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CAVAN - TYRONE 400kV TRANSMISSION LINE

MEATH - CAVAN 400kV TRANSMISSION LINE

STRATEGIC ISSUES REVIEW

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TYRONE-CAVAN INTERCONNECTOR & MEATH-CAVAN TRANSMISSION CIRCUIT

STRATEGIC ISSUES REVIEW

Prepared For

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CHAPTER ONE: INTRODUCTION

RPS Planning and Environment has been commissioned by EirGrid, in consultation with Northern Ireland Electricity (NIE), to prepare this Strategic Issues Review in respect of the planned cross-border 400kV Interconnector that is proposed to extend from the existing NIE network at Turleenan, Co. Tyrone to a proposed 400kV substation in the vicinity of Kingscourt, Co. Cavan (Tyrone-Cavan Interconnector), and the associated 400kV transmission circuit from the proposed Kingscourt substation to the existing Woodland Station near Dunshaughlin, Co. Meath (Meath-Cavan transmission circuit). Together, these comprise an overall strategic cross-border electricity transmission infrastructure project (hereinafter termed the Project). The key objectives of the Project are to enhance security of electricity supply within the island of Ireland, to improve efficiency of the Single Electricity Market (SEM), and to facilitate greater connection of renewable generation on both parts of the island.

The 400kV Interconnector is being planned jointly by EirGrid and Northern Ireland Electricity (NIE), with each party responsible for seeking the required Statutory consent for that portion of the proposal within its own jurisdiction. The proposed Meath-Cavan 400kV transmission circuit is entirely the responsibility of EirGrid.

This Strategic Issues Review complements an ongoing decision-making and evaluation process that is currently being undertaken by EirGrid in the Republic of Ireland in respect of the planned electricity infrastructure Project. The first phase of this process comprised a multi-disciplinary information gathering exercise, addressing technical, environmental and strategic planning issues; in addition, a public consultation and communications process continues to be undertaken, in order to obtain the views of stakeholders, Statutory bodies, and the public regarding the overall Project. This phase of the Project essentially includes the evaluation of technical alternatives for construction of the Project, and the identification of a candidate route of the planned circuits within the Republic of Ireland. The next phases of the Project ultimately move towards an application for Approval of the proposal by An Bord Pleanála, under the provisions of the Planning and Development (Strategic Infrastructure) Act 2006.

It should be noted that the Strategic Issues addressed in this Review are not new issues, but rather constitute the core issues upon which the overall Project is predicated. As such, this Review comprises a synopsis of a considerable body of work that has been undertaken in respect of the proposed Project. It does not therefore contain significant new information, but rather, takes existing information contained within various existing documents, and sets it out in a in a non-technical format so that it may be easily understood.

The structure of this Strategic Issues Review is divided into a number of chapters, addressing the following:-

- The Strategic Need for the Project: an overview of the strategic importance of the Project, the parameters for the Project, and its intended objectives;

- Strategic Infrastructure Constraints: identification of potential technical alternatives for delivery of the planned electricity transmission infrastructure; an overview of these potential alternatives in the context of the strategic objectives for the Project;

- Overhead Transmission Infrastructure versus Underground Cable Infrastructure: an overview of the joint position of EirGrid and NIE regarding the comparative techno-economic merits of overhead line (OHL) and underground cable (UGC) transmission infrastructure for this Project;

- The Project Study Area: how the parameters of the Project, the identified need for the Project, and the physical constraints of the receiving environment, serve to define the Project Study Area;

The overall 400kV electricity transmission infrastructure Project, of approx. 135 Km length, can for the sake of clarity be deconstructed into three portions:-

- that portion of the Interconnector (approx. 35 Km) within Northern Ireland, extending from the existing NIE transmission network at Turleenan, Co. Tyrone to the border crossing at a location proximate to Clontibret, Co. Monaghan – this element of the overall Project is under the control of NIE;

- the Cavan (Kingscourt)-Border 400 kV Interconnector (approx. 40 Km), under the control of EirGrid;

- the Cavan (Kingscourt) – Meath (Woodland) 400 kV Transmission Circuit (approx. 60 Km), also under the control of EirGrid.

EirGrid and NIE retain an open, ongoing and regular dialogue to ensure the realisation of the overall Project.

The presentation of the overall Project in its constituent portions is intended to ensure appropriate clarity of understanding of the technical, environmental and community issues arising for stakeholders, landowners, Statutory and non-Statutory bodies, and the general public. This approach will facilitate a closer identification of the criteria and local issues which will determine selection of an overall Project route. In this regard, however, it is important to appreciate that this proposal comprises a strategic cross-border interconnector and transmission infrastructure Project.

CHAPTER TWO: THE STRATEGIC NEED FOR THE PROJECT

Introduction

This Review details the strategic rationale and need for the overall Project. In summary, this strategic justification has four elements:-

- To improve the security of electricity supply across the island of Ireland;
- To improve the efficient operation of the Single Electricity Market (SEM);
- To accommodate a greater quantity of renewable generation, particularly wind generation, on the island of Ireland;
- The need for reinforcement of the existing strategic transmission infrastructure in the north-east of the Republic of Ireland. This need is exclusive to EirGrid and relates primarily to the proposed Kingscourt-Woodland transmission line;

The transmission network across the island of Ireland is primarily constructed as overhead line (OHL) infrastructure. In the Republic, the 400 kV and 220 kV OHL networks form the backbone of the transmission network, although the 110 kV network is the most extensive element of the National Grid. In Northern Ireland, the backbone of the transmission network is constructed as 400 kV infrastructure, though operated at 275 kV, again with the 110 kV network comprising the most extensive element of the grid.

An existing 275kV double circuit interconnector system between the NIE transmission station at Tandragee, Co. Armagh and the ESB transmission station at Louth, Co. Louth links the electricity networks of Northern Ireland and the Republic. In addition to this 275kV system, there are two 110kV cross-border connections that provide emergency support to local 110kV networks. One of these is between Letterkenny in Co. Donegal and Strabane in Co. Tyrone, and the other is between Corraclassy in Co. Cavan and Enniskillen in Co. Fermanagh. The 110kV interconnectors are only permitted to operate when the high capacity 275kV interconnector is in service.

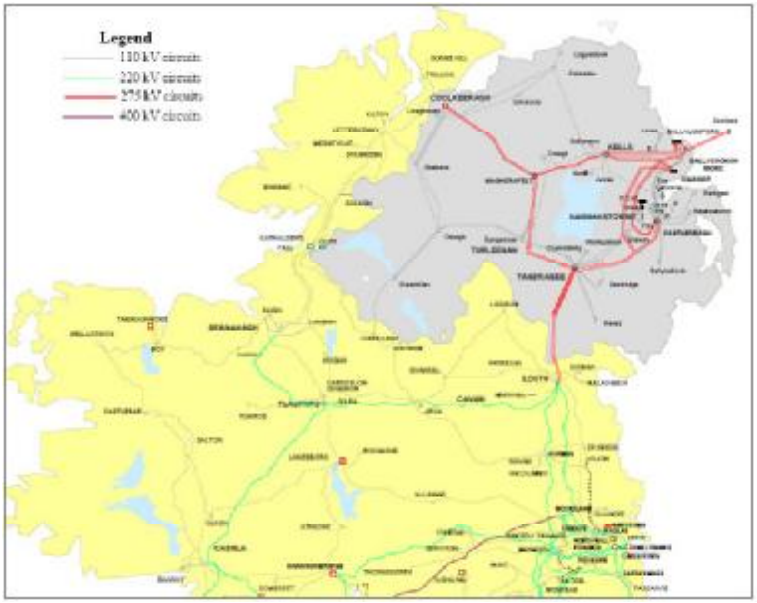


Fig. 2.1: Existing Electricity Transmission Network and Interconnection

The Joint EirGrid and NIE Needs - Need for Improved Security of Electricity Supply on the Island of Ireland, Improved Efficiency of the SEM and Facilitation of Greater Connection of Renewable Generation across the Island

This planned strategic infrastructure Project occurs in the context of an established Single Electricity Market (SEM) for the island of Ireland. Pursuant to EU legislation, an all-island electricity market now exists, with electricity suppliers on the island able to compete for customers.

Notwithstanding this requirement, however, the present low level of interconnection between the electricity transmission networks of Northern Ireland and the Republic of Ireland means that, whilst the two jurisdictions fundamentally operate as a single market, there remain significant constraints in respect of existing transmission infrastructure. In particular, the existence of a single interconnector means that electricity cannot be traded in the most cost-effective and competitive way to facilitate all the benefits that the SEM would be expected to bring to customers.

In this context, it is clear that the existing reliance on a single main North-South interconnector is a significant constraint to ensuring an efficient SEM between Northern Ireland and the Republic of Ireland; a second electricity interconnector is identified as the key solution to removing existing gaps and bottlenecks in the all-island electricity transmission infrastructure system.

A second North-South Interconnector would also reduce the requirement for separate generation capacity for the two jurisdictions on the island of Ireland. This would thereby reduce separate capital investment in electricity generating power stations and other expensive associated strategic infrastructure.

Furthermore, an additional interconnector will allow greater connectivity to wind and other renewable generation sources. Indeed, the realisation of the Project is seen as of fundamental importance for meeting both Governments' ambitious targets for electricity generation from renewable energy sources.

In the context of the need to ensure security of electricity supply across the island of Ireland, it is essential that any additional interconnector be physically and electrically separated from the existing North-South interconnector system, such that a single event, for example a major fault in either the Louth or Tandragee transmission stations, would not cause a loss of both interconnectors. In short, the second interconnector must be constructed some distance away from the existing interconnector and its associated infrastructure, and must not be terminated in either Louth or Tandragee transmission stations.

The EirGrid Exclusive Need - Need for Reinforcement of the North-Eastern Region of the Republic of Ireland

The electricity transmission infrastructure of the North-Eastern region of the Republic of Ireland, including the Dublin–Louth economic corridor, is exclusively within the operational control of EirGrid. This infrastructure has been identified by EirGrid as in significant need of upgrade, as this area continues to develop and expand. In particular, there is an identified concern that the peak load on the existing 220 kV transmission line network that supplies the Louth 220 kV transmission station is approaching its firm capacity. This raises the risk of a voltage collapse should a critical part of the network trip out during a peak period.

As detailed in Fig. 2.1 above, the Louth transmission station serves as the southern terminus of the existing North-South Interconnector, as well as a key node of the existing Dublin-Louth and the Galway/Sligo-Flagford-Louth networks. The 110 kV network serving Counties Cavan, Louth, Monaghan and parts of Meath is supplied from Louth transmission station. Exceeding the firm capacity of the 220 kV lines supplying Louth transmission station places the reliability, and quality, of the electricity supply to the entire North-Eastern region at unacceptable risk, and is not in compliance with current transmission standards.

Feasibility studies have been carried out by ESBI with the intention of identifying a solution for the reinforcement of the North-Eastern region by means of construction of an entirely new 220 kV double circuit line from a transmission station in north County Dublin to Louth transmission station, or the upgrading of the existing 220 kV transmission infrastructure that supplies Louth transmission station. These studies have concluded that the construction of a new 220 kV double circuit line is not feasible, and that while a single circuit 220kV line may be feasible, it would not, on its own, provide the required level of reinforcement. Constraints identified in this regard include the following:-

- Any new route associated with reinforcement of the existing network would pass in close proximity to densely populated areas along the east coast, to the east of the existing concentration of the 220 kV network;

- Any new route served by the existing Dublin transmission stations of Corduff and Finglas would require a crossing of the River Boyne in the vicinity of Drogheda, with significant visual and other environmental implications.

These studies further conclude that, while upgrading of the existing infrastructure would provide the required level of reinforcement, the 'constructability' of this option would have considerable constraints, including the following:-

- In-situ reinforcement of the north-eastern network to provide the required additional capacity would require widespread and significant structural replacement of existing infrastructure. The structures required for a 220kV double circuit line are significantly larger and taller than those of a single circuit line;

- The wayleaves for existing single circuit 220kV lines may not be able to accommodate the larger double circuit structures along their entire route;

- In-situ reinforcement would require significant outage periods on existing transmission infrastructure in an already critically loaded area of the network. EirGrid has determined that such outages are not possible.

It is the case that the provision of the proposed Kingscourt-Woodland transmission circuit, in association with the Tyrone-Cavan interconnector, has the capability of linking into the existing local transmission network within the North-Eastern region of the Republic of Ireland, thereby reinforcing the capacity of transmission infrastructure within the region.

Conclusions

There is a clear need for this overall strategic transmission infrastructure Project, combining both an Interconnector element which provides a link between the grid network systems of Northern Ireland and the Republic, and a transmission circuit within the Republic, and including associated transmission station and local transmission infrastructure.

In determining the technical specification of the proposed transmission infrastructure, EirGrid and NIE have given consideration both to immediate capacity requirements, but also envisaged capacity requirements over the expected life of the proposed assets, that is, in excess of 40 years. The strategy adopted must also take account of the longer-term development path of the transmission system in both jurisdictions on the island of Ireland. In this context, key factors have influenced the selection of a 400 kV single-circuit option, including as follows:-

- The 400 kV system in the Republic is likely to form the backbone of future development of the transmission system, on account of the increasing levels of power required to be transferred, the limited capacity of 220 kV transmission lines, and the potentially excessive short-circuit levels on the 220 kV system;

- Generally, 275 kV transmission lines in Northern Ireland use towers that are suitable for 400 kV;

- The new Interconnector infrastructure will have a capacity equivalent to that of the existing Louth-Tandragee 275 kV double circuit line Interconnector. This is 1,500-1,800 MVA, depending on ambient conditions.

CHAPTER THREE: HIGH LEVEL STRATEGIC INFRASTRUCTURE CONSTRAINTS

Introduction and Methodology

An initial process for EirGrid and NIE to deliver the planned Tyrone-Cavan Interconnector and the Meath-Cavan Transmission Circuit Project is to determine the appropriate technical alternative for delivery of that infrastructure. The technical feasibility of the Project, related to its fundamental objectives, must form the basis upon which all technological alternatives are assessed.

There are a number of technical alternatives by which the overall Project could, in theory at least, be constructed, in order to achieve the identified needs of the Project. The generic technical characteristics of these alternatives are not detailed in this report; such characteristics are addressed in some detail in Chapter 4 of the *Study on the Comparative Merits of Overhead Electricity Transmission Lines Versus Underground Cables* (May 2008), prepared by Ecofys Consultants, by order of the Department of Communications, Energy and Natural Resources.

The various generic options are set out below:-

- AC Overhead
- AC Underground
- AC Undersea
- DC Overhead
- DC Underground
- DC Undersea

There are a number of fundamental components of the overall Project – that is, those key objectives which must be achieved regardless of the technological alternative that is employed. Any technological alternative which cannot achieve all of these objectives can essentially be considered at the outset as incapable of ensuring the deliverability of this Project.

The various technological alternatives listed above can be considered in the context of EirGrid's identified Project objectives, detailed below, in order to identify potential high-level constraints that would deem a particular technological alternative to be unacceptable. The identification of any such strategic constraints in respect of a particular technological alternative may mean that such alternative may not be capable of delivering all the stated objectives of the overall all-island Project.

Strategic Objectives

From EirGrid's perspective there are primarily 3 no. Strategic Objectives of the overall Project, detailed below:-

- **Compliance with Statutory and Regulatory Obligations**
  The Statutory function of EirGrid, in its role as Transmission System Operator (in accordance with SI No. 445 of 2000) is to deliver quality connection, transmission and market services to generators, suppliers and customers utilising a high voltage electricity system, and to put in place the grid infrastructure required to support the development of Ireland's economy. The undertaking of this function occurs by developing, maintaining, and operating a safe, secure, reliable, economical and efficient transmission system. Sub-objectives of this Strategic Objective are identified as follows:-

  - Safety
  - Reliability & Security
  - Cost Effectiveness
  - Due regard for the environment

- **Meet the Specific Objectives of this Project**
  The strategic justification for, and specific objectives of, the all-island Interconnector and Transmission Circuit Project are detailed in Chapter Two above. Sub-objectives of this Strategic Objective are identified as follows:-

  - Reinforce the local transmission network
  - Provide a 2nd high capacity connection between NI & RoI transmission grids
  - Ensure a 1,500 MVA Capacity

- **Meet the General Objectives for all Projects of this type**
  The specific nature and extent of the proposed development must be considered as part of the ongoing and future strategic development of the all-island electricity transmission infrastructure system. It must also be considered in the context of international experience and best practice. Sub-objectives of this Strategic Objective are identified as follows:-

  - Facilitate future grid connections and reinforcements.
  - Technical Solution – be 'best established international practice' with proven technology and a good track record.

Conclusions

Based on their considerable experience in the area of transmission infrastructure, EirGrid and NIE are jointly of the opinion that a number of the potential technological alternatives outlined above may have inherent constraints which would render that alternative incapable of achieving the identified strategic objectives of the overall Project, and which may not be capable of being overcome.

In particular, AC Undersea, and the DC alternatives are currently considered to have severe constraints for achieving the strategic and specific objectives of this Project, on issues of reliability and security, cost effectiveness, the ability to ensure the reinforcement of the local transmission network, the ability to facilitate future grid connections and reinforcement, and their departure from best international practice.

The remaining technological alternatives that are considered to have at least theoretical potential to achieve the strategic objectives of the Project comprise AC Overhead Line (AC OHL) and AC Underground Cable (AC UGC). This is not in any way to say that both alternatives are acceptable – only that they cannot be dismissed as being in principle incapable of ensuring the deliverability of this strategic electricity infrastructure Project. These alternatives are addressed in summary in Chapter Four.

CHAPTER FOUR: OVERHEAD LINE (OHL) INFRASTRUCTURE V UNDERGROUND CABLE (UGC) INFRASTRUCTURE

Introduction

The issue of the nature of transmission infrastructure – overhead line (OHL) versus underground cable (UGC) - has constituted a key issue arising during EirGrid's ongoing public consultation process carried out in respect of the proposed Project. This is understandable, as UGC systems are often perceived by the public as generally safer than OHL, and are less visually intrusive in the landscape, in comparison with OHL transmission infrastructure.

Having carefully considered all the information obtained during the ongoing public consultation process, it remains the position of EirGrid and NIE that an OHL system will provide a more reliable and cost effective solution than a UGC system. It is the case that high voltage AC (HVAC) UGC system is much more expensive than an equivalent HVAC OHL system. In addition, a HVAC OHL option provides a technically superior solution to an equivalent UGC option. It is also the case that all transmission infrastructure is, and will continue to be, operated in full compliance with National and International health and safety legislation and guidelines.

Transmission Infrastructure Options for the Proposed Development

In late 2007, EirGrid and NIE jointly commissioned PB Power, a consultant of international standing, to carry out a comparative and site specific study into the use of OHL versus UGC and HVDC versus HVAC for the Project. When complete the resulting report will inform the joint decision of EirGrid and NIE on this matter.

In early 2008, EirGrid and NIE instructed PB Power to prepare a preliminary Briefing Note on the general technical and cost issues associated with implementing the overall approx. 135 km 400 kV transmission line Project. It was intended that this Preliminary Briefing Note would inform the ongoing public consultation process in respect of the proposed Project, and is available online, on the EirGrid website – www.eirgrid.com. The Preliminary Briefing Note identifies various technical alternatives for construction of the Project, including OHL and UGC options, having regard to the requirement to ensure the technical and economic viability of the overall Project, and to protect the environmental sensitivity of the receiving environment.

The Briefing Note records that HVAC OHL technology accounts for some 99.5% of EHV transmission infrastructure worldwide. The predominance of OHL transmission infrastructure is explained as meeting the best balance from an economic, technical and environmental perspective, and in particular ensures the greatest reliability of a project. UGC options are mainly found in urban and congested areas, or where site specific environmental constraints occur, for example within a visually sensitive area.

The Briefing Note sets out a comparative overview of the technical and economic issues arising in respect of OHL and UGC transmission infrastructure options, particularly in respect of the current overall Project. The following conclusions are considered to be of essential importance for consideration in this instance:-

- HVAC UGC infrastructure has not been used anywhere in the world to date for the route length of this overall Project;

- Both the capital and the capitalised costs of HVAC UGC infrastructure for the overall Project would be much greater than that for a comparable HVAC OHL infrastructure option. A ratio of 8.7 was calculated in this regard, based on costing data from a similar project in Scotland. The cost ratio can increase if complex construction technology is required, such as tunnelling;

In addition to the PB Power report, EirGrid and NIE have jointly commissioned two other all-island technical studies that, when complete, will further inform the evaluation of OHL versus UGC transmission infrastructure, as relevant to the planned Tyrone-Cavan Interconnector and Meath-Cavan Transmission Circuit Project. These studies comprise as follows: -

- a system-wide study that considers the implications, for system reliability and stability, of incorporating multiple HV DC circuits into the integrated all-island AC transmission network;

- a system-wide study that considers the implications, for system reliability and stability, of incorporating very long lengths, and large quantities, of HV UGC transmission infrastructure on the all-island AC transmission network.

The Ecofys Study

This Review has also had detailed regard to the Ecofys *Study on the Comparative Merits of Overhead Electricity Transmission Lines Versus Underground Cables*, of May 2008 prepared by order of the Department of Communications, Energy and Natural Resources. The purpose of this Study, as stated in the tender request is *"to provide the best available professional advice to the Minister on the relative merits of constructing and operating overhead transmission lines compared to underground cables, having regard to technical characteristics, reliability, operation and maintenance factors, environmental impact, possible health issues, and cost"* (p.25).

The Ecofys Study notes that, perhaps unsurprisingly, the vast majority of public submissions during the preparation of the Study favour a UGC solution in preference to OHL. However, Chapter 3 of the Study refers to Current International Practice, and confirms that globally, the majority of the transmission grid is overhead. In particular, it states that *"Until now, 400 kV to 500 kV AC cables for transmission are nearly exclusively used in short sections in urban areas and only rarely in open country"* (p.38). Underground cables are generally used in areas of high population density or high land values – generally urban areas - where it is difficult to find suitable overhead line routes. This is consistent with the findings of the PB Power Briefing Note, and with the publicly stated position of EirGrid and NIE on this matter.

The Study refers specifically to the example of Denmark, where approximately one-third of the world's high voltage underground cable has been laid; however, currently the longest cable in that country is only 20 km in length and consists of two sections, divided by a transmission station. The longest underground cable of 400 kV or greater, in Tokyo, is 40 km in length. The Study concludes that *"Up to now, construction and operation of an EHV UGC in Ireland with a length of up to 100 km would not be backed by any experience worldwide"* (p.44).

In countries where a decision may be taken to underground lower voltage networks of Distribution systems, this is not normally applied to the higher voltage networks of Transmission systems, as the technology involved is substantially different and more demanding. The Study concludes in this regard that *"Though the UGC option may be justified with the growing number of successful cases worldwide, care is required as most existing UGC cases are not representative of transmission"* (p.51).

The Study notes that local resistance to OHL infrastructure is generally related to concerns of:- *"perceived visual impact on the landscape; perceived health risks related to Electromagnetic Fields (EMF); Impact on Property Prices; Impact on local flora and fauna; and Impact on Tourism and Recreation in particular and the local economy in general"* (p.45). However, it also notes in this context that no experience of public demand for UGC in rural areas has actually resulted in the realisation of an UGC in place of an OHL of the size which may apply to future plans in Ireland.

Chapter 4 of the Study provides generic information regarding design characteristics of the various relevant technology options – namely AC OHL and 400 kV AC UGC. The Study concludes in this regard that *"With more than 50 years of experience OHL are state-of-the-art and are the reference technology for transporting large amounts of electric power over distances of several hundreds of kilometres"* (p.53). In addition, Chapter 5 of the Study presents a Comparison of Specific Techno-Economic Characteristics of these systems, addressing issues of Transmission System Adequacy, Operation and Maintenance, and Costs. The conclusions of this Chapter are that from a capital cost point of view - *"OHL is the most attractive option. This does not change significantly when operating costs are included to give a whole life cycle analysis"*. And from a performance and power system adequacy point of view *"The expected Forced Outage Rate of UGC is estimated by a variety of sources at least one order of magnitude higher than that of OHL. From a transmission adequacy perspective both technologies do not yet offer the same performance and, hence, are not equivalent*". These conclusions are consistent with those of the Technical reports prepared in respect of this Route Evaluation process, and with the PB Power Briefing Note, as well as the stated joint position of EirGrid and NIE on this matter.

Chapter 6 of the Study presents a Comparison of Environmental Impacts arising in respect of OHL and UGC systems. In particular, Table 6-1 of the Study gives a summary overview of the comparative environmental implications, based upon generic OHL and UGC technology alternatives. It is noted that the conclusions of Chapter 6 of the Study are consistent with the conclusions of the various Environmental Reports prepared in respect of this Route Evaluation process.

Of particular note, the Study distinguishes between perceived health risks associated with Electro-magnetic Fields (EMF), (though acknowledging that these can lead to an increased sense of anxiety within a community), and actual health risks associated with EMF. In respect of actual health risks arising from exposure to EMF from transmission infrastructure, the Study concludes in this regard as follows:-

> *"Based on the limits published by the International Commission on Non-Ionising Radiation Protection (ICNIRP) [ICNIRP 1988] the WHO recommends a permanent exposure level to magnetic fields below 100 µT and this recommendation has been adopted by the EU (1995/519 EC) and many non-EU countries. Eirgrid designs and operates transmission assets according in line with these guidelines"* (sic). (p.120)

NIE also operates its transmission infrastructure in accordance with established National and International guidelines.

The Study also notes that expected greater public opposition to an OHL project will increase the construction time for that project. On the other hand, the relatively limited availability of high-voltage UGC cable and associated components, as well as technical and civil engineering construction challenges may also impact upon project programme and deliverability.

Conclusions

Chapter 10 of the Ecofys Study presents multi-criteria conclusions regarding the comparative merits of OHL technology versus UGC options. For reference, a summary of the key findings of this Study is also set out in a letter to the Department of Communications, Energy and Natural Resources that accompanied the submission of the Study. A copy of this letter is publicly available on the Department's website at www.dcenr.gov.ie/Energy.

The letter states that the poorer availability of UGC infrastructure in comparison with OHL infrastructure is *"a severe limitation for underground cables"*. It concludes in this regard as follows:- *"Currently, underground cables do not therefore compare to overhead lines in terms of adequacy of the electricity transmission system and in terms of reliability and security of electricity supply."*

Regarding the potential impact from Electro-Magnetic Fields the letter states that:-

> *"EirGrid designs and operates overhead lines in compliance with WHO guidelines on magnetic field exposure. In practice, under normal operating conditions in Ireland, magnetic field strengths directly under transmission lines are as low as 10 – 20% of the maximum levels recommended in the WHO guidelines."*

The letter concludes by stating that:-

> "*The difference in transmission adequacy is the dominating criterion when comparing the technologies. Other aspects certainly affect the overall technology evaluation. However, any of the advantages of underground cables which were identified in the study cannot compensate for the negative impact on transmission adequacy.*"

These conclusions are consistent with the stated position of EirGrid and NIE on the use of OHL infrastructure for projects such as now proposed, having regard to the consideration of transmission options contained in the PB Power Preliminary Briefing Note. This established position will be assessed against the findings of the current studies, detailed above, that are being carried out, in order to inform the final decision of EirGrid and NIE in respect of the technological alternative to be employed in constructing the planned Tyrone-Cavan Interconnector and Meath-Cavan Transmission Circuit Project.

CHAPTER FIVE: THE STUDY AREA, HOW IT WAS CHOSEN AND HIGH LEVEL CONSTRAINTS

Introduction

Chapter Two of this Review has identified the strategic need and justification for the overall Tyrone-Cavan Interconnector and Meath-Cavan Transmission Circuit Project – essentially, to improve the security of electricity supply across the island of Ireland, and to ensure the reinforcement of the existing strategic transmission infrastructure in the north-east of the Republic.

The various technical and environmental constraints reports prepared on behalf of EirGrid, and publicly available on its website – www.eirgrid.com - note that while there remains unused capacity on the existing North-South interconnector, this is primarily due to an operational limitation - i.e. if this existing interconnector was to trip while operating at full capacity, the importing network would experience a severe shortage of generation. At best this would result in extensive automatic load shedding on that network and at worst a complete collapse. The exporting network on the other hand would experience an excess of generation and this would require the generators to very quickly cut back on output. If this did not occur quickly enough, that network could also suffer a complete collapse.

The unused capacity on the existing interconnector can therefore only be further utilised once an additional interconnector and associated separate transmission station infrastructure is constructed and in operation. No scheme based solely upon upgrading the existing interconnector and existing Louth transmission station would therefore be appropriate or adequate.

Chapter Three of this Review sets out the various technological alternatives for transmission infrastructure which are capable, in theory at least, of being used to carry out the Project. This evaluation has acknowledged the concern of EirGrid and NIE that there are considerable constraints associated with DC and Sub-sea options in achieving the objectives of this Project, having regard to the particular nature and extent of this Project, and the concern to ensure that it is capable of future linkage into any expanding all-island transmission network.

Chapter Four of this Review addresses the comparative merits of these two AC options, insofar as they relate to the proposed Project. Having regard to the nature and extent of this overall Project, comprising some 135 km of transmission infrastructure across a rural receiving environment, as well as to the established joint EirGrid and NIE position on the preferred use of OHL infrastructure for this nature of Project, and which position is entirely consistent with the Independent Ecofys Study, it is concluded that OHL transmission infrastructure is an appropriate means of transmission infrastructure for this Project.

Geographical Options Regarding Potential Corridors

High level multi-criteria feasibility studies have been carried out regarding the general location of potential corridors for the overall planned AC OHL Tyrone-Cavan Interconnector and Meath-Cavan Transmission Circuit Project. Three geographical options have been identified, as summarised below (see also Fig. 5.1):-

- **Eastern Option**: Based on a third circuit between Tandragee and Louth Stations. The route corridor in which to facilitate this option would most likely generally be required to follow the route of the existing Interconnector, as a corridor further to the east of the existing corridor is effectively obstructed by the physical and environmental constraints of the Mourne Mountain range, and consequent unwelcome proximity to the urban centres of Newry and Dundalk, which are located in the lowland areas within this range. In short, the physical terrain of the Mourne Mountain range is a major constraint to identification of viable Eastern options. The option to follow the route of the existing interconnector, however, raises concerns – previously expressed – that there would be no geographical separation between the two interconnector systems, with a consequent risk of a single event causing a simultaneous outage of both interconnectors.

- **Western Option**: Based on a circuit between Co. Sligo and Coolkeeragh Station in Co. Derry. This option is considered to have technical limitations, particularly due to the fact that it would connect with the weaker and more peripheral parts of the networks in both Northern Ireland and in the Republic. It would be longer, more expensive, and is considered to effect a greater environmental impact.

- **Mid-Country Option**: This option is based on a circuit that traverses the lower foothills and drumlin landscape to the west of the Mourne Mountain range. It delivers required transfer capacity in either direction. It is the shortest and most cost-effective option, and meets the primary technical requirements of both EirGrid and NIE. It is also capable of linkage to the existing strategic east-west Flagford-Louth 220kV line, (though requiring associated sub-station infrastructure on this line), thus ensuring the reinforcement of the North-East region, without the need for direct access to the existing Louth transmission station.

It is therefore concluded that a Mid-country option is preferred as the option which can best meet the strategic parameters of this particular Project.

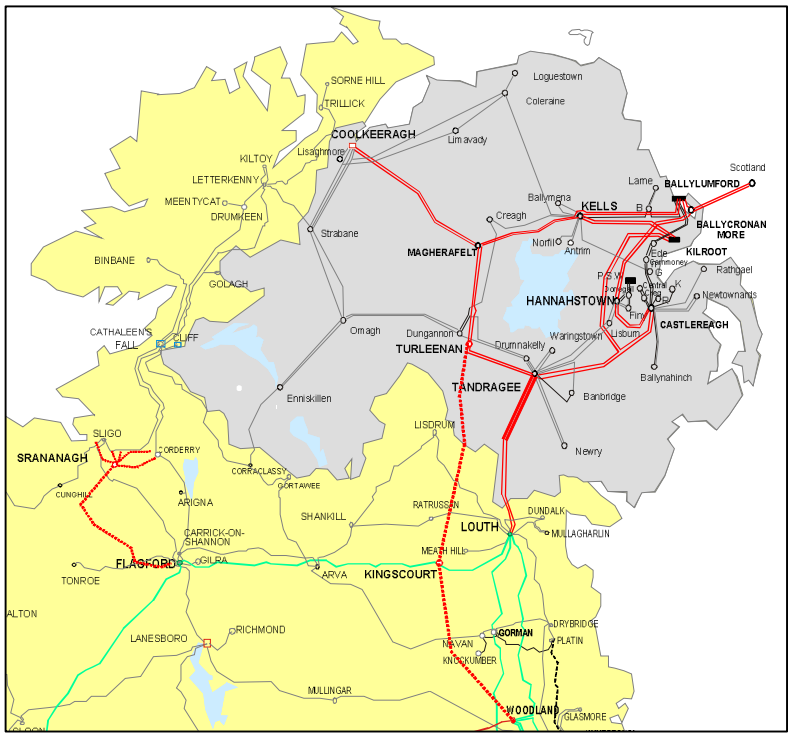


Fig. 5.1: Identification of proposed North-South Interconnector and Transmission Line Project in the context of the existing all-island strategic transmission network

DEFINING A STUDY AREA FOR THE PROJECT

The overall Project comprises an all-island co-operation between EirGrid and NIE. Having regard to the strategic parameters for the Project, including the concern for reinforcement of the north-eastern region, but also to ensure ongoing security of electricity supply on the island of Ireland, it must be ensured that the planned Interconnector system links with the established strategic transmission system. In this regard NIE has determined that the optimum location for linkage of the planned OHL Mid-Country Interconnector system with the established electricity grid network in Northern Ireland is via a planned new substation on the grid network at Turleenan Co. Tyrone. This is taken to comprise the northern extent of the planned Project.

The study area of the northern portion of the overall Project is significantly limited by physical and environmental constraints, as it threads through the western hills of the Mourne Mountain range, and the drumlin landscape of Co. Tyrone and Co. Armagh. There are effectively no practical alternative corridor options within this constrained study area. There are also considerable physical, environmental and cultural heritage constraints within the vicinity of the border between Northern Ireland and the Republic; these effectively restrict potential crossing points for the OHL transmission infrastructure to a single location in the vicinity of Clontibret, Co. Monaghan.

In the context of ensuring that the planned Interconnector system also links at an appropriate location with the corresponding existing transmission network in the Republic of Ireland, it has been identified that the system should link with the existing strategic east-west northern corridor system extending from Flagford Station to Louth

Station. This avoids direct linkage of the planned system to Louth Station where there are identified infrastructural capacity constraints.

Technical studies confirm a preferred option for the southern terminus of the planned Tyrone-Cavan Interconnector system to occur at a new sub-station on the existing Flagford-Louth transmission corridor, near Kingscourt, Co. Cavan (Fig. 5.1). This area has less restricted physical and environmental constraints, and offers scope to consider a number of potential corridor options. This comprises the southern point of the Interconnector Study Area.

The southern terminus of the overall Project comprises the existing Woodland sub-station located near Batterstown, south-west of Dunshaughlin, Co. Meath. Woodland transmission station forms the eastern terminus of the existing 400 kV circuit with Moneypoint, thereby ensuring an appropriate linkage of the National High Voltage transmission network. The use of Woodland avoids reliance upon the existing key Dublin Stations of Finglas and Corduff. Woodland transmission station is therefore taken to comprise the southern extent of the overall Project.

As such, the Study Area for this portion of the overall Project is defined as the area between the proposed Kingscourt transmission station, and the existing Woodland transmission station. Again this area offers scope to consider a number of corridor options.

Conclusions

The Study Area for the Tyrone-Cavan Interconnector and Meath-Cavan Transmission Circuit Project is defined by various constraints and opportunities:-

- A strategic mid-country transmission option;
- Strategic linkage at appropriate locations between the NIE transmission network and the EirGrid transmission network;
- Strategic linkage with the Flagford-Louth east-west transmission network, to facilitate linkage to the North-Eastern region in the Republic of Ireland;
- Potential to remove significant load from the existing transmission infrastructure supplying the existing Louth sub-station;
- Potential to more fully utilise the entire existing Interconnector system, as the all-island transmission network will no longer be reliant upon a single Interconnector;
- Strategic linkage to the National (HV) networks across the island of Ireland;
- Avoidance of the existing congested, and physically and environmentally constrained eastern corridor between Dublin and Louth stations.