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3 Alternatives: Routeing and Substation Site Selection

3.1 Executive Summary

1. The Alternatives Route and Substation Site Selection assessment of the proposed Tyrone – Cavan Interconnector was undertaken by SONI, AECOM and ESBI specialists. SONI (formally NIE[1]) provided technical electrical expertise on line routeing and design, and AECOM provided environmental advice (environmental constraints mapping). Since 2014, SONI has taken responsibly for the Tyrone – Cavan Interconnector. Numerous alternatives for additional interconnection have been considered in the development of the location and routeing for the proposed Tyrone - Cavan Interconnector. Alternatives considered include:

- alternative system connection options, leading to the choice of six possible methods;
- alternative study areas associated with the choice of a preferred route corridor;
- alternatives to the line routeing within the preferred route corridor, and the selection of a final proposed route for the proposed overhead line;
- alternative substation locations, leading to the choice of Turleenan near Moy, County Tyrone; and,
- alternatives to the substation design, and the final choice of a GIS arrangement.

2. The proposed Tyrone - Cavan Interconnector has been subject to an extensive examination of the available alternatives, at each stage having regard to their environmental impact. A fundamental element of the applicant's development process has been to seek the mitigation of environmental impacts by design, and the location of the proposed substation and the routeing of the proposed overhead line are both

[1] The planning of the proposed Tyrone - Cavan Interconnector was originally undertaken by Northern Ireland Electricity (NIE). However, NIE was obligated by the European Commission to transfer its investment planning function (the "Planning Function") to SONI. The SONI transmission system operator licence (the "Licence") was amended on 28th March 2014 to take account of the transfer of the Planning Function following a consultation process by the Northern Ireland Authority for Utility Regulation (NIAUR). The Licence amendments took effect on 30th April 2014. Accordingly, responsibility for the pursuance of the planning applications in respect of the proposal has been transferred from NIE to SONI. Following the transfer of its Planning Function to SONI, NIE will continue to be responsible for the construction, ownership and maintenance of the transmission system in Northern Ireland. Subject to planning consents being obtained for the Tyrone – Cavan Interconnector, NIE will be responsible for its construction, in accordance with said consents.
In summary, any reference to NIE within the applications for approval specifically regarding the planning and consenting of the proposed interconnector should be understood as now referring to SONI in the context of its newly acquired statutory responsibility for the pursuance of the planning applications in respect of the Tyrone – Cavan Interconnector and this approach has been adopted in this TR.

believed to present the best achievable balance between environmental impacts, technical requirements, and economic limitations.

3. As stated in the Statement of Case, there is an overriding need for this proposal, which significantly outweighs its impacts and the possibility of alternatives being more suitable. The proposal clearly meets the terms of policy which does not require the undergrounding of electricity cables but rather careful route selection and minimisation of intrusion, as has been carried out in this case.

3.2 About the Authors

4. The SONI specialist for line routeing and substation site selection is Mr Michael Hewitt, a trained Electrical Engineer and Graduate of The University of Ulster. Mr Hewitt is currently the SONI Transmission Project Development Engineer with over 30 years' experience in the electricity industry and extensive knowledge of distribution and transmission network design, planning, construction, commissioning and project management. He has worked on many major projects during this time, including the Laganside development and voltage upgrade of central Belfast, the North Down and South Armagh Network reinforcement schemes, before moving into Transmission Major Projects in 2001.

5. Since 2001, Mr Hewitt has had responsibility for line routeing and selection of over 300kms of 110/275/400kV network, technical inputs to Environmental Impact Assessments (EIA), and responsibility for obtaining planning permissions for new transmission line routes and substation sites throughout Northern Ireland.

6. In conducting the line routeing and design, Mr Hewitt drew upon the expertise of AECOM and ESBI.

7. Mr Fay Lagan (AECOM) is a chartered environmentalist with a wide ranging experience in the environmental field. He has 15 years' experience in major environmental projects including EIA, noise appraisal, appropriate assessment and planning applications. Mr Lagan is a graduate of Queen's University with a Masters in Applied Environmental Sciences. His principal experience is in the EIA of projects in the UK and Ireland in the energy and highways sectors but has also worked on water sector developments and mixed used development projects.

8. Mr Jarlath Doyle (ESBI) is a chartered engineer and has worked on many overhead line projects in a variety of capacities. He holds a degree (B.E) in Civil Engineering from National University of Ireland, Galway (1999) as well as a Diploma in Management from the University of Limerick (2006).

9. Mr Arthur is a chartered engineer and has also worked on many overhead line projects in a variety of capacities. He holds a Master of Science degree (MSc) in Electrical Power Systems from the University of Bath, United Kingdom (2013) as well as a Diploma in Applied Electronics from the Dublin Institute of Technology Kevin Street, Dublin (2000).

3.3 Policy and Guidance Informing Assessment

10. Regarding transmission infrastructure routeing and siting, the Strategic Planning Policy Statement (SPPS) has a regional objective to "ensure that the visual and environmental impact of telecommunications and other utility development is kept to a minimum" (paragraph 6.2.3.9, bullet 2).

11. The SPPS states that "The importance of other strategic infrastructure to the region such as … energy … is also recognised by Government" (para 6.236), that "The aim of the SPPS in relation to telecommunications and other utilities is to facilitate the development of such infrastructure in an efficient and effective manner whilst keeping the environmental impact to a minimum" (para 6.239), and that "Any proposal for the development of new power lines …. Will be considered having regard to potential impact on amenity and should avoid areas of landscape sensitivity, including AONBS" (para 6.250).

12. The Planning Strategy for Rural Northern Ireland comprises a number of relevant Public Service and Utilities (PSU) policies. PSU 2 (Major Projects) states that "a developer will need to demonstrate …where appropriate … that a thorough exploration of alternatives has been made and that the alternatives are unsuitable".

13. PSU 8 (New Infrastructure) requires that "the Department will wish to be satisfied that there is an overriding regional or local requirement for the development and that a thorough exploration of alternative sites has been carried out. Normally the Department will wish to see the development sited so as to minimise the environmental effects, for

example, the alignment and landscaping of a new road should be designed to achieve the maximum possible integration into the landscape" (page 110). PSU 8 also sets out the important criteria to be considered as including the "existence of alternative sites or routes" (page 110).

14. Policy PSU 11 (Overhead Cables) acknowledges that "One aspect of modern life is the presence of pylons and poles carrying overhead wires for … electricity supply". The potential for "wirescape" to be visually obtrusive where it appears above the skyline is noted in PSU 11, requiring that in the siting of transmission lines consideration should be planned to: avoid areas of landscape sensitivity; avoid sites and areas of nature conservation or archaeological interest; minimise their visual intrusion; make sure that they follow the natural features of the environment; and ensure that wirescape in urban areas is kept to a minimum with preference being given to undergrounding services where appropriate (page 114).

15. Policy PSU 11 does not require that new overhead lines should be undergrounded, with the only reference to this being "*a preference… where appropriate*" in urban areas (page 114). New overhead lines in rural areas are acceptable provided they are designed appropriately. The only preference for undergrounding is where appropriate in urban areas (Conservation Areas) and in AONBs. The relevant consideration for this proposal is to "minimise" visual intrusion.

16. In choosing the overhead line route described in this proposal, the criteria in the Holford Rules and in the "Guidelines for NIE Networks and the Environment" were followed.

17. Guidelines for transmission line routeing known as the 'Holford Rules' have been produced and are widely used. The Holford Rules articulate general environmental principles and best practice in line routeing that provide guidance on line routeing within the more comprehensive EIA process. The Rules and how they were applied to the proposed Tyrone – Cavan Interconnector are detailed in Chapter 4 of the Consolidated ES (pages 103 – 104).

3.4 Summary of Documents

18. This technical report summarises and incorporates by reference the content of the documents submitted in support of the planning applications for the proposed Tyrone -

Cavan Interconnector in respect of Alternatives, Route and Substation Site Selection. These documents are as follows:

- Section 4.2 of Chapter 4 of the Consolidated ES (pages 60-116);
- Figures supporting Chapter 4 of the Consolidated ES, contained in Volume 4 at A3 size:
  - Figure 4.1 Ireland Transmission System Jan 2013;
  - Figure 4.2 Alternative Interconnector Options;
  - Figure 4.3 Alternative Interconnector Study Areas;
  - Figure 4.4 Line Routeing Alternatives;
  - Figure 4.5 Substation Site Alternatives;
  - Figure 4.6 2009 & 2013 OHL Route Comparison (Sheets 1 to 10).
- Volume 3 Appendices of the Consolidated ES 2013.

19. This technical report must therefore be read in conjunction with the Consolidated ES and its Addendum, and not as a standalone document.

20. In a general sense all EIA documentation is interrelated and, particularly with respect to the interaction of impacts, all the EIA documents would be relevant. For clarity, the author considers the key documents are summarised above. The reader should form his or her own view on what documents within the Consolidated ES and its Addendum are relevant, and key, to the topic under consideration.

21. In the interest of readability these documents are not reproduced in full in this technical report. The figures, key documents required for the coherency of this technical report, are reproduced herein and appended.

3.5 Consultation Responses

22. Consultees helped to inform the routeing and site selection process through the data provided on key constraints but also by providing specific comments on the presented alternatives. Prior to the publication of the preferred route, the consultees were consulted in July 2006, November 2007 and December 2008. These consultations helped to inform the selection of the preferred route and the site of the proposed substation. Further details are provided in Chapter 6 of the Consolidated ES (pages 156 – 173).

3.6 Methodology and Surveys

23. This is a summary of the information contained in the Consolidated ES, Chapter 4 – Alternatives (pages 61 - 64) and the Consolidated ES Addendum, Chapter 10 – Technology Alternatives (page 124).

24. The applicant and EirGrid jointly agreed a scope of works for undertaking environmental, technical and economic feasibility studies of the identified study areas and route corridors applicable to each connection option and covering broad geographic areas both north and south of the border. There were ongoing and regular co-ordination meetings between the companies, including joint review of evaluation documents, in order to ensure a consistent approach.

25. The applicant 's environmental analysis involved the following elements:

- The development of a physical and environmental constraints map based on:
  - Physical/terrain issues which could potentially impact on construction and maintenance of a route within each study area, including, inter alia, identification of topography and elevation, urban and rural development, road crossings (particularly major road crossings), geology and soils, quarries/mines/airstrips.
- Environmental constraints to identify and address key environmental issues arising in respect of each study area. This included: ecology and nature conservation designations, known nature conservation areas of interest (available ecological data sources), landscape designations, landscape character, land zoning (including settlements), archaeology and cultural heritage, community sites, tourism amenities, water bodies and large watercourses;
- As landscape and visual and ecological impacts were considered to be likely to cause the most significant environmental impacts, NIE's advisers included a landscape architect and an ecologist from this preliminary stage;
- Reference to guidelines for electricity development, including the Holford Rules and NIE's Guidelines for NIE Networks and the Environment[2]; and,
- The salient environmental features of the area were further investigated by means of surveys and other sources of geographical and environmental information.

[2] (NIE 1998)

26. Technical and economic analysis was applied to the identified study areas and route corridor options. In accordance with the applicant's general obligation under Article 12(2) of the Electricity (NI) Order 1992, the assessment process recognised the need to ensure that the proposed solution should avoid areas of technical difficulty and thus major additional cost and that overall route solutions should be as short and direct as reasonably possible consistent with the obligations of Article 41 and Schedule 9 of the Order. This included :

- Initial assessment of operational considerations associated with reliability in service;
- Practical assessment of constructability and deliverability; and
- Further and updated information on developments and reinforcement plans arising in each jurisdiction since completion of the initial suite of technical analysis.

27. Utilising the above studies, route corridor options were identified within the study areas based on environmental, economic and technical considerations. Principles for route corridor identification were to:

- Identify the shortest and straightest route corridor that was technically, economically and environmentally preferable. Any additional length or additional turns in the route would require additional structures or larger structures (in the case of a turn in the overhead line) with associated additional economic and environmental impacts;
- Minimise environmental impacts through avoiding as far as geographically possible and technically practical known environmental constraints as determined through the constraints mapping exercises; and,
- Minimise environmental impacts through the incorporation of ongoing advice from the project environmental team and in particular a landscape architect and an ecologist.

28. In all cases where a new substation may be required, the applicant undertakes a detailed analysis of the options. Suitable substation locations are primarily constrained by the requirement to be at or near an existing transmission line. This is a practical requirement, as otherwise additional overhead lines would be required to connect the substation to an existing overhead line. These additional overhead lines would themselves have additional technical and environmental impacts, as well as presenting additional cost. In the case of the proposed Tyrone - Cavan Interconnector, this study

was especially important since the location of the substation would form a key strategic node within the future transmission system.

3.7 Assessment Overview

29. This is a summary of the information contained in the Consolidated ES, Chapter 4 – Alternatives (pages 61 - 92) and the Consolidated ES Addendum, Chapter 10 – Technology Alternatives (page 124 - 164).

The Initial Identification of Options for Interconnection

30. As set out separately in each of the EIA documents, and in parallel with the evaluation of transmission alternatives described, the applicant and EirGrid have worked together over a long period to determine joint proposals for the selection of transmission system connection points and for the geographic positioning of a proposed overhead AC transmission line.

31. The first stage in the process was to perform a wide range of technical studies in order to determine the most appropriate physical points at which to connect the two power systems with a new interconnector. These studies were performed jointly by the applicant and EirGrid engineers, and spanned a period from April 2001 to July 2004. The conclusions of the studies identified five technically possible connection options.

32. Connection options 1 to 5 are illustrated in Figure 4.2 of the ES.

Connection Option 1: Multiple 110kV Overhead Line Development

33. This option considered the installation of three new 110kV transmission lines between existing sub-stations on the transmission systems:

- Coolkeeragh, County Londonderry – Trillick, County Donegal;
- Newry, County Down - Louth, County Louth;
- Tandragee, County Armagh – Lisdrum, County Monaghan.

Connection Options 2, 3, 4 & 5: 275kV/400kV Overhead Line Development

34. Several options were considered based on the geographic location of appropriate connection points on the existing 220kV and 400kV transmission systems in the Republic of Ireland and the 275kV network in Northern Ireland. These options were:

Connection Option 2: Eastern Option

35. This option involved reinforcing the existing double circuit transmission line connection between sub-stations at Tandragee, County Armagh, and Louth, County Louth, by constructing a further transmission line connection to be operated at either 275kV or 400kV.

Connection Option 3: Western Option

36. This option was based on a new 275kV transmission line connection between Coolkeeragh, County Londonderry and Srananagh, County Sligo.

Connection Options 4 and 5: Mid-Country Options

37. These options were based on a new 275kV or 400kV transmission line connection between Drumkee, County Tyrone and potential connection points at Arva (Option 4) or Kingscourt (Option 5), both in County Cavan.

3.7.1 Technical Evaluation of Connection Options

38. Having identified the five options described above, and as the second stage of the process, the applicant and EirGrid carried out further detailed technical evaluation on each option in order to determine its suitability for meeting technical performance requirements.

39. The conclusion of this second stage was to reject Option 1 since it was found that this method of interconnection would not be capable of increasing the net transfer capacity in either direction and could not therefore meet the strategic need for additional interconnection capacity. Option 3 was also rejected at this stage since it would connect

weaker and more peripheral parts of both transmission systems and would therefore provide lower transfer capacity than other available options.

40. The remaining connection options were carried forward into a further detailed environmental assessment.

3.7.2 The Environmental, Technical and Economic Assessment of Connection Options

41. The third stage of the process was to assess the remaining connection options having additional regard to potential environmental impacts, and also to economic and practical considerations. All the identified connection options were contained within an overall geographical area that had a northern boundary defined by the existing 275kV double circuit overhead line between Tandragee and Dungannon, and a southern boundary corresponding to the route of ESB's existing 220kV overhead line between Louth and Flagford. The preferred connection points were identified following technical analysis of the transmission systems.

42. These options are illustrated in Figure 4.3 of the Consolidated ES.

43. The applicant and EirGrid jointly agreed a scope of works for undertaking environmental, technical and economic feasibility studies of the identified study areas and route corridors applicable to each connection option and covering broad geographic areas both north and south of the border.

44. This third stage of study involved the development of a physical and environmental constraints analysis based upon:

- Environmental constraints mapping studies to identify and address key environmental issues arising in respect of each study area, including designated landscapes, designated nature conservation sites, landscape character, land zoning, archaeology and cultural heritage, ecology, settlements, community sites, tourism sites etc;
- An assessment of physical route/terrain issues which could potentially impact on the construction and maintenance of a practical route within each study area, including identification of topography, urban and rural development, land use, road crossings, geology, quarries, mines, airstrips and other salient features.

45. As landscape and visual impacts were considered to be the most significant likely environmental impacts, the applicant's advisers included a professional landscape architect.

46. The salient environmental features of the study area were further investigated by means of surveys and other sources of geographical and environmental information.

47. Route corridor options were identified within the study areas based on environmental, economic and technical considerations. In general, principles for route corridor identification were:

- First, working from the identified connection points within each of the existing transmission systems, to identify the shortest and straightest route corridor that was technically, economically and environmentally achievable. It was recognised as part of this process that any additional length or additional deviations in the overhead line route would require additional supporting structures or, in some cases, larger structures (for example in the case of a change of direction in the overhead line route), with associated additional environmental and economic impacts;
- Secondly, to minimise identifiable environmental impacts by avoiding known environmental constraints, as identified through the constraints mapping exercises, as far as was practicable within geographically possible and technically achievable limits;
- Thirdly, to minimise further potential landscape and visual environmental impacts through the advice of a professional landscape architect.

3.7.3 The Joint Selection of a Preferred Route Corridor

48. The selection of a preferred study area and route corridor to take forward for more detailed route selection and design was made by the applicant and EirGrid on balance of environmental, technical and economic considerations having an overall regard to the likely significant environmental impacts. A decision to select connection Option 5, a preferred route corridor running from the vicinity of Drumkee, County Tyrone to the vicinity of Kingscourt, County Cavan was agreed between the applicant and EirGrid in October 2005. Option 5 was chosen as transmission system analysis carried out found that it would significantly increase transfer capabilities in both directions. It would also offer physical separation from existing interconnection, thereby reducing the risk failure.

49. The selection of this preferred route corridor established a potential border crossing zone in the vicinity of Mullyard townland, County Armagh and broadly defined the route corridors for further development and consultation by the applicant and EirGrid within their relevant geographic areas of responsibility.

3.7.4 The Selection of a Detailed Overhead Line Route within the Preferred Route Corridor

50. Following the identification of the preferred route corridor, detailed line routeing studies were then undertaken by the applicant in relation to the portion of the preferred route corridor contained within Northern Ireland, together with ongoing liaison with EirGrid in order to ensure that the conditions for the choice of the overall corridor remained valid.

51. Within the preferred route corridor, a three stage process of “line routeing” was conducted. This is illustrated in Figure 4.4 of the ES.

52. First, a data gathering exercise was undertaken. This used a combination of aerial photography, the detailed mapping of houses, commercial buildings, industrial buildings, and proposed Tyrone - Cavan Interconnectors as well as all known environmental constraints, and extensive site visits to gather accurate data throughout a continuous 5km wide corridor surrounding the most direct route through the study area from Drumkee, County Tyrone to the border crossing area agreed with EirGrid. The chosen border crossing location was selected as being the optimal point taking into account technical, environmental and economic considerations. Routes at Derry~Londonderry round the border to Newry and points between were assessed, as shown on Figure 4.2 of the Consolidated ES. The assessment of technical alternatives helped to inform the routeing and site selection process. As shown in Figure 4.3, the areas were narrowed to corridors in Tyrone, Armagh and Down. These corridors were then narrowed further into line routeing options and these are shown on Figure 4.4. This figure demonstrates the large number of routeing alternatives that were considered, including the large number of potential border crossing locations that were assessed before the final location was chosen.

53. Secondly, detailed overhead line routeing was undertaken to identify a continuous practicable route with regard to the likely significant environmental impacts arising. This

process included a general objective to maximise the distance between the proposed overhead line and all known dwelling places for reasons of general amenity.

54. Finally, and following the determination of a practicable and continuous overhead line route, detailed line design and specific locations for towers were determined and refined in a series of changes that were aimed at achieving an acceptable route with the least environmental impact.

55. Each stage in the line routeing process was performed in compliance with NIE Guidelines[3] and with the overall goal of minimising the likely significant environmental impacts associated with the proposed overhead line. The applicant was at all stages fully aware that the most effective method of avoiding or reducing the environmental effects of an overhead transmission line is by careful routeing.

56. The Holford Rules, formulated by the late Lord Holford, Professor of Town Planning, University College London in 1959, were also taken into account. These set out general environmental principles and best practice in line routeing that provide guidance on line routeing within the more comprehensive EIA process. The Holford Rules provide a valuable basis for an approach to transmission line routeing. The Rules and how they were applied to the proposed Tyrone – Cavan Interconnector are detailed in Chapter 4 of the Consolidated ES (pages 103 – 104). The routeing practice followed for the proposed Tyrone - Cavan Interconnector has therefore been based on the applicant's desire to minimise the environmental impact of the proposed Tyrone - Cavan Interconnector and on the Holford Rules as modified by the National Grid Company Guidelines.

3.7.5 Refinement of Proposed Route

57. In response to statements received from members of the public during preparation for the public inquiry in 2012, the applicant re-examined the location of each tower in light of all design, environmental and engineering constraints. The purpose of this re-examination was to investigate each tower location and to further improve (if possible) its location in environmental terms. The re-examination was not intended to reassess the overall routeing for the proposed overhead line as it was considered that the routeing

[3] (NIE, J63413 10/98 C 10 CN9261)

assessment had optimised the continuous line route in terms of environmental and engineering constraints and no changes were required. The refinement process has resulted in the now proposed tower locations which are considered to represent the best achievable balance between environmental impacts, technical requirements, and economic considerations, and take into account comments made at the 2012 public inquiry. .

58. For these reasons there were a number of minor changes from the positioning shown in the 2009 Environmental Statement.

59. All towers remained the same type of tower, i.e. either intermediate/suspension or angle (see Chapter 5 of the Consolidated ES for explanation of different tower types). Two angle towers changed in degree of angle: Tower 1 was proposed to be a 60 degree angle tower in 2009 and was changed to a 90 degree angle tower, and Tower 13 was a 30 degree angle tower and was changed to a 60 degree angle tower. The change of tower types arose from technical requirements. A review of the previously shown angles determined that the angles of each could be amended to improve the buildability of the towers. The changes in angle were considered to be relatively minor and was fully assessed in the Consolidated ES and its Addendum.

60. The Consolidated ES Addendum (2015) identified a further change to the angle of Tower 102, which changed from a 30 degree angle tower and is now a 60 degree angle tower, the latter being more appropriate to the location.

61. The proposed location of a number of towers moved marginally between 2009 and 2013 to optimise the location and also to reduce environmental impacts. These movements have resulted in both decreases and increases in tower height. The overall stated maximum height of the 400kV towers is now 41m (it was previously 42m) and the maximum height of the 275kV towers associated with the substation connection remain unchanged at 54m. The maximum change in proposed height is 6m and the average change in proposed tower heights is minus 0.5m (a reduction compared to the 2009 design).

62. The average change in tower location was 8.8m. The refinement process brought about no significant difference in the proposal for routeing, location and arrangement of the proposed overhead line.

3.7.6 The Evaluation of Alternatives for the Location of the Proposed Substation

63. As the overhead line route was being developed, a separate parallel process was undertaken to determine an appropriate position and design for the substation installation necessary for connecting the proposed overhead line to the existing transmission system. Connection needs to be made at a substation location capable of safely accommodating all of the voltage transformation, switching, control and protection equipment required for a major transmission circuit.

64. A key consideration for location of the substation site was the need to identify a site close to the existing 275kV overhead line in order to reduce the need for additional infrastructure to connect into the transmission system. This consideration was made with regard to the additional landscape and visual impacts arising from any additional infrastructure.

65. Four alternative sites were considered for location of the substation; three new sites and an upgrading of the existing Tamnamore substation. These are illustrated in Figure 4.5 of the ES.

66. A study of the modifications necessary to accommodate equipment needed for termination of the proposed Tyrone – Cavan interconnector at Tamnamore substation demonstrated that this option would have required a substantial redesign of the existing substation. It also showed that ongoing residential development in the Tamnamore area was severely restricting the scope for achieving an acceptable overhead line route corridor into the vicinity of the substation from the south. The study considered the possibility of undergrounding a short section of the required line connections in the final approach to the substation, but the technical complexities, including the need to cross the M1 motorway, were found to lead to prohibitive costs and this option was rejected. It was determined that a search should be undertaken for a suitable strategic location more suited to the development of a substation expressly designed for termination of the proposed Interconnector.

67. A location for a new substation was sought to the south of Tamnamore substation. Conducting a search south, rather than north, of Tamnamore would reduce the overall length of overhead line required for the proposed Interconnector.

68. The site at Turleenan, near Moy, County Tyrone, was selected as the preferred location taking into account the following key environmental considerations:

- Adequate distance from dwelling houses;
- Existence of natural screening, due to mature vegetation and topography which would reduce landscape and visual impacts;
- Greater distance from the Argory (a National Trust property) and the Clonmore Tower (an archaeological feature) than other sites considered;
- A more southerly location than other sites considered, requiring a reduced overall route length for the proposed overhead line as a result;
- Capacity for elevated above and outside the Blackwater River flood plain, whereas other sites were located wholly within the flood plain; and,
- Preference over other sites for ground quality reasons.

3.7.7 The Evaluation of Alternatives for Design of the Proposed Substation

69. Two key design alternatives were considered by the applicant in relation to the proposed substation at Turleenan:

(a) an arrangement utilising air-insulated 275kV switchgear, which would require the creation of a substantial level area involving significant earth works and landscape disturbance, or

(b) an arrangement using more expensive gas insulated 275kV switchgear (GIS), but, owing to its smaller size, would enable significant reductions in earth works and an improved visual aspect within the landscape.

70. The applicant's decision, having regard to the likely significant visual effects, was to propose the GIS design for 275kV switchgear within the substation at Turleenan.

71. A design decision also made with regard to the likely significant environmental impact of the proposed Tyrone - Cavan Interconnector was to position the entire proposed substation installation at a level above the "once in 200 years" floodplain level.

72. The effects of the substation on landscape character and its individual elements (such as hedgerows and trees) have been limited by choosing the most appropriate location and detailed on-site positioning. Mitigation of the subsequent residual visual effects of the

completed development are aided by the opportunities to use appropriate materials and finishes for the built elements and a combination of surrounding earthworks, which include significant earth mounding around the site, and suitable structure planting, hedgerow planting and woodland screening.

3.8 Response to Third Party and Statutory Consultee Submissions

73. Between 2009 and 2012, there were approximately 6,000 third party submissions made in relation to the proposed Tyrone - Cavan Interconnector. These were reviewed and taken into account in the writing of the Consolidated ES. Following the publication of that document in 2013 and between May 2013 to May 2015, 2,957 third party submissions were made - of which 737 related to project alternatives. All submissions that were made and have been taken into account in the writing of the Consolidated ES Addendum.

74. Between June 2015 and November 2016, there have been 594 third party submissions and of these 187 submissions made reference to project alternatives. The general issues raised by objectors was that either alternative options should be considered and/or that certain alternatives had not been considered. The submissions did not raise any material considerations or any issues that were not dealt within the Consolidated ES and Addendum. The issues raised by the submissions are examined, analysed and evaluated in Chapter 4 of the Consolidated ES (Volume 2) and in Chapter 10 of Consolidated ES Addendum.

3.9 Summary and Conclusions

75. This is a summary of the information contained in the Consolidated ES, Chapter 4 – Alternatives (pages 114 - 116) and the Consolidated ES Addendum, Chapter 10 – Technology Alternatives (page 170).

76. Numerous alternatives for additional interconnection have been considered in the development of the location and routeing for the proposed Tyrone - Cavan Interconnector. Alternatives considered include:

- Alternative system connection options, leading to the choice of five possible methods;

- Alternative study areas associated with the choice of a preferred route corridor;
- Alternatives to the line routeing within the preferred route corridor, and the selection of a final proposed route for the proposed overhead line;
- Alternative substation locations, leading to the choice of Turleenan near Moy, County Tyrone; and,
- Alternatives to the substation design, and the final choice of a GIS arrangement.

77. The proposed Tyrone - Cavan Interconnector has been subject to an extensive examination of the available alternatives, at each stage having regard to their environmental impact. A fundamental element of the applicant's development process has been to seek the mitigation of environmental impacts by design, and the location of the proposed substation and the routeing of the proposed overhead line are both believed to present the best achievable balance between environmental impacts, technical requirements, and economic considerations.

78. As stated in the Statement of Case, there is an overriding need for this proposal. This significantly outweighs its impacts and the possibility of alternatives being more suitable. The proposal clearly meets the terms of policy which does not require the undergrounding of electricity cables but rather careful route selection and minimisation of intrusion as has been carried out in this case.