EIRGRID

ESB NETWORKS

ECP-2

Node Assignment Rules

September 2020

This Node Assignment Paper details the principles and rules in relation to the Node Assignment for the ECP-2 batch.

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INTRODUCTION

This document describes the node assignment rules for ECP-2 and the principles which informed the establishment of these rules. The Node Assignment Rules has been devised by the System Operators (SOs), EirGrid as Transmission System Operator (TSO) and ESB Networks as Distribution System Operator (DSO). The rules aim to establish an efficient screening process for allocating ECP-2 applications to the appropriate nodes at which the generation can connect to the Irish electricity grid. Customers can express a preference for their preferred grid connection method in their application. The exact connection method for each of the generators will be determined following detailed technical studies.

Each ECP-2 applicant will be allocated to a transmission substation (400/220/110 kV) in accordance with the outlined Node Assignment rules presented in this document. These substations may be existing, new, planned or contracted[1] nodes. When applicable, the application will also be associated with an existing, new, planned or contracted distribution substation (38/20/10 kV). Where these rules indicate a connection to the distribution system, normal feeding arrangements at transmission level at the time of the analysis will be assumed.

[1] Contracted substation refers to a planned substation that will be built due to a previous application where a signed connection agreement exists.

PRINCIPLES OF THE NODE ASSIGNMENT ASSESSMENT

There are a number of factors that need to be considered when processing new applications for connections onto the Irish electricity grid. These factors need to be considered for either a single application or, when applicable, a cluster of applications based on their geographically location and interaction to each other.

There are a number of general principles that the SOs take into consideration when processing requests for new connections onto the Irish electricity grid. The following general principles are applied when designing connection methods and determining the initial node assignments for new applications[2]:

- Determine the Overall Least Cost connection method (including shallow and deep reinforcements – where applicable)
- Prudent Planning and Optimised Development of the Distribution and Transmission Network
- Strategic and Optimum usage of existing system assets
- Alignment of new connections with the overall long term System Development Strategy
- Deliverability of new connections

The main purpose of the outlined principles is to ensure that the system is planned in an optimal manner and to ensure maximum utilisation of system assets. This should avoid sterilisation for future connections or system reinforcements and ensure opportunities are retained for expandability and redevelopment of the system.

Considering the significant challenges associated with consenting and delivering grid infrastructure and facilitating network outages to connect the new infrastructure, there is an onus on EirGrid and ESB Networks to ensure existing infrastructure is developed in an optimised and strategic manner and with a sufficient degree of future proofing.

[2] Transmission System Security and Planning Standards (TSSPS): http://www.eirgridgroup.com/site-files/library/EirGrid/EirGrid-Transmission-System-Security-and-Planning-Standards-TSSPS-Final-May-2016-APPROVED.pdf

NODE ASSIGNMENT CONSIDERATIONS

Considering the above principles, the Node Assignment Rules (NAR) were developed to take the following key considerations into account:

OPTIMUM UTILISATION OF CAPACITY

This section is created to ensure that each new connection makes optimum usage of the connection equipment and that the MW size of the new application will optimally match the sized equipment for the new connection. For example, based on the standard transmission conductor for new connections, a 110 kV bay in a new transmission station has an upper capability limit of around 170 MW. Connecting a 5 MW generator to a new transmission bay would therefore be suboptimum utilisation of that bay. In this scenario, the ideal connection method is to connect the new 5 MW generator to the distribution system by establishing a new 110/MV[3] distribution transformer. This will allow for other existing or future generators to share the transmission and distribution assets.

As the largest 110/MV distribution transformer size is 63 MVA, the SO's consider that it is reasonable to expect that approximately 60 MW of generation could be connected to each 110 kV bay that has been allocated to a distribution transformer.

The largest distribution conductors used are 630mm^2 CU XLPE and 1000 Al XLPE underground cables and are able to carry approximately 50 MW.

Considering these equipment ratings, the SO's would consider the following general scenarios as optimum utilisations of system assets:

- Multiple distribution connected generators with a combined capacity of 60 MW are connected to the transmission system via one 110/MV 63 MVA transformer.
- An individual distribution connected generator of less than 50 MW is connected to the transmission system via one 110/MV 63 MVA transformer; this creates opportunities for future generation or demand connections to share that transformer connection.
- An individual transmission connected generator equal or greater than 50 MW is connected to a dedicated 110 kV bay.

The following are specific examples of connections where optimum utilisations of system assets were ensured:

[3] MV here represents a medium voltage level as used by the DSO (10 kV, 20 kV or 38 kV)

- Booltiagh 110 kV station has multiple DSO wind farms totalling 108 MW connected via two 63 MVA 110/38 kV DSO transformers.
- Cauteen 110 kV station has an individual wind farm of 52 MW connecting to the distribution system.

For the purposes of the node assignment only, extensions will be defined as those projects which have the same coordinates and are owned by the same legal entity as an existing development. Where the extension can be accommodated on the line or cable which feeds the existing development, then the transmission node will be assigned on the basis of the present normal feeding arrangements. Where the extension cannot be accommodated on that overhead line or underground cable then the node assignment rules will apply.

COST & CONSENTING

The cost of distribution equipment is lower than for transmission equipment. For example, the cost of a 110 kV 1000 Al cable is €650,000/km[4] compared to a 38 kV 630 Al XLPE cable cost of €253,210/km[5].

The opportunity costs of distribution and transmission system development must also be taken into consideration when identifying the connecting node and what type of connection will be applied, i.e. distribution or transmission. For example, utilising the last remaining spare bay at a transmission substation will come to a greater opportunity cost as there will be sterilisation of substation assets. Further connections into this substation would therefore require a busbar extension. Conversely, connecting multiple generators through shared assets will ensure maximum utilisation of substations and have less impact on the opportunity cost by reducing the need for future station development.

Consenting challenges are also considered. If a substation is not utilised in an optimum manner and as a result needs to be expanded there is no guarantee that it will be possible to get the consents required for these developments. Consenting challenges are also considered in the general context of the connection method. Generally, distribution equipment could be considered as less challenging from a consenting perspective owing to the relatively smaller equipment sizes at the lower voltage levels.

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[4] Cost from the Transmission Standard Development Costs – TSDC Rev. 6 16th November 2015 (Link)

[5] Cost from the Standard Prices for Generator Connections 2020 (Link)

NODE ASSIGNMENT RULES

In the context of the principles and considerations outlined above, the following Node Assignment Rules are defined:

The Node Assignment Rules will first determine the assigned voltage level for each applicant or group of applicants based on Maximum Export Capacity (MEC) of the application(s):

- Single applicants of less than 50 MW will be assumed to connect to the distribution network at 10 kV, 20 kV or 38 kV. (The specific voltage level will be determined based on the MEC and the available capacity).
- Single applicants equal or greater than 50 MW will be assumed to require a 110 kV (or higher depending on the MEC).
- A group of applicants with a combined MEC of equal or less than 60 MW (based on the maximum DSO transformer size of 63MVA with a power factor of 0.95) will be assumed to connect to the distribution network at 10 kV, 20 kV or 38 kV. (The specific voltage level will be determined based on the size of the applications and the available capacity).

Table 1. Summary of Ruleset for Assigning Voltage Levels for ECP-2.

Application Capacity [MW]	Rule – Assumed Connection Voltage
≥ 50MW individual MEC	110 kV (or higher depending on MEC)
≤ 60MW combined MECs	10 kV, 20 kV or 38 kV
≥ 40MW & < 50MW individual MEC	110 kV or 38 kV (case-by-case)
< 40MW individual MEC	10 kV, 20 kV or 38 kV

Table 2. Summary of guidance for Node Assignment at Distribution level for ECP-2.

Application Capacity [MW]	Assumed Connection Node
≤ 10MW & < 40MW	Nearest 110 kV node
≤ 5MW & < 10MW	Nearest 38 kV or 110 kV node
≤ 5MW	Nearest MV busbar

The Node Assignment Rules will then consider and determine based on the geographical location for each ECP-2 application:

- The nearest transmission node or declare a new node and when applicable, nearest distribution node.
- Assumed connection methods for each application or a cluster of applications (subgrouping).
- Generators with the same nearest transmission node can be included together in a subgroup for the purposes of the node assignment. Each generator is then to be further divided up into specific subgroups, if any, based on their level of interaction and geographic location. These subgroups may be changed during the connection method options stage of the ECP-2 process.

The above Node Assignment Rules will be applied in the initial screening assessments for ECP-2 applications. During the offer process a more detailed assessment of the system will be completed and the final connection methods will be defined.

DETAILS FOR NODE ASSIGNMENT

For transmission applications:

- A single application with a total MEC equal to or larger than 40 MW, will first be assessed by the TSO for a connection at transmission level. This will be reviewed in conjunction with the Node Assignment's principles and considerations.
- For all applications less than 50 MW, the TSO reserves the right to consider and propose connection methods at the distribution level. If these connections are acceptable to the DSO then the application will be transferred to the DSO.
- If an applicant of less than 50 MW has a specific request for a transmission connection, this will be considered on a case-by-case basis. As a rule, this will not be facilitated for generators less than 30 MW or in scenarios where a relevant substation has less than three available spare bays.

For distribution applications:

- A single application with a total MEC less than 40 MW, will first be assessed by the DSO for a connection at distribution level.
- Where a group of applications in a given geographical area exists with a total MEC equal to or less than 60 MW (based on the maximum DSO transformer size of 63 MVA with a power factor of 0.95), will first be assessed by the DSO for a connection at distribution level.

- If an application cannot be accommodated at distribution level, based on the justification by the DSO, a transmission connection will be considered.

DETERMINING THE NEAREST NODE

For the purposes of these rules the nearest node is defined as the shortest distance over land, as computed between the co-ordinates of the connection point on the existing system or new node and the co-ordinates supplied on the Application. Overland in this instance is defined as a straight line route with no water crossings of greater than 150 m (i.e. not across obvious obstacles e.g. river estuaries, large lakes etc.). In the event that water bodies greater than 150 m are encountered then the straightest route that circumnavigates the water body or – in the case of a waterway – arrives at a point where a crossing of less than 150 m can be made, will be deemed to the shortest distance to that node[6].

NODE ASSIGNMENT PROCESS STEPS

1. The first step assesses and outlines if an application is assigned to be a distribution or transmission connection. This screening assessment will decide at which voltage level the applicant is likely to connect into.

2. The second step allocates the nearest transmission node and when applicable, the closest distribution node based on a high-level assessment of connection method options. The technical study phase may result in some applications being allocated to a different transmission and/or distribution node than initially decided. Any customer preferences can also be considered at this point. In circumstances where there is no obvious existing connection node, the SOs may declare a new node (for example a new node could be looped into existing circuits in the area).

3. The third step considers subgrouping. This refers to grouping applications at one existing or new node depending on level of interaction and geographical location.

[6] A width of 200 m has been assumed as this represents the typical span length of a 110 kV or 38 kV overhead line. Therefore a greater than distance is likely to be unachievable without special design considerations and the costs associated i.e. use of cable. In the case of transmission this generally necessitates a cable connection all the way to the nearest one of the substations the circuit is linking between. Such a connection is highly unlikely to be LCTA.

4. Connection method options for DSO connections will be defined by ESB Networks. Connection method options for TSO connections will be defined by EirGrid. In circumstances where principles set out in these rules result in a connection method transferring between the SOs, charging exercises will not be undertaken to compare the charges that could theoretically have been applied for the alternative connection methods.

APPENDIX A: ILLUSTRATIVE EXAMPLES ECP-2.

For illustrative purposes, this section provides a number of examples of how the System Operators proposed Node assignment assessment approach will work.

ILLUSTRATIVE EXAMPLE 1 – TRANSMISSION CONNECTION

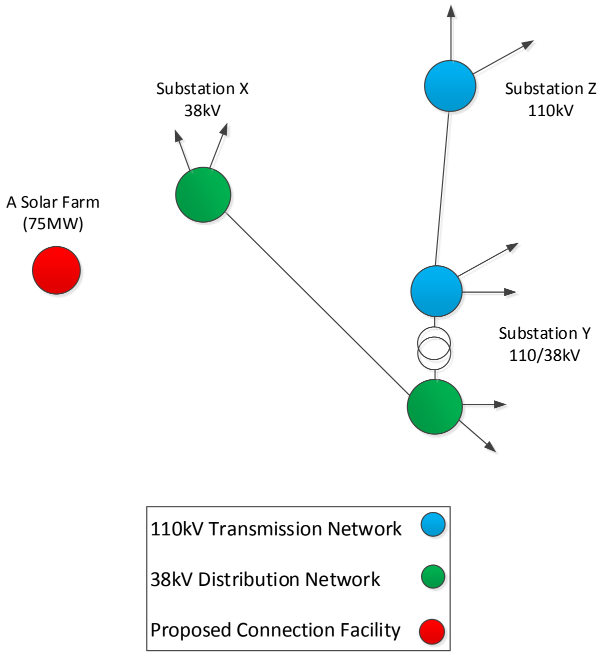

Figure 1. Transmission connection of Dearbhla Solar Farm 75MW.

A Solar Farm (75 MW) has applied for a connection to the Irish electricity grid. Following the above stated principles and considerations, the only connection option for the generator is to connect onto the transmission network. This is mainly because the size of the generator (75 MW) cannot be accommodated on the distribution network due to equipment and voltage level limitations. In this case, the generator will be assigned the closest transmission substation, which is substation Y 110 kV node, and connect to the transmission network. The connection method option phase will determine if substation Y is a suitable option or if alternative transmission connection solutions are applicable.

ILLUSTRATIVE EXAMPLE 2 – DISTRIBUTION CONNECTION

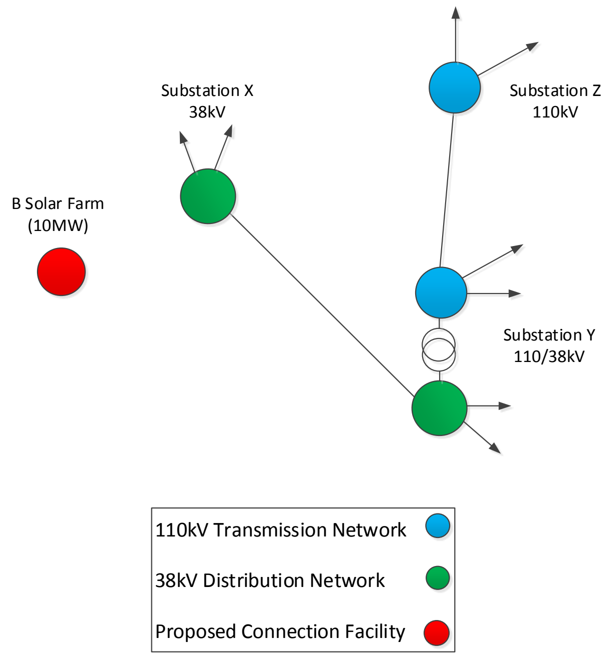

Figure 2. Distribution connection of Roberto Solar Farm 10MW.

B Solar Farm (10 MW) has applied for a connection to the Irish electricity grid. Following the above stated principles and considerations, it is optimal for the generator to connect at distribution level, into the substation X 38 kV node (substation X is the closest distribution node). The connection method option phase will determine if substation X is a suitable option or if alternative distribution connection solutions are applicable.

ILLUSTRATIVE EXAMPLE 3 – DISTRIBUTION CONNECTION (SUBGROUPING)

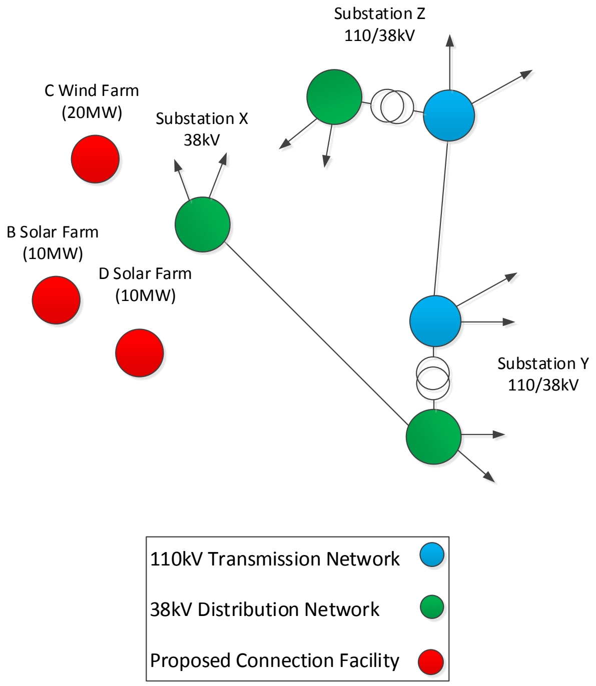

Figure 3. Distribution connection of B Solar Farm (10MW), D Solar Farm (10MW) and C Solar Farm (20MW).

B Solar Farm (10 MW), C Solar Farm (20 MW) and D Wind Farm (10 MW) are all applying for a connection onto the Irish electricity grid. Assessing each application separately according to the stated principles and considerations; they will be assigned a connection onto the distribution network and connect into substation X 38 kV node. Due to the geographical location and interaction, consideration of subgrouping the applications exist and thereby optimise the connection method to allow for a more strategic and prudent planning.

If the 38kV circuit from Substation X to Substation Y would exceed the existing circuit limitation due to the connection of the subgroup, additional connection method option assessments of either uprating the existing circuit or connecting the subgroup into nearby stations will be performed. The connection assessment involves assessing connections into the second closest 38 kV substation or 110 kV substation as a 38 kV connection.

The connection method option phase will determine if substation X is a suitable option or if alternative distribution connection solutions are applicable.