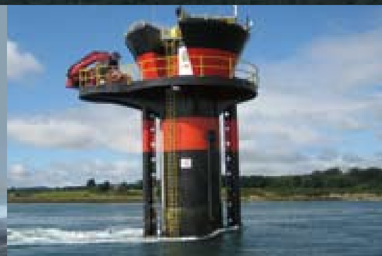
Offshore Grid Study

Analysis of the Appropriate Architecture of an Irish Offshore Network

Executive Report

Advancing the Technological Development to Harness Offshore Power

DISCLAIMER



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Executive Foreword

EirGrid is pleased to present the findings of this Offshore Grid Study. The study was prompted by the first transmission connection offers to be made to offshore generation in the Republic of Ireland and the need for a holistic view of the future development direction of a potential offshore grid.

The study does not purport to define a precise network solution. Rather, it provides sound information on the most efficient development methodologies and standard configurations for developing incrementally an Irish Sea offshore network.

To ensure the robustness of the results, the sensitivity of changes to key assumptions have been examined and the impact to the methodologies and configurations investigated.

The findings of the study will be used to guide future EirGrid policy decisions regarding offshore networks development.

In addition to EirGrid's own needs it is expected that this information will provide a valuable source of information to stakeholders. It will also inform debate on a number of issues relating to offshore network development in not only Irish waters but also in a wider European and International sense.

The techniques used, discussed in length in this report, to provide the findings of this report are in EirGrid's opinion uniquely applied to this task. These techniques may provide interesting opportunities internationally for other similar applications requiring the reduction of large numbers of strategic development options within a reasonable time period to an optimum strategy.

The report is structured to provide information as concisely as possible to meet the needs of the individual reader with the non-technical executive report, providing the key conclusions to the findings, and a more technically focussed detailed report. The detailed report discusses the methodology, assumptions and techniques used in the study, the full spectrum of the findings, and conclusions drawn.

Finally, it is the aim of EirGrid to provide informative, pertinent and accessible information. We would therefore welcome and value your feedback on the presentation, style and content of this report and any of our other reports at all times.

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1 EXECUTIVE REPORT

Driven in part by European objectives, the development of renewable energy has gone from strength to strength, culminating in Irelands Government Target of 40% energy used to be from Renewable sources by 2020, in the framework for "20-20-20" EU initiative.

At the end of 2010, in the region of 1500 MW of renewable generation had been installed in the Republic of Ireland, approximately 25 MW of which comes in the form of off-shore plant.
The committed development of the group processed renewable generation applications in Gate 1 and Gate 2 , in association with those currently being processed in 'Gate 3' have the capacity to supplement the existing developed renewable generation to meet or exceed the Irish 40% renewable energy target by 2020. 'Gate 3' is committed to providing three connection offers totalling approximately 800MW of additional offshore renewable wind generation.

Given that Ireland has some of the most favourable offshore wind, tidal and wave conditions in Europe, offshore development in Irish waters is expected to grow rapidly over the coming years. This is demonstrated by the scale of applications already present, in development, or awaiting an offer for connection to the network totalling a further c.11000MW of wind (c.4000MW in Irish territorial waters and a further c.7000MW in British waters) in the Irish Sea alone.

Although offshore generation applications represent a lower proportion of the overall applications, the abundant resources of both wind and wave in the Atlantic Ocean off Irelands west coast, offer an almost unlimited potential energy source for additional future offshore generation.

The need to develop a philosophy, and policies for the development of an offshore network to meet the immediate need of formulating offers for the generation in Gate 3 in association with the need for information to a develop strategic position on offshore networks culminated in EirGrid initiating this Offshore Grid Study.

1.1 SCOPE OF STUDY

The need to understand not only the immediate requirements for connection of the Gate 3 generation applications, but also how these connections would ideally be constructed to fit into longer term network development was a main driver in determining a scope for the study. This information could then form the basis for the connection of this generation.

A further driver for the study was the need to establish a whole new suite of standard equipment to supplement the existing onshore standard equipment. Standard equipment is used worldwide

Gate 1 – 2004 Direction under which the Commission for Energy Regulation (CER) directed EirGrid and ESB Networks to provide offers for connection to 373MW of renewable capacity

Gate – 2006 Direction (CER/06/112) under which the CER directed EirGrid and ESB Networks to provide offers for connection to c.1300MW of renewable capacity

Gate 3 – 2008 Direction (CER/08/260) under which the CER directed EirGrid and ESB Networks to provide offers for connection to c.3,900MW of renewable capacity

to develop networks to provide economies of scale in manufacture, limit the number of spare parts required, and simplify construction.

Onshore Irish equipment standards and experience have developed over 80 years; there have effectively been none over this period for offshore equipment.

Best practice for determining both the resilience of an initial optimum network design (or 'Expansion Strategy Plan (ESP)') into the future and in defining standard equipment to be used in network development is to determine the requirements from an predicted initial scenario and then test this network development with a wide range of alternative scenarios to see if the development is still acceptable.

The outcome of this analysis demonstrates the robustness of the development to possible alternative and longer term development requirements placed upon it.

A transmission network Expansion Strategy Plan (ESP) for a scenario must consider not only the cost of the capital assets i.e. lines, cables and stations, but also the cost of producing the electrical energy and associated electrical power losses to supply load demand year round. EirGrid in partnership with RSE (the Italian nationally funded research centre for electricity) has developed software and a new methodology to calculate the most efficient ESP considering these three costs.

Engineering judgement based on factual information and experience is critical in defining the wide range of network scenarios to be studied. However, the impact of necessary assumptions chosen can be further mitigated by carrying out 'sensitivity' analysis. This analysis varies each key assumptions whilst fixing all of the other assumptions that have been made and studies the impact to the results and hence the sensitivity of each choice to the final results.

EirGrid selected the Irish Sea as the focal point of the studies. This decision took account of both existing offshore generation applications identified with a high probability for immediate development, and also its geographical location lending to a high probability for the future development of additional interconnection from Ireland.

The study area selected was further desirable as the largest two of the three offshore generation applications in Gate 3 are also located in the Irish Sea and the study supplies additional specific information for both these proposed connections.

The total generation that had been applied for at the time that this study commenced was selected as a base case level for the purpose of this study (c.3GW) to be examined. To put this into context this figure is greater than the Gate 1 and Gate 2 grouped renewable generation applications processed between 2001 and 2007, or roughly 60% of the peak load demand in Republic of Ireland in 2010.

Discussion with these applicants also confirmed that they had future development plans to expand their sites and this increased generation (c.5GW) was selected as the first alternative ESP development scenario. During the course of the study further offshore generation applications has increased the total from c.3GW to over 4GW.

To examine the effects of geographical dispersion of generation the c.5GW scenario was split into two alternatives one with c.5GW in the existing five locations and one with this c.5GW spread over ten sites. The additional five sites were selected by creating a series of additional stations further offshore into the Irish Sea in a North South line from the initial five applications.

In order to reflect reality, both the 3GW and 5GW generation scenario were assumed to have a phased development and a completion date for all generation by 2030 was assumed. Consequently not only the final stage of an ESP could be compared, but also steps along the way.

These phased increases in generation within the scenarios are in addition to the existing generation fleet in Ireland, generation which EirGrid is contractually bound to connect, and the generation within 'Gate 3' which is in the process of being provided connection offers. 'Gate 3' has been assumed to be connected in its entirety based on uptake of offers in the previous two gates.

The examination of the generation scenarios was further divided into two distinct concepts for the studies, an Irish only development and an interconnected development. The Irish only study examined developing network from only the Irish transmission network, whilst the interconnected development looked at the potential added benefits, deficits or changes as a result of interconnection to other networks.

'Sensitivity analysis' was selected to look at the key assumptions:

- Scale of development in the Irish sea
- Development of offshore generation off Ireland being centred in the Irish Sea
- Market cost of reducing offshore generation and its impact on the network development
- The use of different technologies on network development

To examine the scale of generation in the Irish Sea a third generation increase to c.7GW was selected as another alternative scenario. This increase was proportionate at c.2GW to the previous scenarios, and provided sufficient increase to drive an export scenario to adequately accommodate the scale of generation, and the consequential impact that this might cause to the offshore network structure.

'Sensitivity analysis' scenarios were also developed to examine the assumption that generation would be centred in the Irish Sea. These looked at the impact of the additional generation in the ISLES project (c.2GW's off the West of Scotland), and wave energy off the west coast of Ireland (c.4GW).

The software used in the study provides the optimum network ESP, which minimises the combined cost of network development capital costs, the costs of ongoing electrical losses from the network and the cost of production. Therefore, the assumed 'penalty' to the cost of changing the generation selection in the electricity market from its most cost effective to another more costly selection is important. Counter intuitively, a higher cost generation selection may prove ultimately to be a lower cost solution if the cost of development or losses at the same time can be reduced.

Therefore sensitivity analysis was conducted on the market penalty costs and the resulting changes to the Expansion Strategy Plan's (ESP's) between the normal market price for electricity (system marginal price), the current guaranteed price available to be paid for renewable generation (REFIT), and a penalty level which would ensure that renewable energy was never reduced.

These three variables provide the widest possible diversity of the resulting ESPs.

The technology choices for an offshore network are in many ways similar to those for an onshore network. However, as a network purely for the connection of generation and/or the bulk transfer of power to onshore demand, the technological selections for an offshore grid may be markedly different to those of an onshore.

Also unlike onshore networks, offshore networks are almost exclusively cable networks. Technical and cost considerations of a cable network affect the technology choices.

Due to the practicalities in the software of processing millions of possible ESPs to find the optimum solution, the base case analysis was provided different sizes of connection limited to only one possible technological cable solution.

'Sensitivity analysis' was performed with a range of technological solutions to determine what affect this had on the ESPs.

1.2 FINDINGS

The outcome of the analysis answered a number of key questions about the design of the optimum robust offshore network. This network should be:

- 'Meshed' or interlinked and not a series of single connections from generators to the onshore network
- Developed incrementally
- Symbiotic with the onshore network
- In line with the existing GRID25 strategy
- Developed with interconnectors from offshore generators to other networks as well as from onshore points
- Developed making use of 'smart' devices to enhance network flexibility and minimise the scale of the offshore network
- Developed at a high voltage level typically at least 200kV
- Both an AC and DC offshore cable network interlinked
- Designed with the potential for even further future expansion

1.2.1 'Meshed' or 'Radial' network design

A fundamental aspect of this study was to examine whether the offshore network should be built 'Meshed' or 'Radial'.

A 'Meshed' offshore network would be designed with interlinked stations to transfer power between various points offshore, whilst a 'Radial' network would be a series of links from collection points for offshore generation directly to onshore networks which would then transfer the power.

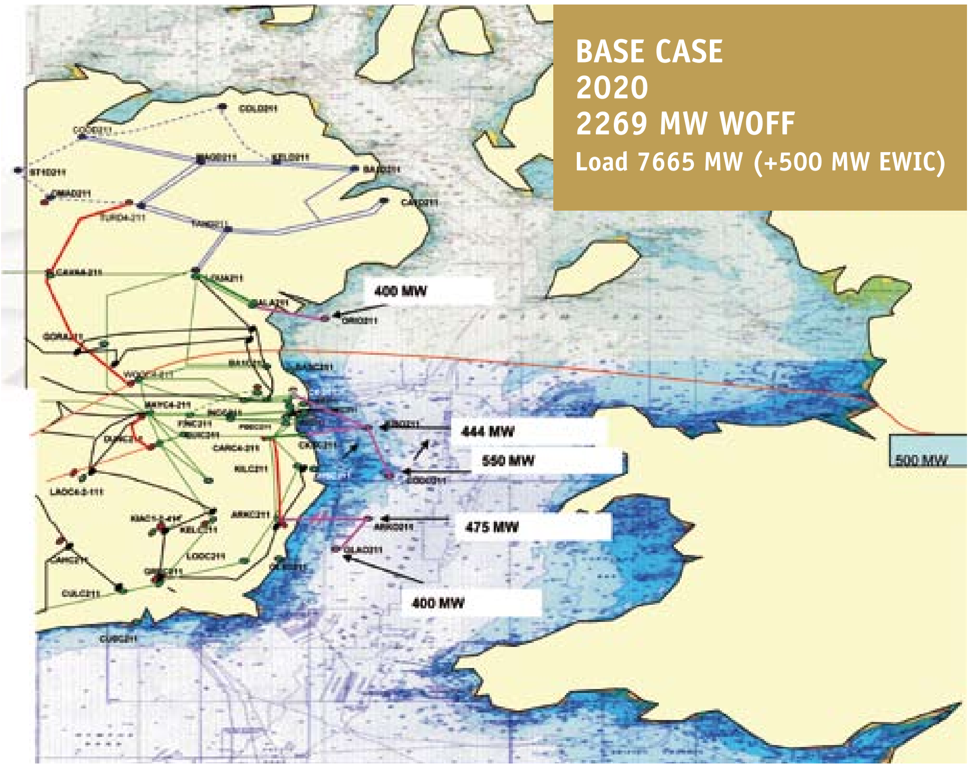
Historically in Ireland the transmission network developed from effectively a 'Radial' network in the early 1930s to the present day highly complex 'Meshed' network. The main rationale for this development strategy has been to minimise the cost of network development while simultaneously maintaining an appropriate level of reliability.

However the cost of offshore networks are markedly higher than those of onshore networks and hence the question arose as to whether it is more efficient to build a 'Meshed' network, which by its nature would require offshore assets as oppose to delivering the power to shore with the minimum amount of offshore assets with a 'Radial' network.

REFIT – Renewable Energy Feed in Tariff, as set by the Department of Communications Energy and Natural Resources (DCENR)

Both 'Meshed' and 'Radial' philosophies need to be able to provide adequate capacity to transmit the power generated across the onshore network to where it is required to be utilised. The difference is that a 'Meshed' network does some of this transmission offshore whilst the 'Radial' does this entirely onshore. Hence there are typically greater assets offshore for a 'Meshed' network.

All of the ESP scenarios conclusively elected to develop a 'Meshed' network. Initial development to connect the first generating facilities as examined in the 3GW Irish only ESP, is developed in some instances as radial connections (see ORIO211 in the Figure below). However even in this earliest year of the c.3GW ESP, four of the five generators are connected together and then connected to shore, with an offshore 'Meshed' connection from North to South of Dublin.



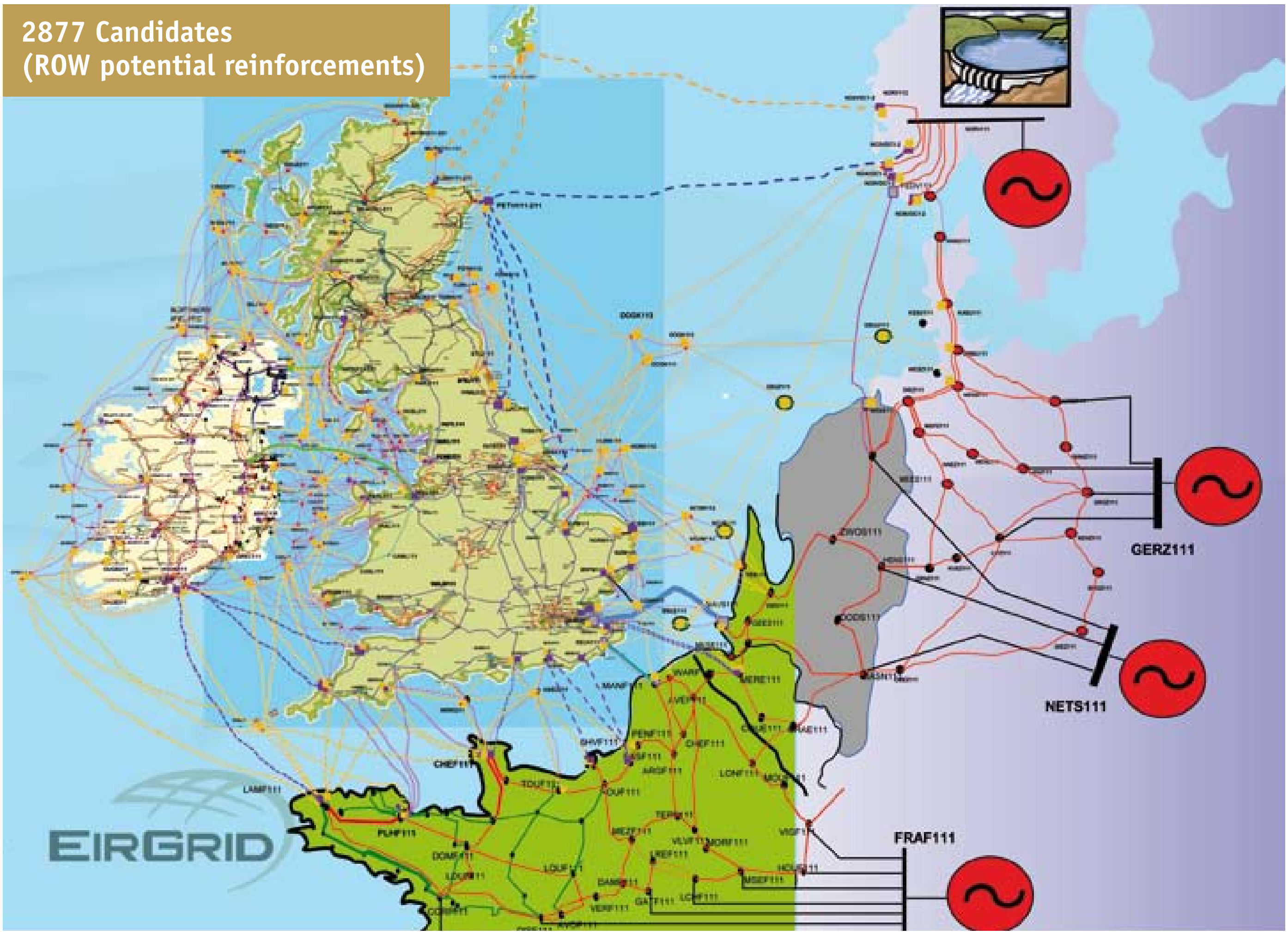
In later years and in other alternative scenarios the network becomes progressively more meshed.

The consistence of the ESPs to elect 'Meshed' networks to minimise the overall cost of offshore generation is conclusive.

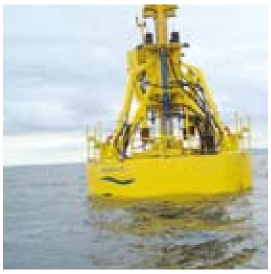
1.2.2 Incremental Development

Possibly the highest risk to efficient development of any transmission network is the risk that a current development project will not be ideally suited to act as part of the network in future. The result would be either costly modifications or at worst the asset becoming stranded and unusable.

Given the currently higher costs of building equivalent offshore assets to onshore assets and the difficulty in practically changing or modifying assets, this risk offshore is compounded.
A major finding from this analysis is that the ESPs show a consistency in their structure for a wide variation of scenarios. Increases in generation either at individual offshore generators or



2877 Candidates
(ROW potential reinforcements)



with the introduction of other generation points, results in the majority of the network in the ESPs being strengthened with additional parallel circuits and not in radical change to the layout or topography of the network.

Similarly examinations of different generation scenarios show that the phases of network development of an ESP out to 2030 are structurally consistent, often with the only apparent changes being when the elements of the network are required. In this way a higher level of generation may require the same network at an earlier point than a lower level of generation scenario.

It should be noted that the software methodology starts with a 'clean sheet' both offshore and onshore for each scenario. As the software is provided with a very diverse list of candidate reinforcements (see the figure below showing with dotted lines an example of the candidate reinforcements) it could choose a radically different set of reinforcements to fulfil the requirements.
As a result the analysis shows that although it is entirely possible for an asset to become stranded the risk of occurrence is likely to be low. This greatest risk is that of insufficient capacity into the future.

A number of options to mitigate capacity risk including, conversion of AC to DC circuits, and the use of smart devices are discussed below.

1.2.3 Symbiosis with the onshore network

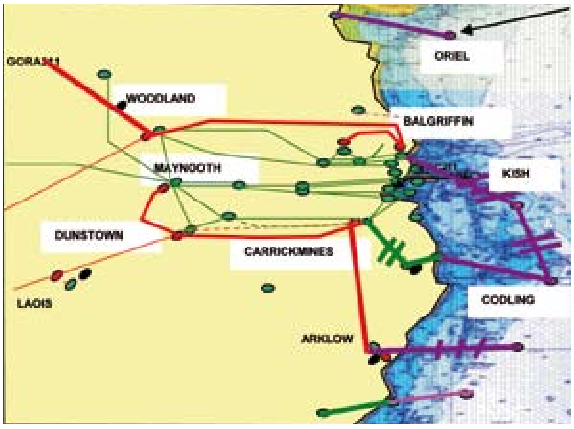
Almost every development to a transmission network has an interaction with the existing network. The level of this interaction and the resulting impact defines whether the development is symbiotic in nature.

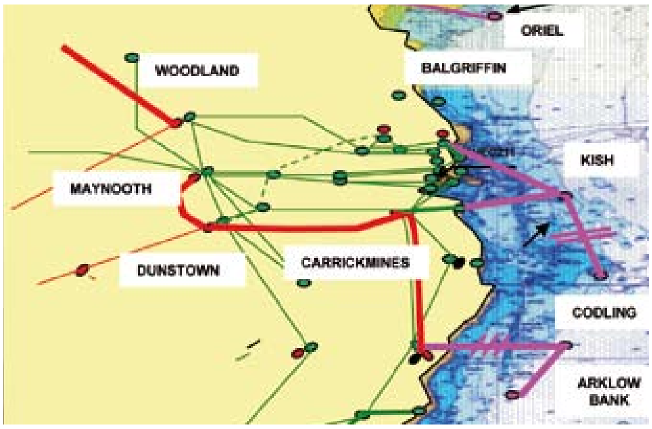
The results of the study show that reinforcement onshore is required for the introduction of generation offshore. This is not purely as a result of the need to strengthen the path from the offshore generation into the network to load demand centres, but also to provide routes through the onshore networks to other parts of the offshore network for bulk power transfer (for example to export to another country). Similarly, pre-identified restrictions in the onshore network are alleviated by having alternative routes provided by new meshed offshore infrastructure

Consequently both onshore and offshore networks are symbiotic in nature, i.e. they assist one another and thereby minimise the overall development requirements.

This finding is best demonstrated in the ESP for the 3GW Irish only scenario, which has a connection from Dublin North via Kish Banks offshore generation to Dublin South (see Figure below). The power transfer through Dublin has been identified as a problem and this link provides an alternative path for power transfer, solving both power delivery from the offshore generation and alleviation of an existing network problem.

Other scenarios have variations on this link, some more convoluted (see Figure below) than other but principally each ESP provides resolution to this problem using the inherent development requirements to cater for the additional generation considered in that scenario.





1.2.4 GRID25 strategy

The Grid Development Strategy GRID25 provides a common understanding of how the development of the Grid should be undertaken to support a long-term sustainable and reliable electricity supply.

Although levels of offshore generation where considered in line with the Government's energy white paper, these levels are significantly smaller than those considered in the scenarios in this report.

The reinforcements identified in the GRID25 process were not restricted to only the needs for offshore generation, but the needs of the system in its entirety to deal with a wide spectrum of load demand and generation scenarios out to 2025.

The GRID25 reinforcements were provided as candidate reinforcements with many other additional reinforcement options, allowing investigation into whether the GRID25 reinforcements which were likely to be required over the period to 2025 where aligned with the needs of the offshore scenarios.

For each of the scenarios some reinforcements are consistently required, and other reinforcements required for some of the scenarios. These are almost exclusively GRID25 identified reinforcements and hence provide confirmation not only to the methodology of the offshore study, but also reaffirmation of the GRID25 reinforcements for even more diverse scenarios.

See Figure A4 of EirGrid Transmission Development Plan

1.2.5 Interconnector Arrangements

Interconnection has historically been developed from onshore points in the network due to the low number of interconnectors, the cost of offshore equipment, and limited existing offshore stations providing no opportunities to do otherwise.

However with the increasing development of offshore generation and hence offshore stations the opportunity exists to make use of these connection points to limit the overall length of an interconnection between networks.

In the Irish Sea this provides a major opportunity due to the distance to the British network and the location of suitable generating sites both of Ireland and Britain. Outside of the Irish Sea development the Celtic sea also offers opportunity to develop from offshore points to either Britain or France.

Not unsurprisingly the ESPs for the scenarios make use of these offshore station opportunities at many points to develop interconnection capacity. This is not exclusive however and the strength of some offshore points may make it preferential to develop a direct onshore to onshore interconnector for capacity reasons.

Aside from the needs for capacity, technology will also influence the location that interconnection is terminated into. Although it is not an assumption of this study that all circuits that are interconnectors should be DC, in reality for technical and market reasons this is likely to be the case for the foreseeable future. The properties of DC technology may also dictate its use.

There are two different types of DC technology LCC and VSC. While based on information currently available LCC has a lower lifecycle cost (is cheaper) it requires a network with its own self powering generating source, which most offshore generation is not designed to be able to provide; further, large power filtering devices would create space constraints for offshore applications. Hence LCC is restricted to onshore to onshore network links in this study.

Therefore the currently more expensive VSC has been considered as possible offshore to offshore/ onshore candidate reinforcements. For connections to offshore stations it has been assumed that VSC DC technology is used, rather than the cheaper LCC DC technology.

However, both LCC and VSC are developing technologies and as such are subject to fluctuations including their respective capital costs, ultimately influencing their choice in future development.

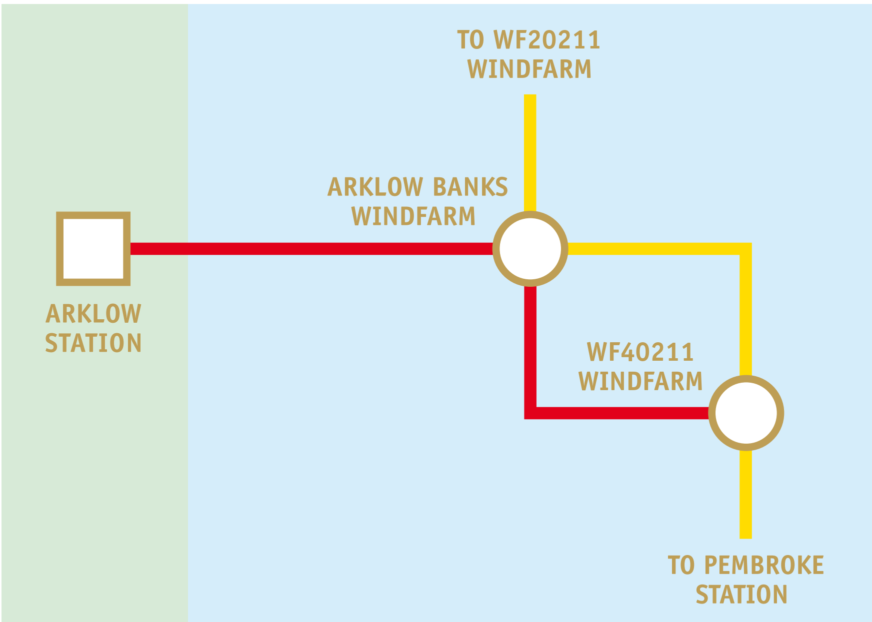
The final scenarios considering both AC and DC technological options have shown development of both British and French interconnection with both onshore LCC technology and offshore VSC technology.

1.2.6 'Smart' device use

The definition of 'Smart' devices in the context of this study refers to devices which can be remotely controlled to control power flows in the network. Examples of these would be devices which can convert AC power to DC power (and vice versa) and Phase Shifting Transformers.

The use of DC devices in ESPs for the scenarios has been selected by the software either specifically for their abilities to control power or as a consequence of the need for that technology in that circuit i.e. for interconnection between networks.

Where power flow devices have been selected as oppose to another capitally cheaper alternative it is because of the ability to control the power on that circuit will minimise the overall cost of the ESPs. These cost savings are made by reducing network build, reducing generation production costs or both.
An example of the use of an AC to DC convertor smart device is shown in the figure below, with the links between ARK0211 and WF40211 offshore stations east of Arklow in the Irish Sea being linked by an AC circuit (shown in Red) and a DC circuit (shown in Yellow). The lowest capital cost solution in this case would have been two AC lines but instead the ESP has utilised a smart device, i.e. the AC/DC/AC conversion devices for the DC circuit, to provide control to the power.

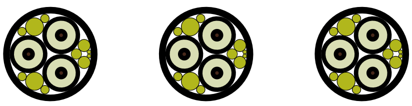


The higher capital cost of the DC circuit will be offset in the ESP by either, the cost of re-balancing generation in certain situations to avoid the risk of overloading equipment, or the cost of additional network infrastructure to resolve this equipment overload risk or both.

Early appraisal of the methodology and software (not contained in this report) examined an AC power controlled network. The results of which show that similar results can be achieved with AC power flow control as DC technology.

Given that the combined cost of AC cables and Phase Shifting Transformers (PSTs), which would allow AC power flow control, is lower than its equivalent DC devices, (it is likely that) some DC circuits shown in the analysis of this report should be examined to see if they are technically acceptable and be replaced by an AC equivalent where possible. Confirmation of technical acceptance requires a more detailed analysis than the present level undertaken in this report.

AC

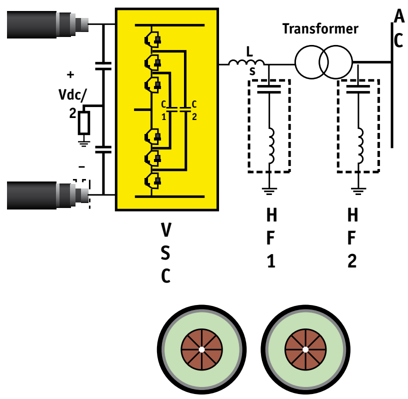


Three 220kV AC cables with 3 combined conductor cores rated at 320 MVA each, total 920MVA

Two 220kV AC cables with 3 separate cable conductor cores rated at 460 MVA each cable, total 920MVA

One 400kV AC cables with 3 separate conductor cores rated at 930 MVA

DC



One + 320 DC cable, with 2 separate conductor cores rated at 360-1080 MVA

See Table 8 of Strategic Environmental Assessment (SEA) of the Offshore Renewable Energy Development Plan (OREDP) in the Republic of Ireland at http://www.seai.ie/Renewables/Ocean_Energy/Offshore_Renewable_SEA/Environmental_Report/SEA_ER_Final.pdf

An important assumption made in this analysis is that a suitable control philosophy can be found and implemented to operate all of the onshore and offshore networks in perfect unison.

1.2.7 Developed at a high voltage level at least 220kV

The predicted typical size of offshore individual wind generators is c.5MW , wave up to 5MW and tidal 1MW, and based on historical experience each in future maybe even larger. Current experience from the existing wind generator applications used in this study is that they are mainly based on a final potential of 1GW, with a typical application for c.300MW for initial commercial scale.

In addition resources for both wind, wave and/or tidal exist in the same area.

Consequently the initial assumptions for the size of a cluster of generation at a point offshore should be expected in the future to also be at least 1GW typically in size.

The analysis has shown that to deliver the quantity of generation and corresponding interconnection capacity requirements in the Irish Sea alone that typical size links between offshore stations of the order of c.1GW will be required, not dissimilar to the size of an offshore generation point. However in many places this can be as high as 3GW links.

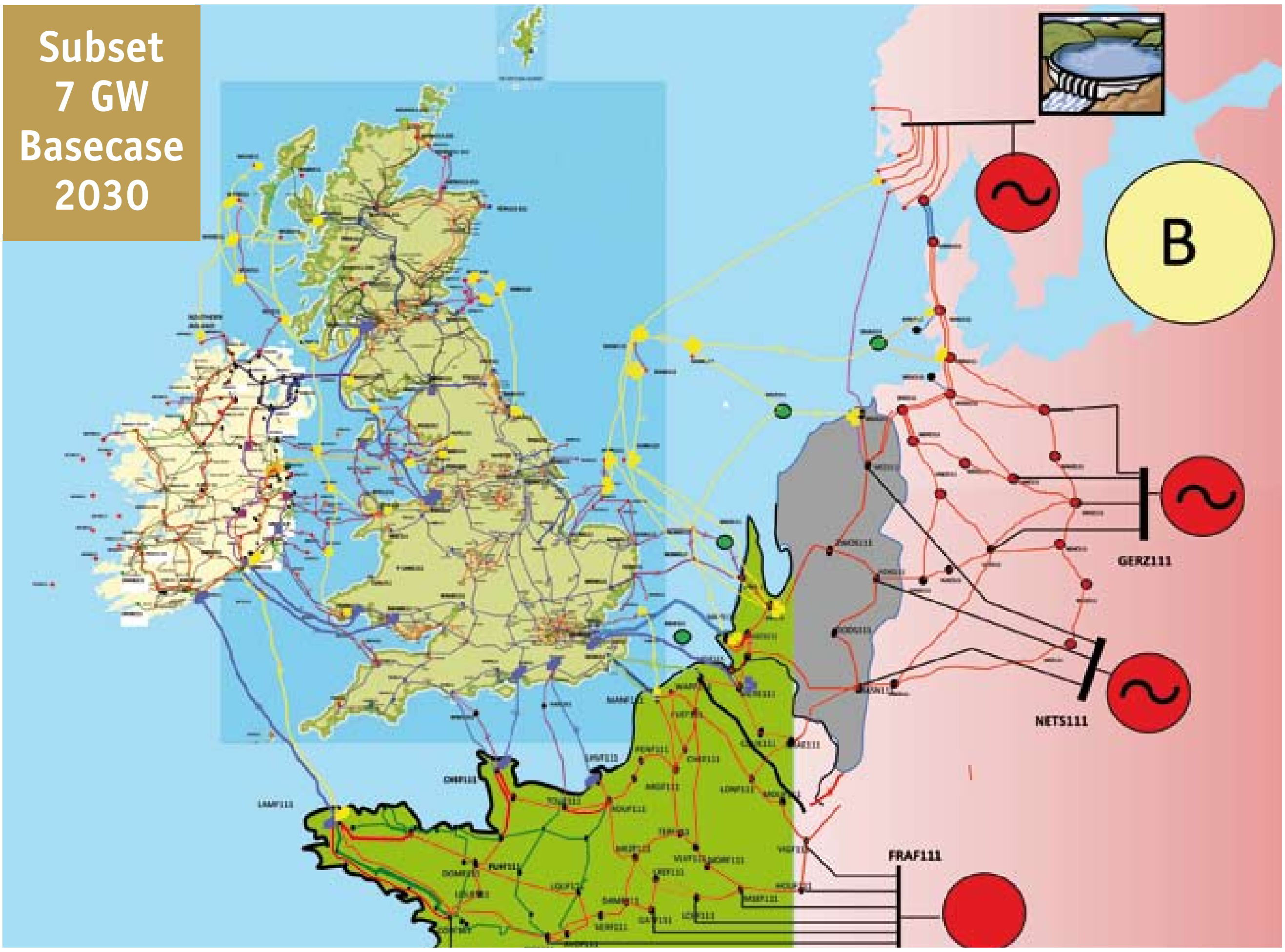
To put the size of these circuits into context 1GW is approximately the capacity of two of the standard 220kV lines used in Ireland. The diagram below shows how the various cable technologies and voltage could provide an equivalent rating.

Practically and economically speaking high quantities of parallel circuits to provide high capacity circuits is not desirable. Consequently higher transfers would preferably be built with higher voltage cables.

However both the cost of development and increasing technical problems associated with 400kV (EHV) cables may prove ultimately to restrict their use. Currently the associated equipment needed to develop offshore EHV cables does not exist, although it is in development, and it may be many years before its use is considered mainstream.

Another consideration is the termination of any offshore circuit onshore in many cases deeply inland which require either multiple overhead lines or cables to be built from shore to the termination point. The practicality (even viability) in comparison to offshore of doing so, and also the associated costs can be magnified when considering the choices of voltage.
Therefore driven by the requirement for multiple circuits and additional transformation between voltages, a circuit at 220kV or higher voltage is deemed appropriate from the analysis, providing the most economic network development voltage.

One interesting increased capacity option is to install 220kV AC cables initially and then seek to convert these to DC operation, which can provide appreciable increases in their rating, at a later stage if the initial capacity is insufficient. Technically this is considered possible but further investigation into the requirements, new standards, qualifications, testing procedures, practicality and cost of the additional AC/DC conversion devices will be needed. In principle this would provide future proofing without initial commitment of higher capital costs until such time as a need arises.



1.2.8 AC or DC offshore network

Another fundamental decision in building a new transmission network is whether the network will be Alternating Current (AC) or Direct Current (DC). Both have their pros and cons, but as historically transmission networks onshore have been built as AC the use of DC in an offshore network requires conversion from AC to DC and vice versa when making links between both network types.

Although DC can be a more efficient method of power transmission it is very expensive. Consequently, DC technology is only economically viable over long distances. In the case of offshore cable networks this has been calculated in this study as being higher than c.60km. Also long aggregate lengths of EHV AC cables have a number of technical issues favouring the use of DC cables. These issues have not been examined in-depth in this report and may make the use of DC preferable at even shorter distances.

The analysis performed with the variety of candidate AC and DC technologies, has shown that neither AC nor DC is exclusively selected but rather a mixed approach with the cost of the two technologies dictating heavily their use. Further detailed technical analysis will need to be conducted to confirm the final quantities of each that will be acceptable.

The diagram below shows that LCC DC technology (shown in purple) forms the majority of the onshore to onshore interconnector circuits, where as the VSC DC technology forms (shown in yellow) the majority of the longer circuits that start from an offshore point. The shorter links are predominately AC (shown in Red); however in some applications the use of DC technology has been used at a higher capital cost presumably to control power (See 'Smart' device use above for more details).

1.2.9 Future expansion

Developments to the transmission network must be designed to meet not only initial needs on the network but also must be resilient to the needs of the network into the future.

Predicting the future needs with any level of certainty is a challenge for all system planners worldwide. The best practice approach is to envisage a number of future scenarios which cover the widest plausible range of developmental changes to the network. If a development project addresses the needs for all scenarios then it is considered robust, i.e. able to meet the widest envisaged range of needs on the network.

Part of the driver for this study was to assess the probability of future development from offshore stations over future years. This information would define whether spare capacity for future expansion should be built into these stations design.

For clarity, this does not mean that additional electrical equipment would necessarily be installed immediately. What it does mean is that consideration for potential future needs should be built into the development particularly when designing civil works i.e. offshore platforms, cable routing, etc.

The examination of a number of future generation levels and dispersion provided a diverse range of future scenarios. Consistently across all of the ESPs offshore development was extensive and 'meshed', with continuing incremental strengthening between these stations with additional circuits of various technologies. The technologies selected would all require additional station equipment, with varying implications for offshore station design.

While expansion should be catered for, additional in-depth analysis of the detailed design options to identify how this would be best achieved is a body of work which was beyond the scope of this study.

However, some key functional requirements can be identified from this study.

Standards and policies for offshore stations should seek a modular electrical design that will permit changes from AC to DC and vice versa on some circuits, for the installation of Phase Shifting Transformers and dynamic or variable reactive compensation.

Standards and policies for offshore reactive compensation, AC to DC conversion, high voltage switchgear equipment, transformers and associated plant should be developed.

Options for expansion of offshore platforms themselves to accommodate future plant should be evaluated to find the most cost effective method of delivering expansion, including but not restricted to whether to front load expansion requirements.

1.3 CONCLUSION

This Offshore Grid Study has successfully provided EirGrid with the necessary information and understanding on which to base its functional requirements for offshore generator connections, and standards or policies for offshore equipment.

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