km north-west of Dungiven, Co. Londonderry) were collated and weighted according to their stage.

<table>
<thead>
<tr>
<th>Generator</th>
<th>Stage</th>
<th>Weighting</th>
<th>MEC MW</th>
<th>Weighted MEC MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glenconway</td>
<td>Approved</td>
<td>1.0</td>
<td>18.4</td>
<td>18.4</td>
</tr>
<tr>
<td>Altahullion 3</td>
<td>Approved</td>
<td>1.0</td>
<td>30.0</td>
<td>30.0</td>
</tr>
<tr>
<td>Farkland</td>
<td>Awaiting Planning</td>
<td>0.8</td>
<td>51.0</td>
<td>40.6</td>
</tr>
<tr>
<td>Monnaboy</td>
<td>Awaiting Planning</td>
<td>0.8</td>
<td>12.0</td>
<td>9.6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td>109</td>
<td>98.6</td>
</tr>
</tbody>
</table>

The total weighted MEC for a cluster substation at Altahullion is 98.6MW.

The closest existing transmission node to the Altahullion area is Limavady Main (11km). The use of 3 to 4 33kV overhead lines or underground cables to Limavady Main was not considered further for the following reasons:

- The distance from the wind farms to Limavady Main would result in the voltage at the wind farms approaching or above the upper limit.
- Farkland wind farm would be likely to request a 110kV connection, therefore a 110kV line would be required from Limavady Main regardless.
- There were no particular opportunities identified for enabling three new 33kV lines to Limavady.
- No wind connection would be unduly delayed by adopting a clustered approach.

An environmental report was not deemed necessary. Following a desktop route select, the following was proposed:

- Establish a 110/33kV substation in the Altahullion area, initially with a single 90MVA 110/33kV transformer.
- Construct a new 110kV overhead line from Limavady Main to Altahullion.

Pre-construction approval for this cluster has been granted by UR and pre-construction work is proceeding. The case of need will be kept under review and the justification for a construction approval to UR will be based on the application of the methodology agreed as a result of this consultation.
4. **Mid Antrim**

Generators within a 10km radius of the Mid Antrim area (close to Rasharkin village, Co. Antrim) were collated and weighted according to their stage.

<table>
<thead>
<tr>
<th>Generator</th>
<th>Stage</th>
<th>Weighting</th>
<th>MEC MW</th>
<th>Weighted MEC MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long Mountain</td>
<td>Approved</td>
<td>1.0</td>
<td>27.6</td>
<td>27.6</td>
</tr>
<tr>
<td>Glenbuck 1</td>
<td>Approved</td>
<td>1.0</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Glenbuck 2</td>
<td>Approved</td>
<td>1.0</td>
<td>15.0</td>
<td>15.0</td>
</tr>
<tr>
<td>Altaveedan</td>
<td>Awaiting Planning</td>
<td>0.8</td>
<td>20.7</td>
<td>16.6</td>
</tr>
<tr>
<td>Eglinny Hill (revised)</td>
<td>Awaiting Planning</td>
<td>0.8</td>
<td>22.0</td>
<td>17.6</td>
</tr>
<tr>
<td>Rathsherry (revised)</td>
<td>Awaiting Planning</td>
<td>0.8</td>
<td>16.5</td>
<td>13.2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>104.8</strong></td>
<td><strong>93.0</strong></td>
</tr>
</tbody>
</table>

The total weighted MEC for a cluster substation at Mid Antrim is 93.0MW.

The closest existing transmission nodes to the Mid Antrim area are Ballymena Main (17km) and Coleraine Main (21km). The use of three 33kV overhead lines or underground cables to Ballymena or Coleraine was not considered further for the following reasons:

- The distance from the wind farms to both substations would result in the voltage at the wind farms above the upper limit.
- There were no particular opportunities identified for enabling three new 33kV lines to Ballymena or Coleraine.
- A cluster approach is less expensive than individual 33kV circuits.

An environmental report was not deemed necessary. Following a desktop route select the following was proposed:

- Establish a 110/33kV substation in the Mid Antrim area (near Rasharkin), initially with a single 90MVA 110/33kV transformer.
- Connect the substation into the nearby Kells to Coleraine 110kV overhead line.

Pre-construction approval for this cluster has been granted by UR and pre-construction work is proceeding. The case of need will be kept under review and the justification for a construction approval to UR will be based on the application of the methodology agreed as a result of this consultation.