TRANSMISSION DEVELOPMENT PLAN

2006-2010

ESB National Grid

June 2006

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Abbreviations

ACSR	Alluminium Conductor Steel Reinforced
CER	Commission for Energy Regulation
CCGT	Combined Cycle Gas Turbine
CP No.	Capital Project identification number
CT	Current Transformer
DC	Direct Current
DSO	Distribution System Operator
ESB	Electricity Supply Board
ESBNG	ESB National Grid
GAR	Generation Adequacy Report 2006-2012
GIS	Gas Insulated Switch-gear
HV	High Voltage
IPP	Independent Power Producer
NI	Northern Ireland
NIE	Northern Ireland Electricity
NSS	National Spatial Strategy
PST	Phase Shifting Transformer
RES	Renewable Energy Schemes
SCADA	Supervisory Control and Data Acquisition
SI445	Statutory Instrument 445 (2000)
SONI	System Operator Northern Ireland
SVC	Static Var Compensator
TAO	Transmission Asset Owner
TSO	Transmission System Operator
VT	Voltage Transformer

Summary

The Transmission Development Plan 2006-2010 is the proposed plan for the development of the transmission system over the next five years. This five year plan presents the components of the overall long term development of the transmission system where there is some level of certainty. Only projects that are either committed or about to be committed for construction are detailed in this report. However, the other likely areas where development projects may soon be required are also discussed. The report has been prepared in accordance with Regulation 8.6 of Statutory Instrument 445 (2000), entitled European Communities (Internal Market in Electricity) Regulations, 2000.

A reliable electricity infrastructure providing quality performance is vital for Ireland's socio-economic development. The high voltage transmission system, similar to the motorways and broadband telecommunications networks, is a component of the backbone infrastructure which supports the economy.

The Transmission System

The transmission network forms the backbone of the electricity supply system in Ireland. It is a meshed network of high voltage lines and cables for the transmission of bulk electricity supplies around Ireland. The transmission system comprises 400 kV, 220 kV and 110 kV networks linked through transmission stations.

The network is designed to comply with the Transmission Planning Criteria. These set out objective reliability standards, which are comparable with planning standards internationally, and which have been found to deliver an acceptable compromise between cost of development and level of transmission service provided.

The Role of the Transmission System Operator

The Statutory Instrument 445 (2000), which gives effect to the current electricity industry arrangements, among other things assigns responsibilities for transmission network development to the Transmission System Operator (TSO). ESB National Grid, as the TSO also has the responsibility for operating and ensuring the maintenance of the transmission system. Generation, Distribution and Supply (sales) functions are carried out by other parties.

ESB, as the Transmission Asset Owner (TAO), is charged with constructing the assets for the transmission system infrastructure. This Development Plan provides the TAO with an overview of the transmission projects that are in progress and an indication of the level of development that is likely to emerge in the period to 2010. ESB also has the role of Distribution System Operator (DSO) with which the TSO coordinate planning and development requirements.

The funding for the transmission system ultimately comes from all electricity customers and therefore developing high quality infrastructure, while investing efficiently and economically, are key considerations. The CER has the role of approving the overall level of investment in the transmission infrastructure.

Historical Context of the Development Plan

Over the past five years, an unprecedented level of new generation, both from new thermal and renewable plants, has been facilitated and connected to the system. New generation of over 1,800 MW has been added since 2000 to a system where peak demand has increased by over 20% in the same period to around 4,500 MW (net of generator house load).

Five years ago, as an input to the TSO's 2001-2005 Price Review submission the TSO identified that large areas of the transmission network were at risk of being outside standards in the coming years. There were a number of reasons for this including the raising of some technical standards to international norms, and a large increase in electricity demand, driven by the "Celtic Tiger", following on from period of low network investment.

A capital investment programme was put in place and carried out in the 2001 to 2005 period and the network has improved significantly. The system is now substantially within the required reliability standards at current demand levels. However, ongoing investment is required to meet the future needs of a growing economy.

Developments for 2006 to 2010

Electricity peak demand is forecast to increase by about 20% over the period of the plan. In addition to the 532 MW of new thermal generation and 43MW of wind generation that was connected to the transmission system between November 2005 and March 2006, a further 737 MW of generation capacity has signed connection agreements. All of this is expected to be connected by 2010. This Development Plan sets out the development projects that have been initiated to meet these future needs, and discusses the potential for further development in the next five years.

The main features of the plan, which involves developments in all parts of the country, include:

- Expansion of the 220 kV system into the North-West;
- Expansion of the 400 kV system to provide necessary bulk transfer capacity out of Dublin and Moneypoint;

- Strengthening of the networks in and around Athlone, Castlebar, Cavan, Cork City, Galway, Letterkenny, Meath Hill, Newbridge, Tullamore, and Wexford;
- Connection of eight new DSO stations;
- Connection of ten new generators to the transmission system;
- Reduction of high short circuit levels in Dublin and Tarbert;
- Strengthening of the Dublin to Louth corridor;
- A second major interconnector with Northern Ireland.

Other Potential Developments

On the basis of current assumptions, a number of areas have been identified where further infrastructure will be needed in addition to the projects currently in progress. The TSO is considering options for solving these emerging challenges. Some of these issues are expected to emerge late in the period and may be resolved with short lead times solutions. Development projects will be initiated at the optimum time to meet the network requirements.

Other development requirements may emerge depending on a number of factors not yet certain, such as the connection of demand, generation and interconnections, and on new refurbishment requirements that will be identified as condition assessments are carried out. The potential drivers include:

- The proposed interconnection with Great Britain;
- Wind-farm applications totalling 3,144 MW as at the end of April 2006 (63 MW live connection offers and 3,072 MW in the application queue – up to 1,300 MW of this is likely to be included in the Gate 2 process);
- Applications for the connection of thermal generation;
- Increasing Short Circuit Levels;
- DSO plans for new 110 kV / MV transformers and connection for new 110 kV stations;
- Closure of generation plant;
- The need to refurbish a number of stations and overhead lines which were identified after initial condition assessments and will be confirmed following more detailed refurbishment investigations.

The TSO is constantly monitoring and reviewing the above drivers and factors to determine when and how they will require attention. Once a sufficient level of confidence in the investment drivers is reached the various requirements are considered in preparing a co-ordinated development strategy to best deal with them. It is expected that some of these strategic developments will feature in future development plans.

Renewable Energy

The TSO is committed to supporting present and future government policy on renewable energy and to integrating further renewable generation as an increasingly important part of the overall generation mix. Ireland is on target to meet the current target of 13.2% of energy from renewable sources by 2010. The level of connected wind generation, signed connection offers and issued connection offers highlights the fact that wind power generation is expected to be the major contributor to this target.

A long term view to facilitating an increased penetration of renewable generation to the generation capacity of the country is required. To this end the TSO is contributing to an All Island study on the implications and consequences of large scale penetration of renewable energy on the island of Ireland. In addition, it has contributed to the draft vision paper for renewable energy in 2020 being prepared jointly by the Department of Communications, Marine and Natural Resources and the Department of Enterprise, Trade and Investment in Northern Ireland. The TSO will take account of new renewable targets in future Development Plans.

Regional Development

Because of the importance of the electricity system to customers all over Ireland, the Transmission System Operator is very conscious of the need to support regional development.

It will be noted that a significant portion of the investment in this Development Plan will be undertaken in the Border/Midlands/Western (BMW) region with over 25% of the transmission development allocated directly to this area. This investment will significantly improve the electricity infrastructure and provide the backbone for further economic development in the regions.

Capital Expenditure

The TSO estimates that transmission development requirements will involve major expenditure between 2006 and 2010. However, as highlighted above, many projects are at a preliminary design stage, while others have not yet been initiated. Better expenditure estimates will evolve as project scopes become more certain.

The TSO welcomes the CER's continued support for investment in the transmission network. The CER in its 2006-2010 Transmission Price Control Review Decision Paper has set a cap on capital expenditure on transmission at €520 million for the period.

The impact of this capital constraint will be continually reviewed as project designs and costs evolve.

Conclusion

The TSO is committed to delivering quality connection, transmission and market services to its customers and to developing the transmission grid infrastructure required to support the development of Ireland's economy.

With the projects outlined in this development plan forming part of the overall long-term transmission system development, coupled with the constant review of the transmission infrastructure and the changing environment requirements, the TSO is confident that the needs of a growing Irish economy will be met well into the future.

1 Introduction

Electricity supply is an essential service in Ireland's economy. The transmission system is a meshed network of 400 kV, 220 kV and 110 kV high voltage lines and cable and plays a vital role in the supply of electricity. It is the backbone of the power system and provides the means to deliver power from generation sources to demand centres within acceptable technical security and reliability standards. It is analogous to the motorway and national road networks allowing producers (generators) bring their product to large customers and to major depots for onward distribution to smaller customers.

1.1 The Role of the Transmission System Operator

The Statutory Instrument 445 (2000)[1], which gives effect to the new electricity market arrangements, among other things assigns responsibilities for transmission network development to a Transmission System Operator (TSO). ESB National Grid, as the TSO has the legal responsibility for developing the transmission system.

The TSO's role is entirely separate to the companies which generate, distribute and sell electricity in Ireland. The funding for the transmission system comes from all electricity customers and therefore developing high quality infrastructure, while investing efficiently and economically, are key considerations.

ESB, as the Transmission Asset Owner (TAO), is charged with constructing the transmission assets as specified by the TSO. This Development Plan provides the TAO an overview of the transmission projects that are in progress and an indication of the level of development that is likely to emerge in the period to 2010. ESB also has the role of Distribution System Operator (DSO) with which the TSO coordinate planning and development requirements.

1.2 The Transmission Development Plan

The Transmission Development Plan 2006-2010 is prepared in accordance with Regulation 8.6 of Statutory Instrument 445 (2000).

[1] Statutory Instrument 445 (2000), entitled European Communities (Internal Market in Electricity) Regulations, 2000

This report presents the TSO's view of how the future transmission needs are likely to change and its plan to develop the network between now and 2010 to meet those needs. The long term development of the transmission grid is constantly under review. This plan comprises a list of development projects that are in progress and for which there is some level of certainty and a description of other areas where further development is likely to be required.

This is the first such plan to be issued. Hereafter, the plan will be reviewed and updated annually.

1.3 Context of the Plan

The development of the network is a complex process involving forecasting future needs and planning solutions that strike a balance between network reliability, costs and environmental impacts. The process must be dynamic to meet the ever-evolving needs but also to enable the strategic development of the system in the long term. This plan is a snap-shot of the developments for the period 2006 to 2010 in the process at this point in time. It is possible that changes will occur in some project delivery dates, in the scope of some projects or in the need for some developments. Similarly, it is likely, given the continuously changing nature of electricity transport requirements, that new developments will emerge that will change the plan as presented. These changes will be captured in the annual review and updated in future development plans.

1.4 Background to the Transmission Development Plan

Five years ago, at the beginning of the 2001-2005 pricing period, the transmission system was outside standards in many areas. There were a number of reasons for this including the raising of some technical standards to international norms, and a large increase in electricity demand driven by the "Celtic Tiger", and the fact that there had been low network investment in the previous decade. A capital investment programme was put in place and carried out in the 2001 to 2005 period such that the system is now substantially within standards.

However, analysis of future network performance based on the assumptions outlined in Chapter 3 points to the need for an equally challenging programme of investment to maintain the system within standards demanded by a modern economy. The scope of this infrastructure programme is the subject of this development plan.

1.5 Document Structure

The Summary section gives an overview of the main highlights of the document and presents the plan in summary terms.

Chapter 1 gives the purpose and context of the plan.

Chapter 2 provides information on the TSO's legal requirements in relation to development and describes the TSO's planning process and strategies employed.

Chapter 3 describes the factors that drive network development and presents the TSO's forecasts and assumptions relating to the drivers for this plan.

Chapter 4 lists the development projects that are currently in progress. It provides a brief description of the scope of works and a reason for the development.

Chapter 5 lists areas where development needs are expected to emerge in the future and other potential development needs that may arise.

Chapter 6 gives a high level summary of the network development plan.

Appendix A presents details of the demand forecasts at each transmission interface station.

Appendix B includes a map of the existing network and a second map illustrating the locations of major development projects.

Appendix C provides details of major development projects in the detailed planning or construction phase.

Appendix D provides details of major development projects currently in the public planning process.

Appendix E includes the text of Regulation 8(6) of Statutory Instrument 445 (2000) which obliges the TSO to produce this Development Plan.

Appendix F provides a glossary of terms used in the document.

2 Transmission Development Approach

A reliable electricity infrastructure providing quality performance is vital for Ireland's socio-economic development. The development of that infrastructure is of national strategic importance. The high voltage transmission network forms the backbone of the electricity supply system in Ireland which supports the economy.

This chapter provides a high level overview of the approach that the TSO follows to determine the network requirements, find the appropriate solution and implement the necessary works by presenting the context of transmission planning, the objectives, strategies and criteria as well as an explanation of the planning process within the TSO.

It is important to note that while the transmission network is studied and planned in the context of the long-term strategic development of the power system, this report concentrates on the committed transmission projects that are in progress and other potential developments identified at this point in time.,

The contents of this chapter are set out under the following headings:

- Statutory and Legal Requirements
- Development Objectives & Strategies
- Transmission Planning Criteria
- The Network Development Planning Process

2.1 Statutory and Legal Requirements

Statutory Instrument 445 (2000)[1], modified by Statutory Instrument 60 (2005)[2], outlines the roles and responsibilities of the Transmission System Operator. Under Regulation 8(1)(a) of Statutory Instrument 445 (2000), the Transmission System Operator is assigned the following exclusive function:

> *to operate and ensure the maintenance of and, if necessary, develop a safe, secure, reliable, economical, and efficient electricity transmission system, and to explore and develop opportunities for interconnection of its system with other systems, in all cases with a view to ensuring that all reasonable demands for electricity are met having due regard for the environment.*

[1] Statutory Instrument 445 (2000), entitled European Communities (Internal Market in Electricity) Regulations, 2000

[2] Statutory Instrument 60 (2005), entitled European Communities (Internal Market in Electricity) Regulations 2005

This gives the TSO exclusive responsibility for the operation and development of the transmission system within the Republic of Ireland. It also requires the TSO to strive for a balance between development to improve security and reliability and the cost and environmental impact of the developments.

The TSO has a statutory obligation to produce a Transmission Development Plan. As part of the preparation the TSO is required to consult on the Development Plan prior to submitting it to the CER for approval. The text of Statutory Instrument 445 (2000) Regulation 8(6) which deals with the Development Plan is included in its entirety in Appendix E.

In preparing this development plan the Transmission System Operator has taken account of other Regulations:

SI445 8(1) (c) *to take into account the need to operate a co-ordinated distribution system and transmission system*;

SI445 8(1) (i) *to offer terms and enter into agreements, where appropriate, for connection to and use of the transmission system with all those using and seeking to use the transmission system*.

SI445 8(3) *In discharging its functions under these Regulations, the transmission system operator shall take into account the objective of minimising the overall costs of the generation, transmission, distribution and supply of electricity to final customers.*

SI60 8(1) (c) *to plan the long term ability of the transmission system to meet reasonable demands for the transmission of electricity*;

(ca) *to contribute to security of supply through adequate planning and operation of transmission capacity and system reliability*;

Regulation 8(8) of SI445 (2000) precludes the TSO from developing generation directly as a solution to network needs. However, the TSO does facilitate connection of third-party generation and when future connections are confirmed it takes their impact into consideration when evaluating network development requirements.

SI445 8(8) *The transmission system operator shall not engage in the generation, distribution or supply of electricity in the State*.

Section 19 of SI445 (2000) gives the ESB the responsibility as Asset Owner to carry out construction work in accordance with the Transmission System Operator's Development Plan.

SI445 19. *The transmission system owner shall-*

(a) as asset owner, maintain the transmission system and carry out construction work in accordance with the transmission system operator's development plan, subject to the provisions of Regulation 18(3)

2.2 Development Objectives and Strategies

An objective of the Transmission System Operator is to develop a safe, secure, reliable, economical, and efficient electricity transmission system to meet reasonable demands for the transmission of electricity in accordance with its legal obligations. The TSO plans the development of the grid taking account of the long-term needs and the economics of various development options.

The demands for the transmission of electricity are driven by a number of factors including but not limited to growth in electricity demand, and developments of generation and interconnection. These drivers are discussed in Chapter 3.

The need for development is determined by assessing long-term future network performance against technical standards embodied in the Transmission Planning Criteria (TPC), as described in the next section.

When it is established that these demands cannot be met without violating the deterministic criteria, a wide range of issues is taken in to account in selecting a transmission enhancement strategy. These include long-term economic assessments of a range of transmission alternatives. These assessments attempt to take account of the full range of costs and benefits associated with each option. However, it is not possible to calculate with absolute precision the full range of benefits.

The factors considered in selecting the optimum development project are described in Section 2.4.1 under "*Select Optimum Development Project*". In considering these factors, the TSO adopts a number of high level strategies, described below, to optimise development.

The TSO seeks to find single development projects to meet multiple network requirements where possible. When assessing development options to address future potential network needs the TSO considers the impacts of each possible option on other potential development needs. In some cases a proposed project will meet one or more other development requirements and may prove more economic and more environmentally friendly than multiple projects.

When examining alternative development the TSO considers the effectiveness of the options in meeting the longer-term needs. In some cases it may be more cost effective to choose a higher cost project that will perform better in the long-term and may obviate the need for further development. Where a more costly development is needed in the long-term the TSO will seek ways to phase the project. For example, a 220 kV project could be selected for its long-term benefits even though the immediate requirement is for a 110 kV solution only. In some cases, a line could be constructed as a 220 kV line but initially operated at 110 kV thus deferring the more expensive 220 kV station equipment costs until the line is energised at 220 kV at a later date.

The future operation of the network is considered when evaluating options for meeting future transmission requirements to ensure that the flexibility required for an efficient market is not unduly compromised.

By making more effective use of the existing system, the TSO can delay large investment or avoid the need for additional circuits. Examples of this strategy include:

- installing a phase shifting transformer in Dublin to manage power flows on cables and delay the need for additional cables;
- using relatively low cost capacitors to support voltages, thus delaying larger investment in lines and stations;
- installing 220 / 110 kV stations rather than new 110 kV lines where economic to relieve the stress on the underlying 110 kV network and make better use of 220 kV line capacity;
- installing 400 / 220 kV stations where economic to maximise the benefit of the 400 kV network.

Consideration is also given to applications for temporary derogations while the cost of development is unduly onerous.

Overhead lines are normally used to provide new transmission circuits as they are easier to maintain and repair and so provide a more reliable means of supply than underground cables. They are also substantially less expensive. Underground cables are considered where appropriate such as in city centres or urban areas.

2.3 The Transmission Planning Criteria

The requirement for grid development is identified when simulation of the future conditions indicates that the transmission planning standards would be breached. These standards, which are in line with international standards, are set out in the Transmission Planning Criteria (TPC) and can be accessed on the TSO's website, www.eirgrid.com (under "About Us" / "Publications").

These criteria are deterministic as are those generally used throughout the world in transmission planning. They set out an objective standard which has been found to deliver an acceptable compromise between the cost of development and the service delivered. Transmission investment planning consists of many different decisions to address different problems. Rather than attempting to carry out subjective benefit analysis in each case it is preferable to plan to meet an objective standard and carry out analysis of the range of options available to comply with the standard.

Once a violation of the criteria has been identified, a wide range of issues is taken in to account in selecting a transmission enhancement strategy as described in the previous section. The objective is to come up with investment plans that meet the transmission requirements in an efficient and cost effective manner in compliance with the principles of the Transmission Planning Criteria .

The criteria include standards for voltage range and deviations, maximum thermal loading of grid equipment, system security, dynamic stability and short circuit levels. The grid must operate within these specified standards for intact network conditions, and following an unexpected outage of any circuit or generator. This also applies during maintenance outages of any other lines, cables, transformers or generators.

Table 2-1 Contingency types tested for different demand scenarios

Contingency	**Winter Peak**	**Summer Peak**	**Summer Valley**
Loss of any single item of generation or transmission plant	✓	✓	✓
Overlapping single contingency and generator outage	✓	✓	✓
Trip-Maintenance i.e., loss of any single item of generation or transmission plant when another circuit is out on maintenance	✗	✓	✓

Table 2-1 indicates the contingencies tested for three separate demand scenarios. The *Winter Peak* represents the forecast maximum annual demand. The *Summer Peak* refers to the average week-day peak value between March and September inclusive, which is typically 20% lower than the winter peak. This demand level is of interest because although the overall grid power flow may be lower in summer than in winter, this may not be the case for flows on all circuits. In addition, the capacity of overhead lines is lower because of higher ambient temperatures, while network maintenance, normally carried out in the March to September period, can deplete the network, further reducing its capability to transport power.

The Summer Valley is the annual minimum which generally occurs in August. Annual minimum demand is typically about one-third of the annual maximum demand. Analysis of summer valley cases is concerned with the impact of low demand and low levels of generation. This minimum condition is of particular interest when assessing the capability to connect new generation. With local demand at a minimum, the connecting generator must export more of its power across the grid than at peak times.

The TSO intends to review the application of the Transmission Planning Criteria this year in the context of the new interactions between increasing wind generation and thermal generation. In particular the TSO will look at the range of generation profiles that might be tested against the criteria.

2.4 The Network Development Planning Process

2.4.1 Network Development

The network development planning process is of necessity a dynamic process to deal with the ever-evolving requirements for transmission services. The Development Plan is a snap shot in time of the development needs in the process.

Figure 2-1 illustrates the various stages in the process which are described below.

Develop Forecasts of Future Conditions: The beginning of the process involves reviewing and making projections of the main drivers as outlined in Chapter 3. The projections are incorporated into models of the future network.

Evaluate Network Performance: The network models are used to assess the future long-term performance of the network against planning standards. This review of network adequacy identifies areas of weakness which may require development. This includes an assessment of various factors such as: diverse generation dispatches, different interconnection power transfers, generation closure, network stability. Analysis of potential long-term needs provides useful information when considering solution options, as it enables the selection of a more optimum solution and avoids sub-optimal incremental development.

Evaluate Connection Applications: An analysis of shallow connection and associated deep reinforcements are generally carried out when an application is received for connection of new generation or demand, or for a Distribution System Operator (DSO) connection. If the applicant signs the connection agreement the shallow connections are progressed, while optimum deep reinforcement options are considered for selection.

Confirm Need for Development: The previous stages provide a list of potential problem areas that may arise in the future. In some cases there may not be an immediate need to progress a solution. Therefore, at the appropriate time, a detailed review is carried out on each problem to determine if there is a definite requirement for development.

Consider Options for Development: Once the need is confirmed, a list of potential options will be developed. Each option will be evaluated to ensure it meets the technical requirements.

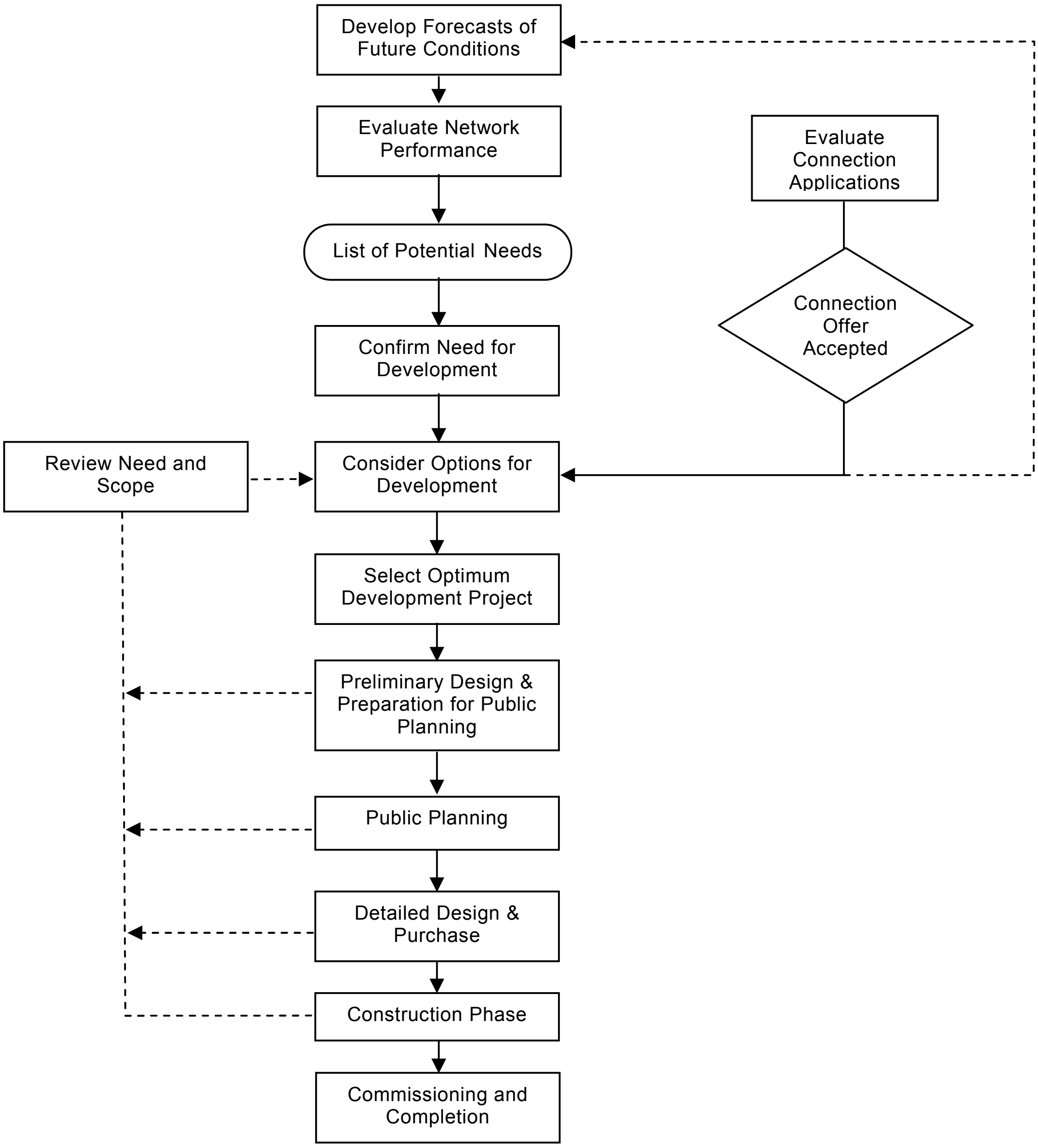


Figure 2-1 Flow Chart of Network Development Process

Select Optimum Development Project: Where more than one technically feasible option is available, selection of the optimum project involves the consideration of many factors including:

- Compliance with the Transmission Planning Criteria;

- Economics of alternative development options;
- Project lead-times and feasibility of options;
- The impact of constraints in the transmission system on generation costs;
- Flexibility in scheduling generation to support the operation of an effective market;
- Robustness to alternative future needs and long-term benefit of options;
- The impact on transmission operations, protection and maintenance;
- Co-ordination with the DSO requirements;
- The impact of alternative development plans on distribution costs;
- The potential impact on the environment;
- Synergy with refurbishment projects.

The challenge for the TSO is to find robust solutions that deliver the best long term value to the customer taking account of these factors and of the uncertainties in demand and generation projections. Uncertainty in generation not only relates to location and size of new connections but also to the operation level of all connected generators.

After careful analysis and internal review a preferred option is put forward as a solution. Internal approval is sought to progress the project to the next stage.

Preliminary Design and Preparation of Planning Applications: For developments that require Planning Permission this phase includes a number of tasks: preparation of preliminary designs, route surveys, meetings with stakeholders (landowners and local representative bodies), preparation of an environmental impact statement as required and in compliance with environmental legislation, preparation of Planning Applications to the relevant local authorities

Public Planning: This part of the process is the most uncertain in terms of timing and outcome. The Planning Application is submitted to the relevant local authority (or authorities where necessary) and any subsequent queries from the local authority are dealt with. The planning authority decides whether or not to grant planning permission for the project. If planning permission is granted it may be subsequently appealed to an Bord Pleanála. The TSO would then be involved in responding to queries an Bord Pleanála.

Once planning permission is secured, the requirement for the project is reviewed and the project cost is re-evaluated before progressing to the next phase.

Detailed Design and Purchase: When planning permissions are secured where necessary and internal approval obtained to proceed to construction, the materials are procured, station sites are finalised where necessary, and construction arrangements put in place.

Construction Phase: Once the detailed design and purchase are completed, construction is carried out.

Commissioning and Completion: When the development is constructed it must undergo commission testing and approval before going into operation. This is to ensure that equipment is safe, will operate as per design and that signals and controls are correctly installed.

Review Need and Scope: The process is presented above in a sequential format for explanatory purposes. It is in fact a dynamic and non-linear process i.e., there are opportunities at various stages for a review and possible change of the project scope. For example, the process includes a review following the planning process when more accurate project costs based on an actual route are obtained. If these turn out to be significantly higher than estimated, the project justification and selection would be reviewed. If planning permission is not granted, or if there are particular difficulties during construction it would be necessary to re-assess the project. If the original assumptions underlying the project justification change dramatically at any time, the project would be reviewed. This avoids unnecessary investment and ensures that the network development plan matches requirements as far as possible.

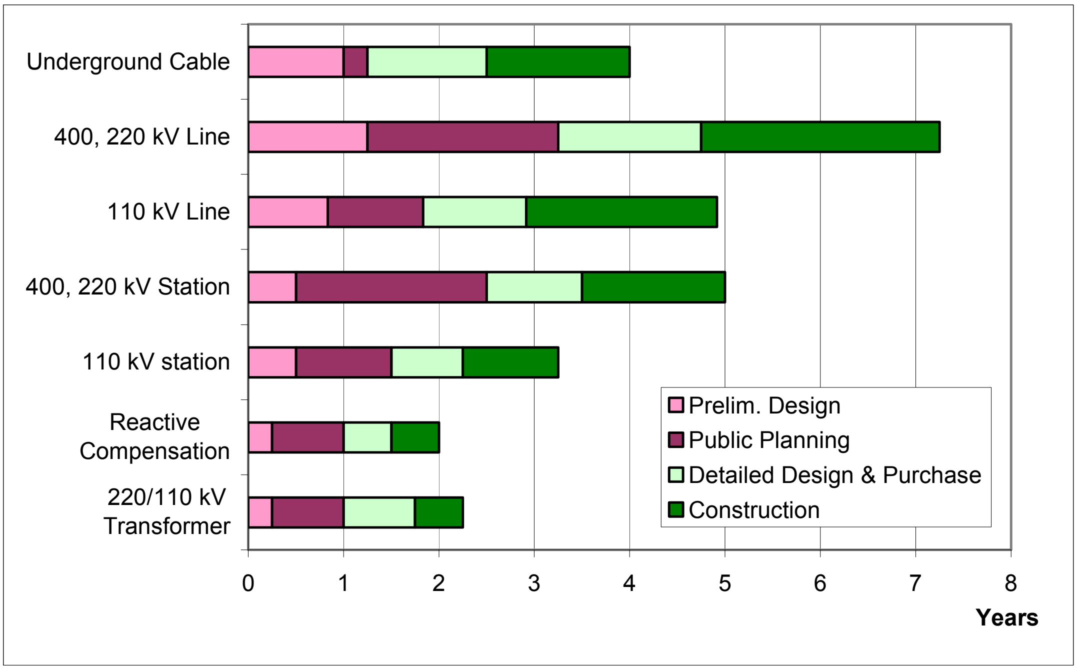


Figure 2-2 Typical Lead times for Development Projects

Figure 2-2 shows the typical lead-times for various types of development projects from the decision to proceed with a selected project to final completion. These times are based on experience of recent projects and are not meant to indicate targets or accepted practice. Because of the uncertainty in the public planning process these lead-times should be considered indicative only.

It is encouraging to note that the national importance of electrical infrastructure projects is recognised in the government's proposed Critical Infrastructure Bill.

2.4.2 Refurbishment

Refurbishment involves the replacement of equipment to extend the life of the transmission assets. The development of a refurbishment programme is a complex process as described below. While age of plant may be a trigger which initiates the process it is by no means the only consideration. Other factors which impact on the decision to refurbish plant include safety and environmental considerations, increasing fault frequency, increasing cost and complexity of maintenance, lack of spares, and plant obsolescence.

The process of network refurbishment is illustrated in Figure 2-3. The main inputs into the process are represented by the two blocks titled "Initial Condition Assessment" and "Performance and Technology Review".

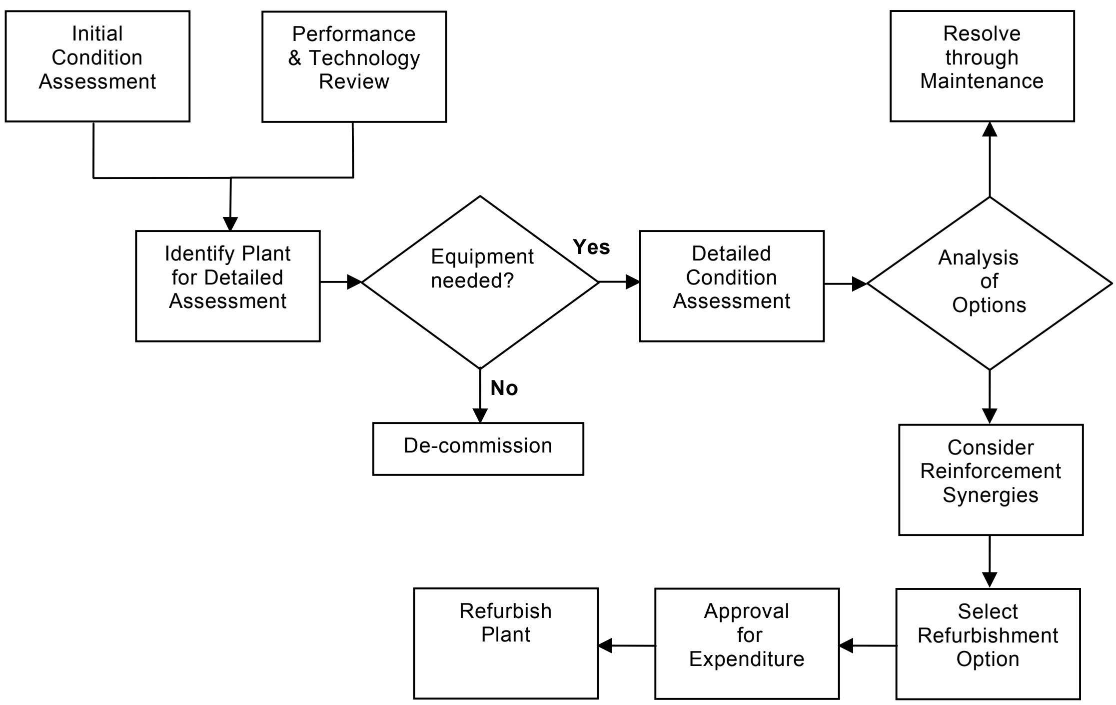


Figure 2-3 Flow Chart of Network Refurbishment Process

Initial Condition Assessment: Most transmission maintenance is condition based. Consideration may be given to a refurbishment programme when regular condition assessments identify that the condition of a significant amount of plant is showing signs of deterioration which would otherwise require costly, special or excessive amounts of maintenance to rectify.

Performance and Technology Review: The performance reviews are undertaken on an ongoing basis and the results are used to identify if a particular asset or a family of equipment type is not performing as well as expected. Technology reviews determine if any of the installed equipment is obsolete or if it is still adequate to provide the necessary performance and able to interact with the rest of the system.

Identify Plant for Detailed Assessment: Input from the first two activities result in the creation of list of plant requiring a detailed assessment of their condition.

Equipment Needed: Before embarking on a detailed assessment program the continued need for the equipment is established.

Detailed Condition Assessment: The detailed assessment of the condition of the relevant asset or plant will identify which individual items of plant, if any, need to be replaced. This could include for example, in the case of overhead lines, the replacement of individual pole-sets, insulators and hardware at selected locations and the replacement or strengthening of selected angle tower foundations. In the case of stations, such a detailed condition assessment would identify the requirement for the replacement of selected items of high voltage plant, protection and control equipment, vintage civil works etc.

Analysis of Options: Based on the detailed condition assessment report the economics and cost-benefit of a full refurbishment project versus a special maintenance project (or enhanced maintenance) will then be considered. Analysis of refurbishment options could include for example, the like-for-like replacement of old switchgear, use of more modern switchgear or the construction of a new station to replace the old one. Following the analysis a decision is made to resolve the problem either through maintenance or through a refurbishment project.

Consider Reinforcement Synergies: Having identified the refurbishment options, an analysis is then carried out to determine if synergies exist between the refurbishment and potential reinforcement projects. In the case of overhead line projects for example, the refurbishment project may provide the opportunity to uprate the line to meet future load requirements. The decision would be based on an assessment of the economics of uprating the line early during the refurbishment works as against uprating later as a stand-alone project. Likewise in station refurbishment projects, the opportunity may be taken to uprate busbars and switchgear or upgrade protection equipment, if economic to do so.

Select Refurbishment Option: The chosen option is determined by factors such as cost, economic trade-off, environmental considerations, system safety, security and reliability. A final scope of work for the selected option is developed and an estimated cost prepared.

Approval of Expenditure: The final scope with estimated costs for the refurbishment project is submitted for internal approval.

Refurbish Plant: Following approval an overall project programme is developed and the project is initiated and the works carried out.

3 Future Network Development Needs

Section 8.1.(c) of Statutory Instrument 60 (2005) requires the TSO "to plan the long term ability of the transmission system to meet reasonable demands for the transmission of electricity". This chapter describes the factors that are expected to drive the need for network development and presents the TSO's assumptions of those drivers:

- Government objectives
- Electricity Demand Forecasts
- Generation
- Interconnection with Other Systems
- All Island Energy Market
- Condition of the Network

The expected impact on the performance of the network of these drivers is summarised in Section 3.7.

3.1 Government objectives

The TSO seeks to take into account national and regional government policy objectives in putting together its Development Plan. There are a number which have a bearing on development needs including policy to support the development of renewables, the furtherance of interconnection and therefore trading opportunities with other jurisdictions and the development of the full potential of each region through the National Spatial Strategy. The impact of these objectives on other drivers is described in the relevant sub-sections below.

As has already been outlined it is a statutory duty for the TSO to support the development of the Irish economy and society by ensuring the network is able to support all reasonable demands for electricity. In addition, it is a requirement for the system operator to enter into agreement for connection with parties seeking to connect to the system under such terms approved by the Commission for Energy Regulation. The TSO seeks to develop the network to ensure it is able to meet both of these commitments, while continuing to have regard to its primary responsibility to operate a safe secure, economic and reliable system that underdevelopment of the network will not affect Ireland's overall economic development either locally or at an aggregate level.

The TSO must also ensure that it protects the interest of the final customer who ultimately pays for any additional investment in the network. If the network is developed in anticipation of future developments which fail to materialise in a timely manner, there would be a degree of what is known as 'stranding' in the assets which would be underutilised but which would still have to be paid for by the existing customer base.

However, given the potentially significant number of renewable generators seeking to connect to the system, and the desire to see that government targets for the penetration of energy from renewable sources are met, the TSO has in some instances as part of the group processing approach accelerated or upgraded current network connections in anticipation of the likely connection of future renewable parties. These works have been carried out where construction at a higher specification is likely to lead to both lower cost and more timely connection in the future. In such instances the regulator has looked favourably on the cost of the advancement of these works being underwritten by transmission use of system (TUoS) until such times as contributions are received from parties seeking to connect. Further details on how the TSO has helped contribute towards the delivery of the government's renewables policy are given in section 3.3.2 under renewable generation.

3.2 Electricity Demand Forecasts

Increasing or changing load demand alters the flow of power on the network, and as such will have an impact on system performance. Reinforcement of the network may be required where future forecast demand levels would otherwise lead to the network performance going outside standards. Demand changes are dealt with in the following categories:

- Generic demand growth
- New demand connections
- Demand reductions
- National Spatial Strategy

3.2.1 Generic Demand Growth

Generic demand growth is the underlying increase occurring typically at all transmission stations resulting from economic growth1. Forecasts of demand growth at a system-wide and local 110 kV station level are prepared each year taking account of

[1] Section 3 of the TSO's *Generation Adequacy Report 2006-2012* explains the correlation between economic performance and electricity demand

new and updated information available. Table 3-1 presents the forecasts of transmission demand for the five years 2006 to 2010. These forecasts of system demand were generated based on predictions of key economic variables and using a proven relationship between electricity demand and these economic variables. These values correspond to the forecasts in *Transmission Forecast Statement 2005-2011.* The forecasting process is described in detail in the corresponding *Generation Adequacy Report* 2005-2011. Both documents are available on www.eirgrid.com.

. Three demand values are presented for each year:

- The annual maximum, also referred to as the winter peak;
- The average summer peak;
- The annual minimum, also referred to as the summer valley.

Table 3-1 Transmission Demand Forecasts, MW

Year	Summer Peak	Summer Valley	Winter Peak
2006	3,789	1,563	4,736
2007	3,940	1,625	4,925
2008	4,098	1,691	5,123
2009	4,256	1,756	5,320
2010	4,412	1,820	5,515

Appendix A lists the forecast demand at each transmission interface station at time of summer peak, summer valley and winter peak for each year of the plan. Transmission interface stations are the points of connection between the transmission system and the distribution system, or directly connected customers.

Demand projections at individual transmission stations are developed from the system demand forecasts on a top-down basis. The forecasting process includes regular monitoring and review of trends in consumption in all parts of the country. The allocation of the system demand forecast to each station is based pro-rata on an up-to-date measurement of actual peak demand at each station. In this way, changes in the geo-diversity of electricity consumption are captured. This process provides a station demand forecast and by extension a regional demand forecast for the short to medium term.

The system-wide demand forecasts, presented in Table 3-1, include transmission losses whereas the individual station demand forecasts do not. Transmission losses therefore account for the difference between the system-wide demand forecasts and the sum of the forecasts at each interface station in Appendix A.

3.2.2 New Demand Connections

Demand connections describe the connections of new large demands at existing or new stations. The demand could be a large industrial plant or a new DSO station.

The DSO develops its plans to reinforce the distribution system to accommodate increasing demands and embedded generation connections. Where the DSO requires new stations or changes in connection methods it submits a connection application to the TSO. The TSO will make a connection offer having considered the implications for the transmission system. Once the connection offer is accepted, the TSO and DSO cooperate in progressing these connection projects through to approval and completion.

Table 3-2 lists the new 110 kV distribution stations that are either in the preliminary design phase, in the public planning process or under construction. Details of the developments required to connect these stations are included in Section 4.

Table 3-2 DSO 110 kV Station Connection Projects

Station	Location
Athy	Athy, Co. Kildare
Ballycummin	Raheen, Co. Limerick
Baltrasna	Ashbourne, Co. Meath
Banoge	Gorey, Co. Wexford
Bunbeg	Na Doire Beaga, Co Dún na nGall
Camus[2]	Camas, Co. An Gailimh
Charlesland	Greystones, Co. Wicklow
Nenagh	Nenagh, Co. Tipperary
Hartnett's Cross	Macroom, Co. Cork
Great Connell (The DSO has indicated that this project is currently under review)	Newbridge, Co. Kildare
Kilmurry	Waterford Port, Co. Kilkenny

In addition, projects are being progressed to provide a second connection to Meath Hill, Thornsberry and Richmond 110 kV stations and to modify the connection at Kilteel 110 kV station.

The DSO has plans for other new 110 kV stations, for which the grid connection project has not yet been initiated. It is likely that some of these stations will be connected within the period of the plan. The potential for future developments arising from these connections is discussed in Section 5.2.

[2] The transmission works at Galway 110 kV station to connect the new Camus 110 kV station have been completed. Completion of the distribution works is outstanding. (In April 2006, an Bord Pleanála refused planning permission for the 110 kV line from Galway to Camus.)

At present there are no signed connection agreements for new demand customers. However, an application for a connection is currently being processed, and if accepted by the customer is likely to lead to a new 110 kV station looped into an existing 110 kV line and associated deep works.

3.2.3 Demand Reductions

Closure of demand facilities can reduce the power flows on lines feeding the load. However, in certain cases, where the demand is absorbing local generation and reducing the amount of generation exported from the area, the closure can lead to increased power flows.

For example, the Unifi factory supplied from Kiltoy station near Letterkenny, Co. Donegal has recently closed. A significant amount of wind generation is connected in north Donegal. While the Unifi closure will relieve the loading on the lines feeding Letterkenny during low wind-generation periods, it will increase the power exported from Letterkenny during periods of high wind-generation. The closure is likely to increase constraints on wind-generation at times of low demand and high wind.

Large customers are required to give 18 months notification of reduction in their maximum load requirements. As of the end of 2005, the TSO has not received notification of any other significant demand reduction from its directly connected customers.

3.2.4 National Spatial Strategy

The National Spatial Strategy (NSS) was published in November 2002. The NSS is a 20 year spatial planning framework covering the entire country. In implementation terms it has been further developed through a series of Regional Planning Guidelines prepared by each Regional Authority. The NSS seeks to ensure that each region grows according to its potential. To ensure this the NSS requires that areas of sufficient scale and critical mass are built up through a network of gateways and hubs, which are supported by development of transport, energy and communications infrastructure. It is not within the scope of the TSO to deliver the NSS – that is a matter for government. However, the TSO seeks to facilitate its delivery through the provision of high quality electrical transmission infrastructure where it is required while continuing to promote national competitiveness for customers currently connected to the system through only developing the system and therefore levying charges at an efficient level.

The Development Plan is based on updated demand forecasts which are derived using the latest information on regional demand shifts. The TSO, therefore, takes account of best estimates of likely growth patterns in determining which of a number of possible transmission solutions ought to be advanced to meet a particular requirement.

3.3 Generation

The network must be capable of transporting the output from generators to demand stations. Because of the relative size of generation it can have a more significant impact on changes to power flows than demand. The largest generator in Ireland is just over 400 MW, which is approximately 9% of peak demand.

The addition of new generation capacity requires network development to connect the new generator to the grid, thus providing a path for the power from the new generator. The new generation capacity will inevitably alter the power flows across the network, potentially creating overload problems deep into the network, leading to the need for reinforcements (known as deep reinforcements) to allow full grid access. Recent experience shows that connection of large generators leads to large-scale deep reinforcements. However, even relatively small generators may require some deep reinforcements. The results of the transfer capability analysis presented in the TSO's *Transmission Forecast Statement 2005-2011* indicate that spare capacity in the network has effectively been used up by generation connections and that at many locations the addition of even small amounts of new generation would require deep reinforcements.

Embedded generation i.e., that connected to the distribution system, is generally smaller than transmission connected plant. However, its impact on the network is practically the same as if the same generation was connected to the transmission system. As such it also changes flows on the network and in certain cases it can cause the network to go outside standards and hence require deep network reinforcement.

The output from existing generators can change for a variety of reasons including: relative market economics, balancing changes in the system demand, generator faults, and closure.

The network has been designed to accommodate existing generators and known additions. These provide reactive power capability to the local network, which assists the system operator to maintain voltages within allowable limits. In certain locations the generation supplies the local demand, thus reducing the import of power from other parts of the network to meet the local demand. Closure of an existing generator, therefore, will remove reactive support and local power infeed. If not replaced by generation with similar active and reactive power capabilities it can lead to the requirement for network reinforcements.

At the end of 2005 some 6,524 MW (net) of generation capacity was installed in Ireland. Of this 6,057 MW is connected to the national grid and a 467 MW is connected directly to the distribution system.

In July 2003, ESB and NIE signed an agreement by which NIE would procure energy and capacity from a power station in Ballylumford, County Antrim and deliver it to ESB over the main interconnector. This contract was terminated as of the end of March 2006. The capacity deliverable under this contract is not included in the installed generation capacity figures quoted above.

The assumptions regarding the changes in generation from 2006 underlying the development plan are dealt with in the following categories:

- New Generation Connections
- Renewable Generation
- Planned Generation Closures

3.3.1 New Generation Connections

Table 3-3 lists the generators, as yet not connected, that have signed agreements for connection to the grid as at the end of April 2006. Capacity values listed are the maximum continuous rating (exported) which may differ from contracted MEC values.

Table 3-3 Future Planned Generation Connections

Generator	Description
Arklow Banks	60 MW offshore wind farm[3]
Athea	51 MW wind farm
Coomacheo	41.2 MW wind farm
Glanlee	30 MW wind farm
Huntstown 2	400 MW CCGT
Moneypoint	21.9 MW wind farm
Mountain Lodge	24.8 MW wind farm
Pallas	37.8 MW wind farm
Ratrussan	70 MW wind farm

Aughinish (150 MW) and Tynagh (382 MW) power stations were connected at the end of November and the end of December 2005 respectively. Coomagearlahy wind farm was connected in March 2006. Taking these together with the generators listed in Table 3-3, a total of 1,311 MW of generation will have been connected to the transmission system between November 2005 and 2010.

At present, a total of 305 MW of wind-generation and a further 7.9 MW of non-wind renewable generation have signed connection agreements with the DSO for connection to the distribution system.

3 This is in addition to the existing distribution connected 25 MW wind farm on the Arklow Banks

In addition to the committed generators, there is potential for development of other generation connections in the period of the plan.

- As of the end of April 2006, offers for wind farm connections totalling 63 MW have been made by the DSO, but not yet accepted. A further 194 applications for wind farm connections totalling 3,072 MW have been received by the TSO and DSO. Up to 1,300 MW of these are likely to be processed under the 'Gate 2' direction proposed by CER.
- Two thermal generators have applied for connection. The TSO's *Generation Adequacy Report 2006-2012* highlights the fact that under a variety of plausible scenarios there will be a requirement for additional generation capacity from 2009.

New generators are only expected to pay the shallow connection costs, i.e. the costs of the plant to directly connect the generator to the grid. Any further strengthening of the network that is required, referred to as deep reinforcement, to integrate the generation is implemented by the TSO and the TAO and the costs are reflected in the transmission tariff to the customers.

3.3.2 Renewable Generation

The Government's Renewable Energy policy, reflecting the RES-E Directive of the European Parliament and Council (Directive 2001/77/EC), sets a target for Ireland of 13.2% of total electricity consumption from renewable sources by 2010. Wind power generation is expected to be the major contributor to this target. This 13.2% target can be achieved with just over 1,000 MW of wind power generation installed by 2010[4]. The figures for wind generation as at the end of April 2006 are:

- Connected wind generation: 579.6 MW
- Signed connection offers: 641.5 MW
- Connection offers issued: 62.6 MW
- Applications in process: 3,071.7 MW

The total for wind farms connected, with signed connection agreements and with live connection offers is 1,284 MW. This figure suggests that the 13.2% target is likely to be surpassed before 2010.

The TSO recognises that there are a considerable number of potential renewable generators waiting to connect to the system. The TSO has facilitated the connection of a greater quantity of renewable plant through the introduction of group processing

4 The other non-wind renewable generation brings the total capacity to the required level of approximately 1,400 MW

and issued a significant number of offers as part of the 'Gate 1' process. The TSO is continuing to work with the CER and industry to ensure that 'Gate 2' offers will also be processed in a timely manner.

Group processing not only allows more plant to connect at a given time but also means the overall cost for the group to connect is likely to be lower given the potential to share connection assets with other interacting applications. However the individual costs per generator plant will vary depending on their relative location. In addition when the TSO specifies connection for new plant the TSO takes into account likely future developments, including the potential for future connections in the area when specifying the connection type and connection assets to be constructed. This means that future connecting parties are likely to be able to connect sooner, and at a lower cost than would otherwise be the case. Meanwhile the original connecting party is assured of paying only the cost of the least cost technically acceptable connection.

3.3.3 Planned Generation Closures

The connection agreements for the peaking units at Aghada and Tawnaghmore run up to the end of 2006. At present the future operation of these two plants is unknown. The Rhode peaking units, which were assumed in the *Transmission Forecast Statement 2005-2011* to retire by the end of 2007, are now expected to remain in service beyond the Plan Period. The CER has advised that these plants should be given non-firm access. They will not, therefore, delay other generation through reservation of network capacity.

In the absence of further notice of plant closures, all other existing generation capacity is assumed to remain in service.

Existing generators are required to give 24 months notice to the TSO for the closure or reduction in output of any generator unit.

3.4 Interconnection with Other Systems

3.4.1 Interconnection with Northern Ireland

The national grid is electrically interconnected with Northern Ireland, which is in turn interconnected with Scotland via the Moyle submarine interconnector. The main interconnector with Northern Ireland connects Louth station to Tandragee in County Armagh. The physical interconnection consists of three 275[5]/220 kV transformers in Louth station, one 600 MVA unit and two ganged[6] 300 MVA units, connected to a

5 The transmission system in Northern Ireland is designed at 275 kV and 110 kV.
6 Connection in parallel through common switchgear.

double circuit 275 kV line from Louth to Tandragee in Northern Ireland. In addition to the main 220/275 kV interconnector, there are two 110 kV connections, one between Letterkenny in County Donegal and Strabane in County Tyrone (NI), and the other between Corraclassy in County Cavan and Enniskillen in County Fermanagh (NI). The purpose of these 110 kV interconnections is to provide support to either system for certain conditions or in the event of an unexpected circuit outage. Phase shifting transformers in Strabane and Enniskillen are used to control the power flow under normal conditions.

In November 2004, the Minister for Communications, Marine and Natural Resources, Noel Dempsey T.D., and his Northern Ireland counterpart, Barry Gardiner MP, Minister for Enterprise, Trade and Investment endorsed plans for a second North-South electricity interconnector. This is intended to form a significant part of the robust infrastructure that is required to meet the needs of the new All Island Single Energy Market and enhance security of supply for consumers.

ESBNG and NIE are working on provision of this second major interconnector which, along with other network developments, will improve transfer capability between the two systems. This project is at an advanced stage after comprehensive joint ESBNG/NIE studies identified a preferred interconnection option at 400 kV located to the west of the existing 275 kV interconnector. The project, identified as CP466, is listed as a Network Reinforcement Project in the preliminary design phase in Section 4.3.1 of this document.

3.4.2 Interconnection with Great Britain

In February 2004, the then Minister for Communications, Marine and Natural Resources, Mr Dermot Ahern TD, announced the intention to develop a project for two 500 MW electrical interconnections between Ireland and Wales. The Minister requested the CER to process the project if possible on a merchant basis. Following a process of testing of the market, the CER concluded that a purely merchant project was unrealistic and that a partly regulated and partly merchant project was a more realistic prospect. In March 2005, the CER appointed a team of consultants led by KPMG to advise it in relation to the optimal design of a competition for such a project. The TSO understands that the decision in relation to the interconnector project is the subject of a submission from the CER to the Minister for the Department of Communications, Marine and Natural Resources and that a decision is expected shortly.

The TSO is co-operating with CER in its considerations and has carried out an analysis of possible deep reinforcements arising from different route and connection options. In addition, the TSO's Transmission Forecast Statement 2005-2011 examined the capacity at various parts of the network along the east and south coasts, for the connection of a 500 MW interconnector to Britain. The analysis indicated that, regardless of where the connection is made, significant deep reinforcements will be required to allow the full 500 MW transfers in both directions.

At present, however, the connection points for the interconnector to Great Britain are unknown. As such, connection projects and associated deep reinforcement projects cannot and have not yet be initiated. The potential for development as a result of the proposed interconnector is therefore dealt with in Section 5.3.1 in Chapter 5.

3.5 All-Island Single Energy Market

The Minister for Communications, Marine and Natural Resources, Noel Dempsey TD, and his Northern Ireland counterpart, Barry Gardiner MP, Minister for Enterprise, Trade and Investment, reaffirmed their respective Governments' commitment to an all-island energy market in November 2004. They jointly released a document entitled "*All-Island Energy Market Development Framework*", which provides the strategic blueprint for creation of an all-island energy market. The current bilateral trading model in Ireland will be replaced by an all-island mandatory pool spot market. Further details can be found on the All Island Project website, www.allislandproject.org.

The new trading arrangements are planned to take effect in July 2007. At this time the interconnectors will effectively become internal circuits in the new market. The new market has the potential to increase the appetite for transfers between the two systems on the island. The current interconnection and the networks in each system could pose a constraint on required transfers. The second interconnector to Northern Ireland, described above in Section 3.4.1, and other planned network developments are expected to alleviate these constraints thus providing increased capacity for transfers between the two jurisdictions.

3.6 Condition of the Network

The transmission network consists of equipment and plant at the voltage levels of 400 kV, 220 kV and 110 kV. There are also two sections of transmission line and three power transformers at the 275 kV voltage level which form part of one of the transmission interconnections with Northern Ireland.

The decision whether to refurbish particular transmission assets is based on detailed condition assessments, as discussed in Section 2.4.2. The age of the assets is one of the contributory factors to the need to refurbish. Other factors include the local environment and the quality, reliability and serviceability of the asset.

The age profile breakdown of the main transmission assets on the system are shown in Table 3-4.

The expected lifespan of a transmission line is of the order of 40 years, after which either major refurbishment or uprating are generally required. The majority of the existing transmission lines were constructed after 1960. A significant amount of the older lines have been refurbished in recent years, leaving a relatively small number of lines dating from pre-1960. The remaining lines that are greater than 40 years old are approaching the age when the TSO would consider the need for their refurbishment. This will be driven by the need to replace conductors, pole-sets and hardware as they deteriorate with age. The focus of line refurbishment is, therefore, likely to be on these old lines; however, the decision to refurbish is condition based.

Table 3-4 Transmission Asset Age Profile [Source: ESB Networks]

Transmission Asset	up to 1960	1960 1969	1970 1979	1980 1989	1990 1999	2000 2004	Total
Overhead lines - circuit (km)							
400kV lines	-	-	-	432.7	-	-	432.7
275kV lines	-	-	21.0	-	-	-	21.0
220kV lines	-	479.8	772.4	300.5	122.1	47.2	1,722.1
110kV lines	1,086.8	999.6	979.6	422.2	208.6	343.1	4,039.9
Total: -	**1,086.8**	**1,479.4**	**1,773.0**	**1,155.4**	**330.7**	**390.4**	**6,215.7**
Underground cables - circuit (km)							
400kV cables	-	-	-	1.8	-	-	1.8
220kV cables	-	-	45.3	16.2	14.7	26.8	103.0
220kV cables (sub-marine)	-	-	2.6	-	-	-	2.6
110kV cables	-	4.3	5.5	1.8	2.8	-	14.5
Total: -	**-**	**4.3**	**53.4**	**19.7**	**17.5**	**26.8**	**121.9**
Switchgear (units)							
400kV substation bays	-	-	-	17	-	3	20
275kV substation bays	-	1	1	-	-	1	3
220kV substation bays	-	25	38	57	15	48	183
110kV CB (GIS)	-	-	-	4	6	8	18
110kV CB - other	25	99	93	74	136	162	589
110kV Isolators	26	263	319	198	294	378	1,478
Total: -	**51**	**388**	**451**	**350**	**451**	**600**	**2,291**
Transformers (units)							
400/220kV transformers	-	-	-	3	-	1	4
275/220kV transformers	-	1	1	-	-	1	3
220/110kV transformers	-	6	12	2	5	13	38
Total: -	**-**	**7**	**13**	**5**	**5**	**15**	**45**
Capacitors (units)							
110kV Capacitors	-	-	-	-	3	24	**27**
Total: -	**-**	**-**	**-**	**-**	**3**	**24**	**27**

The transmission lines that have been approved for refurbishment are listed in Section 4.1.4 and the lines identified for possible refurbishment in the near future are listed in Section 5.3.8. As the condition monitoring of the transmission lines is an ongoing process it is possible that other lines may be identified for refurbishment before the end of the Plan Period.

The majority of the station plant and equipment was installed between 1970 and 2000. It is not expected that any transformers will have to be replaced due to poor condition or because of excessive overloading.

Provided there has not been excessive operation of the switchgear there should only be limited amount of replacement required due to poor condition. However, switchgear equipment may need to be replaced to provide higher breaking current capability where new generators increase the short circuit current levels, or higher rating where demand levels have increased. These types of replacement projects would be considered reinforcements rather than refurbishment projects.

The refurbishment of station plant and equipment will be driven in part by the need to upgrade the control, instrumentation, protection and telecommunications equipment within the station to leverage increased opportunity provided by modern SCADA systems. These types of equipment and software have a much shorter lifespan as the technology advances and therefore more refurbishment projects can be expected to emerge in the Plan Period.

3.7 Implications of Drivers for Network Development

The drivers described in the previous sections indicate that the demands made on the transmission network are set to increase significantly over the period of the plan.

The peak electricity demand forecasts presented in Table 3-1 represent a 20% increase for the period up to 2010. Analysis of system performance, based on the assumption that planned reinforcements are completed as expected, has shown that this demand increase will generally use up capacity in many areas, which would lead to breaches of voltage, thermal line loading and security standards if developments were not undertaken.

As of the end of 2005, there is 779 MW of generation with signed connection agreements with the TSO. Combined with the 532 MW of new thermal generation connected at the end of 2005 this represents an increase of over 20% in transmission connected generation capacity by 2010. It is important to note that the new generation capacity does not correspond in size or location with the forecast demand increases. This is likely to increase network power flows. In particular, the connection of the large thermal units at Tynagh and Huntstown will create a significant increase in generation connected in Dublin and on the 400 kV network. This will stress the paths for power flows from this group of generators to the demand blocks in the west and the south-west.

Connection of generation in the south-west will stress the 110 kV lines in that area, particularly the 110 kV lines between Tarbert and Clashavoon 220 kV stations. Further connections expected in this area are likely to give rise to significant development requirements.

The TSO's *Transmission Forecast Statement 2005-2011* included an analysis of the capacity in the network for new generation. The results indicated that deep reinforcements would be required to accommodate the connection of large generators in most locations and smaller generators in many of the locations examined.

In addition to the wind farms connected or committed to connect, there are a large amount of wind farm applications in the connection process. A large penetration of wind-generation in any one part of the network will create a number of challenges for network development. The network must be developed to accommodate output from the wind-farms when wind is blowing and also to serve demand when it is not since the output of all the wind-farms in an area are affected by the level of wind in that particular area. Thus the network performance must be examined against a greater range of possible generation profiles. As wind penetration increases the level of development required to integrate wind is expected to increase.

An All Island study is currently being scoped to investigate the implications and consequences of large scale penetration of renewable energy on the island of Ireland. The results of this comprehensive study, when completed, will highlight what further network development is required to facilitate large penetration of wind generation and other types of renewable energy. The Department of Communications, Marine and Natural Resources and the Department of Enterprise Trade and Investment in Northern Ireland are developing a joint policy for All Island Renewables up to 2020. When the targets for wind generation and the staging of those targets are decided, the TSO can and will develop the necessary plans to accommodate it.

The *Transmission Forecast Statement 2005-2011* included an analysis of the ability to connect a 500 MW DC interconnector to Britain. The results of the analysis showed that none of the likely connection points could accommodate the interconnector without additional reinforcements. The addition of two 500 MW interconnectors with Britain will lead to a potential range of 2,000 MW transfers (i.e., +/- 500 MW on each tie). In conjunction with the possibility of wind generation being off or close to full load, this creates more complex and uncertain conditions under which the network must perform.

4 Planned Network Developments

The network development planning process for the transmission network followed by the TSO was outlined in Section 2.4. This chapter presents and discusses the network development projects that the TSO has progressed to the point where they are the preferred option to meet the changing system requirements in the context of the long-term development of the network. The development projects are presented in three sub-sections under the following headings:

- Developments in the Detailed Design and Construction Phase
- Developments in the Public Planning Process
- Developments in the Preliminary Design Phase

Within each sub-section development projects are listed in separate tables, categorised as appropriate by the main development drivers as follows:

- Network Reinforcements
- DSO Connections
- Generator Connections
- Refurbishments
- Line Alterations and Diversions

The tables present the following project information:

- Capital Project number (CP No.) – each project is referenced with a Capital Project number for coordination between the TSO and TAO;
- Project Description provides a project title and a brief description of the works involved;
- Major New Equipment – a high level equipment list where appropriate describing the new transmission assets (e.g. bays, km line, etc.) added to the network on completion of the project (not provided for refurbishment projects where no new assets are added);
- Reason for Development – a brief description of the reason for the network development projects (omitted for DSO and Generator connections, where the reason for the development is in all cases the connection);
- Expected Completion Date (E.C.D.) – the estimates provided are subject to the planning process where applicable, the construction progress, availability of transmission outages and commissioning and may be liable to change.

- Expected Start Date (E.S.D.) – this is the date the project could enter the detailed design and construction phase, and is provided for projects not yet in this phase. The date estimate is subject to the public planning process and construction start-up and may be liable to change.

A map in Appendix B illustrates the location of the larger network development projects.

4.1 Developments in the Detailed Design and Construction Phase

This section presents the projects that have received public planning permission where appropriate and are under construction or at the initial stage of procurement and engineering design.

4.1.1 Network Reinforcements

Table 4-1 lists the Network Reinforcement projects driven by demand growth and deep reinforcements for generator, demand and interconnector connections, which are in the construction phase. Appendix C presents more detailed information for the larger network reinforcement projects.

Table 4-1 Network Reinforcement Projects in the Detailed Design & Construction Phase

CP No	Project Description	Major New Equipment	Reason for Development	E.C.D.
CP061	Kilteel-Maynooth-Newbridge 110 kV line Uprate: This line has been refurbished and uprated. Replacement of droppers and CTs remains to be completed in 2006.	Uprated 110 kV line: 45 km	This line has previously been uprated and the replacement of the droppers and CTs will enable the full uprated thermal level to be utilised.	Oct-06
CP122	Tarbert 110kV works: The 110 kV bays at Tarbert station are to be upgraded with the installation of a new busbar protection scheme.	10 upgraded 110 kV bays	The upgrade of the 110 kV bays are required as part of the integration of new generation in the area.	Oct-06
CP129	Aughinish-Moneteen 110 kV line Uprate: This line has recently been refurbished and re-conductored from 200 mm^2 to 425 mm^2 ACSR at 80°C. Minor works are still outstanding, to be completed in 2006.	Uprated 110 kV line: 27 km	Following connection of generation the rating of the Aughinish-Moneteen 110 kV line would be insufficient under trip maintenance conditions.	Completed

CP No	Project Description	Major New Equipment	Reason for Development	E.C.D.
CP184	Aghada-Raffeen 220 kV circuit: The new 220 kV circuit consisting of a section of cable and a section of overhead line.	220 kV bays: 2 220 kV cable: 7km 220 kV line: 8 km	This is necessary to ensure a reliable supply of electricity to Cork city and harbour area.	Oct-09
CP211	Srananagh 220 kV Station and Line: A new Srananagh 220/110 kV station connected by a new 220 kV line to Flagford 220 kV station; A 250 MVA 220/110 kV transformer installed at the station; The Cathaleen's Fall–Sligo 110 kV line looped into the new Srananagh station to form the Sligo-Srananagh 110 kV line and the Cathaleen's Fall–Srananagh No.1 110 kV line; The Cathaleen's Fall–Corderry 110 kV line looped into the new Srananagh station to form the Corderry-Srananagh 110 kV line and Cathaleen's Fall–Srananagh No.2 110 kV line; A second line from Sligo to Srananagh constructed at 110 kV.	220 kV Station: 250MVA Trfr: 1 220 kV bays: 2 110 kV bays: 7 Bays in other stations: 220 kV bays: 1 110 kV bays: 1 New Lines: 220 kV: 55 km 110 kV: 49 km	This development is needed to reinforce the network in the North-West area by supporting the voltage and reducing the risk of loss of supply during the winter peaks and the summer maintenance outages.	Dec-06
CP216	Completion of Corduff 220 kV Station Project Installation in Corduff 220 kV station of the second 220/110 kV 250 MVA transformer. Looping of the College Park-Mullingar 110 kV line into Corduff station.	220kV bays: 1 110kV bays: 3 250MVA Trf : 1 110 kV line: 1 km	This is the final phase of the Corduff 220 kV Project, a new 220 kV station in the north Dublin area. The project provides the required capacity to meet continuously increasing demand in the area	Completed
CP217	Newbridge loop-in of the Blake-Cushaling-Maynooth 110 kV line: Looping of the Blake–Cushaling–Maynooth 110 kV line into Newbridge 110 kV station, creating the Cushaling–Newbridge and Blake–Maynooth–Newbridge 110 kV lines.	110 kV bays: 2 110 kV line: 20 km	To improve the quality of supply to the 110 kV stations in this area by preventing low voltages and line overloads under certain contingencies.	Dec-07
CP246	Tarbert-Tralee No.2 110 kV line: A second line from Tarbert to Tralee constructed at 110 kV.	110 kV bays: 2 110 kV line: 47km	This is needed to overcome 110 kV line overloads and voltage collapse in the Tralee area. The final completion date is currently under review.	Mar-07
CP257	Great Island-Waterford No.1 & 2 110 kV lines – Uprate of River Crossing The two 110 kV lines have already been refurbished and re- conductored except for the double-circuit section crossing the River Suir. This project is to complete that crossing with 425 mm^2 ACSR. This is expected to be completed in 2006.	River Crossing Section only uprated 110 kV line: 2 km	The refurbishment was identified following a detailed condition assessment of the two circuits which required the replacement of the old conductor. The line ratings were increased to improve the performance of the network in this area under certain contingency conditions.	Sep-06

CP No	Project Description	Major New Equipment	Reason for Development	E.C.D.
CP330	Cow Cross-Whitegate 110kV line Uprate: This line is being uprated from 40°C to 80°C as a result of a complete line refurbishment project.	Uprated 110 kV line: 18 km	The poles and suspension hardware of this line were in poor condition and are being replaced as part of a refurbishment project. As a result of the new poles the height of the line has been increased and the thermal rating has been increased from a template temperature of 40^{0}C to 80^{0}C.	Completed
CP357	Carrigadrohid Station connection: A new switching station connected into the existing Kilbarry-Macroom 110 kV line; connection of the Carrigadrohid generation station to this new switching station and disconnection of the existing teed connection to the Inniscarra-Macroom 110 kV line.	110 kV bays: 3 110 kV line: 5 km	The existing connection arrangement for Carrigadrohid generation station using a solid Tee is temporary and can not be utilised on a long term basis because of protection requirements and operational concerns.	Jun-06
CP369	Corduff-Drybridge 110kV Line Uprate: This line has recently been re-conductored from 200 mm^2 to 425 mm^2 ACSR at 80°C. The replacement of the CTs and busbar at Drybridge 110 kV station is required to complete the project.	Uprated 110 kV line: 37 km	A detailed assessment found that the conductor was showing signs of severe internal corrosion and recommended that it should be replaced. This uprate will help reduce the limitations on the NI interconnection transfer capabilities.	Oct-06
CP372	Knockearagh-Oughtragh-Tralee 110 kV line Uprate: Re-conductoring and uprating of this line from 200 mm^2 to 425 mm^2 ACSR at 80°C.	Uprated 110 kV line: 45 km	Assessment of the line showed signs of severe internal corrosion requiring the replacement of the conductor. This uprate improves the power transfer capability in the area.	Oct-06
CP405	Cashla 3rd 220/110 kV transformer. Installation in Cashla 220 kV station of a third 220/110 kV transformer and a 220 kV coupler.	220 kV bays: 2 110 kV bays: 1 250MVA Trfr: 1	Following the connection of new generation a new 250 MVA 220/110kV transformer is required at Cashla 220kV station. (Because of an urgent need for greater transformer capacity the new 250 MVA transformer was installed into one of the existing 175MVA 220/110kV transformer bays. The old 175 MVA transformer will now be installed into the new bay)	Completed
CP419	Corduff-Platin 110 kV line Uprate: Re-conductoring of this line from 200 mm^2 to 425 mm^2 ACSR at 80°C. The replacement of the CTs at Platin 110 kV station is required to complete the project.	Uprated 110 kV line: 37 km	Under certain contingency conditions the existing line could be overloaded by more than 10%. This uprate will help reduce the limitations on the NI interconnection transfer capabilities.	Oct-06

CP No	Project Description	Major New Equipment	Reason for Development	E.C.D.
CP426	Tarbert Neutral Reactor: Reactors installed on each of the 110 kV neutral points of the two 220/110 kV transformers in Tarbert 220 kV station.	Neutral earth Reactor: 2	The neutral earth reactors are required to limit short-circuit currents in the Tarbert area to a safe level.	Jun-06
CP428	Maynooth 4th 220/110 kV transformer and 110 kV coupler: A fourth 220/110 kV transformer, rated at 250 MVA, and a third 110 kV busbar coupler installed in Maynooth 220/110 kV station. This will enable the station to be sectionalised.	220 kV bays: 1 110 kV bays: 2 250MVA Trfr: 1	The ability to sectionalise the station at Maynooth is required to limit short-circuit currents in the area to a safe level and provide flexibility to alleviate line and transformer overloads during certain contingency conditions.	Completed
CP429	Poolbeg 220 kV Interbus Reactor: A new 450 MVA series reactor installed in the 220 kV busbar at Poolbeg between the connections to North Wall and Shellybanks and the rest of the station.	220kV bays: 2 450 MVA Reactor: 1	The series reactor at the 220 kV busbar at Poolbeg is part of the plan to limit short-circuit currents in the area to a safe level. The high fault levels are as a result of the connection of new generation and the increasingly interconnected network in the Dublin area. Shellybanks station will be sectionalised with units PB14 and PB16 connected to Irishtown and unit PB15 linked to Poolbeg via the new reactor.	Oct-07

4.1.2 DSO Connections

Table 4-2 lists the development projects in the Detailed Design & Construction Phase that relate directly to the connection of new TSO/DSO interface stations to the grid, or to changes in existing DSO connection arrangements. Deep reinforcements required as a result of the connections are listed in Table 4-1.

Table 4-2 DSO Connection Projects in the Detailed Design & Construction Phase

CP No.	Project Description	Major New Equipment	E.C.D.
CP138	New 110 kV Bay at Killonan station: A new 110 kV bay constructed at Killonan station to facilitate the tail connected DSO 110 kV connection to a new DSO 110 kV station at Nenagh.	110 kV bays: 1	Dec-06
CP173	Banoge 110 kV Station: The existing Arklow–Crane 110 kV line looped into a new Banoge 110 kV station, creating new Arklow–Banoge and Banoge– Crane 110 kV lines.	110 kV station 110 kV bays: 4 110 kV line: 6 km	Oct-06

CP No.	Project Description	Major New Equipment	E.C.D.
CP201	Athy 110 kV Station: The existing Carlow–Portlaoise 110 kV line looped into a new Athy 110 kV station, creating new Athy–Portlaoise and Athy–Carlow 110 kV lines.	110 kV station 110 kV bays: 4 110 kV line: 12 km	Dec-06
CP205	New 110 kV Bay at Lanesboro station: A new 110 kV bay constructed at Lanesboro station to facilitate a second 110 kV line to the existing DSO station at Richmond.	110 kV bays: 1	Completed
CP403	Baltrasna New 110 kV Station: The existing Corduff-Drybridge 110kV line looped into a new Baltrasna 110 kV station near Ashbourne in Co Meath, creating the new Baltrasna-Corduff and Baltrasna-Drybridge 110 kV lines.	110 kV bays: 4 110kV line: 1 km	Dec-07

4.1.3 Generator Connections

Table 4-3 lists the development projects in the Detailed Design & Construction Phase that relate directly to connection of generation to the transmission system or to changes in existing generation connection arrangements. Some of these connections are contestable, i.e. the generator has decided to build the connection assets to TSO specified standards. The Estimated Completion Date (E.C.D.) is the TSO’s current best estimate of when the generation connection will be completed. It should be noted that this is dependent on progress by the applicant. The date of completion for these projects is coordinated with the IPP programme of connection.

Table 4-3 Generator Connection Projects in the Detailed Design & Construction Phase

CP No.	Project Description	Major New Equipment	E.C.D
CP294	IPP38 Arklow Bank Connection: New IPP built off-shore Arbank 110 kV station and undersea cable to Arklow 110 kV station for the Arklow Banks offshore wind farm. A new gas insulated switchgear (GIS) 110 kV bay is to be provided in the existing Arklow 110 kV station. Note: It is anticipated that this connection may be delayed until 2009/10. The TSO is awaiting formal notification in this regard.	110 kV bays: 1 (GIS)	Dec-07
CP341	IPP38C Ratrussan: New IPP built Ratrussan 110 kV station will be located directly underneath and connected to the existing Louth-Shankill 110 kV line for the connection of the Ratrussan wind farm.	110 kV station 110 kV bays: 4	Jan-07

CP No.	Project Description	Major New Equipment	E.C.D
CP343	IPP42 Mountain Lodge: An additional 110 kV bay will be included in the new IPP built Ratrussan 110 kV station (see CP341 above) for the connection of the Mountain Lodge wind farm.	110 kV station 110 kV bays: 1	Jan-07
CP389	IPP28C Huntstown Phase 2: A new underground 220 kV cable will be installed to connect the new Huntstown Phase 2 400 MW CCGT generator unit to the Corduff 220 kV station.	220 kV bays: 2 220 kV cable: 5 km	Nov-06
CP397	IPP51A Moneypoint: An existing 110 kV bay at Moneypoint 400 kV station will be refurbished to facilitate the IPP connection of a new wind farm.	Refurbished 110 kV bay	Dec-08
CP435	IPP48 Coomagearlahy: A new 110 kV station will be built to facilitate the connection of Coomagearlahy wind farm. The Coomagealahy station will be connected to the grid via a 15 km cable to Clonkeen 110 kV station.	110 kV station 110 kV bays: 3 110 kV cable: 15 km	Mar-06
CP475	IPP90 Glanlee: A new 110 kV station will be built to facilitate the connection of Glanlee wind farm. The Glanlee station will be connected into the new Coomagearlahy 110 kV station by a 3 km 110 kV cable.	110 kV station 110 kV bays: 3 110 kV cable: 3 km	Oct-06

4.1.4 Refurbishments

Table 4-4 lists the station and line refurbishment projects that are currently in the Detailed Design and Construction Phase.

Table 4-4 Refurbishment Projects in the Detailed Design & Construction Phase.

CP No.	Project Description	Reason for Development	E.C.D.
CP100a	Trabeg Station: Marina 110 kV line bay Circuit Breaker replacement	Replacement of the circuit breaker at Trabeg station in the Marina 110 kV line bay is required to increase the short circuit capability to a safe level.	Sep-06

CP No.	Project Description	Reason for Development	E.C.D.
CP100c	Cashla Station: Prospect 110 kV line bay Circuit Breaker replacement	Replacement of the circuit breaker at Cashla station in the Prospect 110 kV line bay is required to increase the continuous current rating capability to a safe level.	Sep-06
CP100d	Replacement of Overfluxing Relays	The obsolete transformer overfluxing relays at Dunstown, Moneypoint and Woodland stations are to be replaced as part of a technology upgrade programme.	Sep-06
CP157	Bellacorick 110kV Station refurbishment	The closure of the power station on site necessitated the replacement of relays and control equipment to transfer the control functions to a new Control Room. The majority of the works are complete and only minor works and the new security fence are to be completed in 2006.	Dec-06
CP192	Kilbarry 110 kV Station refurbishment	The project involves the replacement of obsolete protection, control and telecommunications equipment as part of a technology upgrade programme. A new Control Room and the replacement of the HV equipment are included in this project. Most of the work has been completed. Only 3 transformer bays, 1 line bay and 1 coupler bay need to be refurbished in 2006 to complete the project.	Oct-06
CP203	Cahir 110 kV Station refurbishment	The project involves the replacement of all the obsolete protection, control and telecommunications equipment in the station as part of a technology upgrade programme. The HV equipment dating back to the 1960s will also be replaced. The project is expected to be completed in 2006.	Sep-06
CP213	Knockraha 220 kV Station refurbishment	Due to the age and condition of the existing station a full refurbishment of the entire station was undertaken. The replacement of all the HV equipment was included in this project. A new Control Room was constructed and all the relays and control equipment was replaced. Most of the work has been completed. One 220kV line bay needs to be refurbished in 2006 to complete the project.	Apr-07
CP219	Binbane-Cathaleen's Fall 110 kV line refurbishment (34 km)	The pole-sets, hardware insulators and other miscellaneous items were replaced as part of the refurbishment project. This project is almost complete and only 4 pole-sets remain to be upgraded in 2006.	Dec-06
CP225	Shannonbridge 220/110kV Station refurbishment	The closure of the old power station on site necessitated the replacement of relays and control equipment to transfer the control functions. Due to the age and condition of the existing station a full refurbishment of the entire station is required.	Dec-08
CP322	Protection Upgrades	The obsolete protection equipment at various stations will be replaced as part of an ongoing refurbishment programme.	2006 to 2008

CP No.	Project Description	Reason for Development	E.C.D.
CP331	Carlow-Portlaoise 110 kV Line refurbishment (40 km)	The line which was in poor condition was refurbished by replacing the pole-sets, hardware insulators and other miscellaneous items where required. This project is almost complete with one pole set remaining to be refurbished in 2006.	Sep-06
CP346	Disturbance Recorders	The installation of disturbance recorders will be done at various stations to improve the instrumentation capabilities at the stations and gain better knowledge of the system and its behaviour.	2006 to 2008
CP368	Raffeen-Trabeg 110 kV line refurbishment (12 km)	The existing line which is in poor condition is to be refurbished by replacing the conductor with like-for-like as well as upgrading the pole-sets hardware insulators and other miscellaneous items where required. This project is expected to be completed in 2006.	Sep-06
CP373	Arigna-Carrick on Shannon-Corderry and Corderry-Cathaleen's Fall 110 kV Lines refurbishment (57 km)	These lines, which formed the Arigna–Carrick on Shannon–Cathaleen's Fall line prior to the connection of Corderry, are in poor condition and are to be refurbished by replacing the conductor "like-for-like" as well as upgrading the pole-sets where required. This project is expected to be completed in 2006. (Note that the Cathaleen's Fall-Corderry line will be looped into Srananagh 220 kV station as listed in Table 4-1. Only the old section of line will be refurbished.)	Oct-06
CP381	Portlaoise-Shannonbridge 110 kV refurbishment (67 km)	The existing line is in poor condition and the line is to be refurbished by replacing the pole-sets, hardware insulators and other miscellaneous items where required. This line refurbishment project is almost complete with only 10 pole-set remaining to be refurbished in 2006.	Sep-06
CP400	Remote Control Upgrade	This project involves the installation of new SCADA facilities in the Maynooth, Cathleen's Fall, Pollaphuca and Newbridge stations to improve the remote control capabilities.	Dec-06
CP465	Mallow Station: Kilbarry 110 kV Line bay refurbishment	The obsolete relay equipment in this line bay will be replaced as part of a technology upgrade programme.	Sep-06
CP476	Woodland 500 MVA transformer Repair	The 500 MVA 400/220 kV transformer suffered a failure in 2005. The windings and bushings will be replaced and the refurbished transformer installed and commissioned back at Woodland station.	Dec-06
CP484	Steel Structures Life Extension	The painting of steel structure at various locations across the country will be undertaken as part of life extension programme.	Dec-07

4.1.5 Line Alterations and Diversions

Table 4-5 lists the Transmission Line Alteration and Diversion projects that are currently in the Construction Phase. These projects relate to minor line works on existing transmission lines to facilitate road development and third party developments.

Table 4-5 Line Alterations & Diversions in the Detailed Design & Construction Phase

CP No.	Project Description	Reason for Development	E.C.D.
CP439	Dunstown - Moneypoint 400kV line alteration	The 400 kV transmission line to be raised as a result of the N7 road extension. Six taller towers are to be installed to achieve this.	Jul-06
CP441	Drybridge - Platin 110kV line diversion at Rathmullen	Developments in this area have necessitated the line to be diverted. Four towers are required for this diversion project.	Dec-06
CP447	Drybridge-Navan 110 kV line diversion at Tullyallen	Developments in this area have necessitated the line to be diverted. Three towers and eleven pole-sets are involved in this project.	Sep-06
CP448	Carrickmines-Dunstown 220kV Cable at Stepaside	A major development in the area has necessitated the installation of a 2 km section of cable plus the interface compound and station works required to integrate the cable into the existing transmission line.	Sep-06
CP457	Kilbarry-Marina Nos. 1 & 2 110 kV lines diversion	Developments in this area have necessitated the line to be diverted. Four double circuit towers are required for this diversion project and will commence once agreement is reached with all concerned parties.	Jul-06
CP472	Arklow-Great Island 220kV line alteration at Ballyfad	This 220 kV line is required to be raised to facilitate a development in the area. One additional 220kV tower is needed to raise the line to the required height.	Sep-06
CP480a	Cashla-Ennis/Cashla Galway/Cashla Shannonbridge 110 kV line diversion	Developments in the Cashla area have resulted in the requirement for these three 110 kV lines to be diverted. This project requires the installation of five angle towers and 20 pole-sets.	Dec-06
CP480c	Flagford-Sligo 110 kV line diversion	Developments in this area have necessitated the line to be diverted. Three towers are required for this diversion project.	Sep-06
CP480d	Cashla-Ennis 110 kV line diversion	Developments along the route of this transmission line require the line to be diverted. The project involves the installation of three towers and four pole-sets.	Dec-06

CP No.	Project Description	Reason for Development	E.C.D.
CP480f-1	Maynooth-Ryebrook and Dunfirth-Kinnegad-Rinwade 110 kV lines diversion	Developments in the Maynooth area have resulted in the requirement for these two 110 kV lines to be diverted. The project consists of three double circuit towers.	Sep-06
CP480g-1	Aghada-Whitegate 110 kV line	Developments along the line route of this transmission line have required the line to be diverted. The project involves the installation of three mono-pole towers, but the final design details are yet to be completed.	Dec-06

4.2 Developments in the Public Planning Process

This section lists the projects or developments that have been approved at the appropriate level internally and have entered the public planning process. There are no projects in this phase for this development plan for the 'Generator Connections', 'Refurbishments' and 'Line Alterations and Diversions' categories.

Because of the uncertainties inherent in the public planning process, the dates and the scope of these projects is subject to change.

4.2.1 Network Reinforcements

Table 4-6 lists the Network Reinforcement projects, driven by demand growth and deep reinforcements for generator, demand and interconnector connections. Appendix C presents more detailed information for the major network reinforcement projects.

Table 4-6 Network Reinforcement Projects in the Public Planning Process

CP No	Project Description	Major New Equipment Estimates	Reason for Development	E.S.D. - E.C.D.
CP254	Cashla loop-in of the Dalton-Galway 110 kV line: Looping of the Dalton–Galway 110 kV line into the Cashla station, creating the Cashla–Dalton line and the Cashla–Galway No. 4 110 kV line.	110 kV bays: 2 110 kV line: 25 km	To avoid overloading the existing Cashla-Galway 110 kV lines during certain contingencies by removing the Dalton load connection and providing an additional circuit into Galway.	Dec-06 - Dec-08

CP No	Project Description	Major New Equipment Estimates	Reason for Development	E.S.D. - E.C.D.
CP421	Binbane-Letterkenny 110 kV line: A new 110 kV line between Binbane 110 kV station and Letterkenny 110 kV station, in County Donegal; this new line looped into a new 110 kV switching station, east of Glenties.	110 kV bays: 4 110 kV line: 65 km	The DSO has requested a second 110 kV connection to Binbane. The Binbane-Letterkenny line meets the DSO's needs while facilitating generation exports from Donegal during low demand periods and meeting the increasing electricity demand in the area.	Dec-06 - Dec-09

4.2.2 DSO Connections

Table 4-7 lists the DSO Connection projects that are in the Public Planning Process. These projects relate directly to connections of new TSO/DSO interface stations to the transmission system, or changes in existing DSO connection arrangements.

Table 4-7 DSO Connection Projects in the Public Planning Process

CP No.	Project Description	Major New Equipment Estimates	E.S.D. - E.C.D.
CP075	Ballycummin 110 kV station: Looping of the existing Limerick-Rathkeale 110 kV line into a new Ballycummin 110 kV station.	110kV bays: 4 110kV line: 1 km	Mar-05 - Dec-06
CP421 (Part b)	Bays for 110 kV DSO link to Derrybeg: A new 110 kV switching station east of Glenties in County Donegal will be established as part of the project CP421 as listed in Table 4.6 above. Also included in this project are two 110 kV line bays for new DSO 110 kV lines to the DSO station at Derrybeg. The DSO have advised that the timing of the two DSO 110 kV lines may be phased.	110kV bays: 2	Mar-05 - Dec-06

4.3 Developments in the Preliminary Design Phase

This section lists the projects or developments that have been approved at the appropriate level internally and are at the preliminary design stage.

There are no projects in this phase for this development plan for the 'Generator Connections' and 'Line Alterations and Diversions' categories.

The project descriptions provided here are the TSO's current best estimates. However, because they are still in the preliminary design phase they are liable to change.

4.3.1 Network Reinforcements

Table 4-8 lists the Network Reinforcement projects, driven by demand growth and deep reinforcements for generator, demand and interconnector connections.

Table 4-8 Network Reinforcement Projects in the Preliminary Design Phase.

CP No	Project Description	Major New Equipment Estimates	Reason for Development	E.S.D. - E.C.D.
CP197	Cushaling-Thornsberry 110 kV line: Construction of a new Cushaling-Thornsberry 110 kV line as a second connection to Thornsberry 110 kV station.	110 kV bays: 2 110 kV line: 30 km	The DSO has requested a second 110 kV line to the DSO station at Thornsberry to improve the security of supply.	Dec-07 - Dec-09
CP218	Gorman-Navan No. 3 110 kV line: A third line from Gorman 110 kV station to Navan 110 kV station will be constructed.	110 kV bays: 2 110 kV line: 5km	To alleviate unacceptable overloads of the Arva-Navan 110 kV line in 2010 and either of the existing Gorman-Navan 110 kV lines from 2012 under certain contingencies.	Dec-09 - Dec-10
CP241	Lodgewood 220kV Station: A new Lodgewood 220/110 kV station in county Wexford, connected into the Arklow–Great Island 220 kV line, and linked with a new Crane–Lodgewood 110 kV line, through a 250 MVA 220/110 kV transformer.	220 kV bays: 3 110 kV bays: 3 250MVA Trfr: 1 220 kV line: 1 km 110 kV line: 10 km	To provide support to the 110 kV network in this area and by preventing low voltages and line overloads under certain contingencies.	Oct-06 - Oct-08
CP250	Castlebar-Tonroe 110kV line: A new Castlebar-Tonroe line constructed at 220 kV and operated at 110 kV.	110 kV bays: 2 220 kV line: 60 km (energised at 110 kV)	To alleviate unacceptable overloads of the Cunghill - Sligo 110 kV line in 2011 and other lines in the area from 2012 during certain contingencies. The line also forms part of a long term development to introduce 220 kV to support future load growth.	Apr-08 - Oct-10
CP261	Athlone-Shannonbridge No. 2 110 kV line: A second 110 kV line constructed between Athlone and Shannonbridge 110 kV stations.	110 kV bays: 2 110 kV line: 25 km	To alleviate unacceptable voltages at Athlone and overloading of the existing Athlone-Shannonbridge 110 kV line under contingency conditions.	Dec-07 - Dec-10
CP292 a	Gorman-Meath Hill 110 kV Line: A second 110 kV line will be constructed between Gorman and Meath Hill 110 kV stations.	110 kV bays: 2 110 kV line: 30 km	The DSO has requested a second connection to Meath Hill 110 kV station.	Jun-07 - Dec-09

CP No	Project Description	Major New Equipment Estimates	Reason for Development	E.S.D. - E.C.D.
CP374	Arva-Shankill No. 2 110 kV Line: A second 110 kV line constructed between Arva and Shankill 110 kV stations.	110 kV bays: 2 110 kV line: 20 km	To alleviate unacceptable overloads of a number of 110 kV lines in the area for certain contingency conditions. This reinforcement is associated with generation connection.	Jun-06 - Dec-08
CP399	Moneypoint-Tarbert 400 kV circuit: A new submarine cable constructed across the Shannon Estuary from Moneypoint in Co. Clare to Tarbert in north Co. Kerry.	400 kV bays: 3 220 kV bays: 1 500MVA Trfr: 1 400kV cable: 10 km	To provide an alternative route for power into the south west as well as an additional link between the 400 kV and 220 kV networks.	Nov-07 - Nov-09
CP466	Second NI Interconnector: Construction of a second north-south interconnector circuit at 400 kV between Northern Ireland and a new station in Co. Cavan. (See project CP469 regarding this station.)	400/220 kV 500MVA Trfr: 1 400 kV line: 60 km	To increase transfer capacity between the two systems in both directions and avoid situations where a single event could lead to system separation.	Dec-09 - Dec-12
CP468	New 400/220 kV Station in the Nenagh area: Construction of a new 400/220 kV station, near Nenagh in County Tipperary, connected into the Dunstown-Moneypoint 400 kV line; looping of the existing Killonan-Shannonbridge 220 kV line into the new station to form the Nenagh-Shannonbridge and Nenagh-Killonan 220 kV lines; uprating of the Nenagh-Killonan 220 kV section.	400 kV bays: 3 220 kV bays: 3 400/220 kV 500 MVA Trf: 1 400 kV line: 10 km 220 kV line: 30 km	To reinforce the 220 kV network to the south and avoid overloading of this network following the loss of the planned Moneypoint Tarbert circuit.	Mar-08 - Mar-10
CP469	New 400 kV line from Woodland: A new 400 kV line constructed between the existing Woodland 400 kV station, in south east Co. Meath and a new 400 kV station in Co. Cavan, connected into the Flagford-Louth 220 kV line.	400 kV bays: 1 220 kV bays: 2 400 kV line: 60 km 220 kV line: 10 km	The loading on the transmission network is reaching the capacity of the corridor between Dublin and the North East. Unacceptable overloads and low voltages in the area will occur in the future under contingency conditions. This project forms part of the long term development to meet the future demand of the area.	Mar-10 - Mar-13

4.3.2 DSO Connections

Table 4-9 lists the DSO Connection projects that are in the Preliminary Design Phase. These projects relate directly to connections of new TSO/DSO interface stations to the transmission system, or changes in existing DSO connection arrangements.

Table 4-9 DSO Connection Projects in the Preliminary Design Phase

CP No.	Project Description	Major New Equipment Estimates	E.S.D. - E.C.D.
CP196	Kilmurry 110 kV station: A new Kilmurry 110 kV station, near Bellview in Co. Waterford, connected by looping in the Great Island–Kilkenny 110 kV line. Planning permission has been granted for the TSO element of this project. However the required completion date is currently under review by the DSO.	110 kV bays: 3 110 kV line: 5 km	Mar-10 - Mar-11
CP285	Kilteel 110 kV loop in and 110 kV Transformer bay: The present connection of Kilteel is a solid T off the Maynooth-Monread 110 kV line. The T will be removed and the line between Maynooth and Monread will be looped into Kilteel 110 kV station. The DSO have also requested a second 110 kV transformer bay for a new 31.5 MVA transformer.	110 kV bays: 2 110 kV line: 2 km	Dec-06 - Dec-07
CP307	Great Connell 110 kV Station: The existing Monread-Newbridge 110kV line will be looped into a new Great Connell 110 kV station, near Naas, Co. Kildare. (The DSO has indicated that this project is currently under review)	110 kV bays: 4 110 kV circuit: 5 km	Dec-06 - Jan-08
CP402	Charlesland 110 kV Station: The existing Ballybeg-Carrickmines 110kV line will be looped into a new Charlesland 110 kV station, near Greystones in Co. Wicklow.	110 kV bays: 4 110 kV circuit: 10 km	Dec-06 - Dec-07

4.3.3 Generator Connections

Table 4-10 lists the development projects relating directly to connection of generation to the transmission system or to changes in existing generation connection arrangements that are in the Preliminary Design Phase, prior to entering the Public Planning Process. Some of these connections are contestable, i.e. the generator has decided to build the connection assets to TSO specified standards. The Estimated Completion Date (E.C.D.) is the TSO's current best estimate of when the generation connection will be completed. It should be noted that this is dependent on progress by the applicant. The date of completion for these projects is coordinated with the IPP programme of connection.

Table 4-10 Generator Connection Projects in the Preliminary Design Phase

CP No.	Project Description	Major New Equipment	E.S.D. - E.C.D.

CP No.	Project Description	Major New Equipment	E.S.D. - E.C.D.
CP477	IPP38G Coomacheo: A new 110 kV station will be built to facilitate the connection of Coomacheo wind farm. The Coomacheo station will be connected to the grid via a 15 km cable to Clonkeen 110 kV station.	110 kV station 110 kV bays: 3 110 kV cable: 15 km	Dec 06 - Dec-07
CP478	IPP53 Pallas: A new 110 kV station named Clahane will be built to facilitate the connection of the Pallas wind farm. The Clahane station will be connected into the existing Tralee-Trien 110 kV line.	110 kV station 110 kV bays: 3 110 kV line: 5 km	Jun-06 - Mar-07
CP479	IPP55 Athea Connection: New Athea 110 kV station connected to the existing Trien 110 kV station, for the connection of Athea wind farm	110 kV station 110 kV bays: 3 110 kV line: 15 km	Sep-06 - Jul-07

4.3.4 Refurbishments

Refurbishment projects do not normally require planning permission as they involve replacing "like-for-like" equipment. However some projects do involve a much higher level of detailed design. Table 4-11 lists the station and line refurbishment projects that are currently in the Preliminary Design Phase.

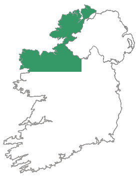
Table 4-11 Refurbishment Projects in the Preliminary Design Phase

CP No.	Project Description	Major New Equipment Estimates	E.S.D. - E.C.D.
CP228	Marina 110 kV Station Replacement The existing Marina Station is obsolete and in poor condition, thus requiring major refurbishment. Due to operational, environmental and site restrictions a new GIS station is required to replace it.	New GIS 110 kV station 110 kV bays: 12	Jun-06 - Dec-08

4.4 Regional Benefits

Most of the network is performing within the required standards at present. Some areas have been identified as likely to go outside standards in the absence of network reinforcement as the demand increases and/or new generation is connected. The network reinforcement projects identified in the above sections have been designed to deal with these emerging challenges.

Because of the meshed nature of the network, developments benefit a wider area than those supplied directly by the stations reinforced. For example the proposed Castlebar-Tonroe 110 kV line will benefit all Mayo, not just the towns of Castlebar and Ballaghadreen (Tonroe).



North-West

Sranangh 220 kV station, due in 2006, will extend the 220 kV network and will strengthen the whole North-West region.

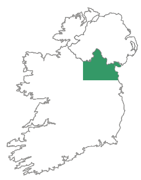
Athlone-Shannonbridge 2 110 kV line will provide greater reliability for customers supplied by Athlone 110 kV station and improve the ability of the network to move power from the south to the north-west.

Binbane-Letterkenny establishes a connection for a new DSO station giving much needed relief to the distribution system in Donegal. It will also increase the capacity for new generation in north Donegal and provide for future demand growth.

Castlebar-Tonroe 110 kV line will provide a fourth connection into Mayo and enables the network to meet the forecast demand in Mayo well beyond the Plan Period.

Some of the projects on the West will also help strengthen the North-West area. Further developments in the North-West should only be required within the Plan Period in the event that new as yet unknown generation or demand developments emerge.

North-East

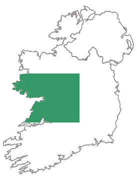


The connection of Gorman 220 kV station in 2005 has significantly improved the capacity of the network in the North-East. The uprating of the Corduff-Drybridge and Corduff Platin 110 kV lines will further enhance the network in this area.

The Arva-Shankill No. 2 110 kV line will overcome capacity problems supplying the Cavan and Monaghan loads. To achieve the full potential of this line in providing for future demand, further development will be required to prevent potential voltage problems in the area (see Section 5.1).

The Gorman-Meath Hill 110 kV line will provide a second circuit to Meath Hill, giving more reliability to the supply in east Cavan. The Gorman-Navan 110 kV line will improve the quality of supply to Navan and surrounding areas.

The 400 kV line from Woodland to a new station connected into the Flagford-Louth 220 kV line is a major addition to the transmission system. It will provide a step change in the ability to transfer power northwards from Dublin where there is currently an excess of generation capacity. This will benefit the whole North-East as well as the North-West and will also assist in cross-border trading.

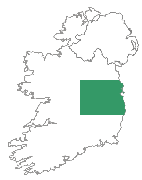


West

The looping of the Dalton-Galway 110 kV line into Cashla station will create a fourth 110 kV circuit between the Cashla 220 kV station and Galway 110 kV station. It also removes the Mayo load from Galway station, thus improving the supply to both Galway and Mayo. This will allow for demand growth at Galway for the foreseeable future.

The third Cashla 220/110 kV transformer, due to be installed in early 2006, will provide the necessary additional transformer capacity in this station which is an important point of supply for both the West and North-West regions.

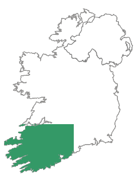
East



The looping of the Blake-Cushaling-Maynooth 110 kV line into Newbridge provides two more circuits to Newbridge. This will provide essential infrastructure support to this fast growing region.

The Cushaling-Thornsberry 110 kV line will provide a second circuit to Thornsberry station which will make supply to Tullamore and the surrounding area more secure and allow for further demand growth.

Connection of generation in Dublin will continue to raise short circuit current levels. The provision of a series reactor in Poolbeg and sectionalising the system in Dublin will help reduce the levels.



South-West

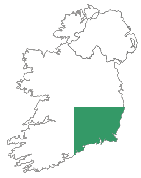
A number of important network projects identified above will enhance the network infrastructure in the South-West.

The Aghada-Raffeen circuit will provide a more secure supply to Cork City and harbour area. The area around Tralee and Killarney is currently outside standards; the planned Tarbert-Tralee No. 2 110 kV line will rectify this situation.

The Moneypoint to Tarbert 400 kV circuit and the 400/220 kV station near Nenagh will provide two additional high capacity paths from the 400 kV system into the South-West. This will greatly enhance the reliability of service to demands in the South-

West. In addition it will provide much needed flexibility for the dispatch of the system generation which will improve reliability and economics for the benefit all electricity customers.

South-East



The uprating of the Great Island to Waterford 110 kV lines in 2006 will provide additional capacity on these existing lines which will benefit the Waterford region and allow for greater transfers from generation in Dublin to the Southern region.

The proposed Lodgewood 220 kV station near Enniscorthy will connect the 220 kV network to the 110 kV network providing a more reliable supply into Co. Wexford. To maximise the benefit of the new Lodgewood station, the line from Crane to Wexford will be require to be uprated or reinforced following completion of this project, which is expected in 2008.

5 Potential Further Developments

This chapter covers the areas on the network that may require some form of development to start within the next five year planning period, for which a specific development project has not yet been approved or identified. These are regarded as potential developments and they are separated into the different categories as follows:

- **Expected reinforcement requirements** identified through analysis of the system performance based on forecasted demands and generation.
- **DSO plans for further connections** which are currently under investigation or being prepared for approval.
- **Possible future developments** resulting from potential drivers, such as new loads, generation or interconnections, which some indication of occurring has been received or identified.

The three categories of potential development are discussed separately below.

5.1 Expected Reinforcement Requirements

The results of long-term technical analysis of future network performance have identified a number of areas where, in the absence of further development, sub-standards performance will arise. The analysis is based on the expected demand growth and generation connection assumptions outlined in Chapter 3 and on the assumption that the reinforcement and refurbishment projects covered in Chapter 4 are completed and in service by the given completion dates.

The areas are listed in Table 5-1 below grouped together on a regional basis to place them in context. They are discussed separately after the table and are broadly indicated in the map in Figure 5-1.

It is expected that if demand and generation evolve as assumed it will be necessary to commence further developments to meet these needs within the period of this plan.

Table 5-1: List of Areas with Future Development Needs Identified

Identified Areas of Future Needs by Region	
North-West	Section 5.1.1
No further development needs are expected in this area	
North-East	Section 5.1.2
Low voltages at Louth and Gorman 220 kV stations and at Navan, Lisdrum, Shankill and Mullingar 110 kV stations	
West	Section 5.1.3
Line overloading of • Cashla-Cloon 110 kV • Cashla-Ennis 110 kV • Ardnacrusha-Killonan 110 kV • Ardnacrusha-Limerick 110 kV • Ikerrin-Shannonbridge-Thurles 110 kV Low voltages at Ardnacrusha, Drumline, Ennis, Lisheen and Thurles 110 kV stations Transformer loading at Killonan 220/110 kV station	
East	Section 5.1.4
Low voltages at Kilkenny 110 kV station Overloading of the Crane-Wexford 110 kV line	
South-West	Section 5.1.5
Voltage stability issues Overloading of Tarbert-Tralee No. 1 110 kV line Security of supply to West Cork 110 kV stations Low voltages at Charleville and Glenlara 110 kV stations Overloading of numerous 110 kV lines as a result of Gate 1 wind farm connections	
South-East	Section 5.1.6
No further development needs are expected in this area	

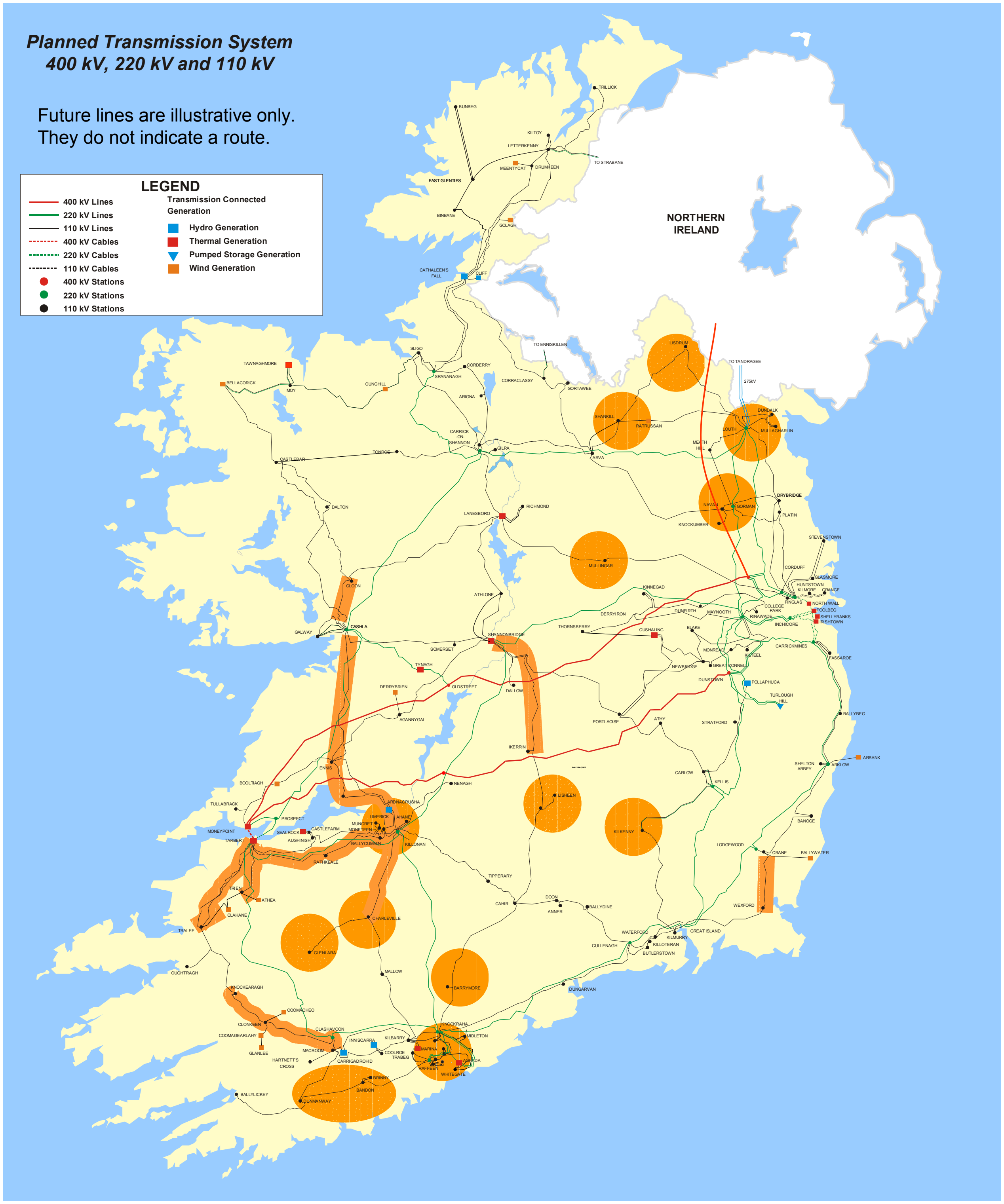
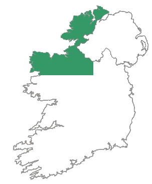


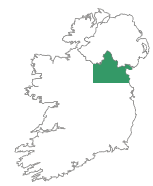
Figure 5-1: Map Indicating Location of Expected Future Development Needs

5.1.1 North-West



There are no further network development needs expected in this area based on the expected demand growth and currently committed generation connections and on the completion of planned transmission projects.

5.1.2 North-East



Low voltages at Louth and Gorman 220 kV stations and Navan 110 kV station

The Louth and Gorman 220 kV station are the two most northern stations on the eastern 220 kV power corridor to Northern Ireland. Navan 110 kV station is very close to Gorman station, linked by two 110 kV lines. Around 2010, based on expected demand growth, certain contingency conditions involving 220 kV lines in this power corridor can result in the voltages at Louth and Gorman 220 kV stations falling below the minimum levels. Since these two stations support the underlying 110 kV network several of the 110 kV stations in the area will also experience low voltage levels, in particular the Navan 110 kV station, at this time. The likely short-term solution is to support the voltage by installing capacitors at the Louth and Navan stations. This would form part of the long-term strategy for developing the transmission network in the area.

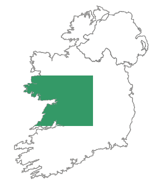
Low Voltages at Lisdrum and Shankill 110 kV stations

Lisdrum 110kV station in Co. Monaghan is connected to the Louth 220/110 kV station and the Shankill 110 kV station which is in turn connected to the Arva 110 kV station. From 2006, the voltages at the Lisdrum and Shankill 110 kV stations could fall below acceptable levels under certain contingency conditions, particularly if the generation is out of service at either the Lough Ree or the Cathaleen's Fall power stations. The addition of reactive compensation support would support the voltages for the foreseeable future and a proposal in this respect is being prepared for submission for approval.

Low voltages at Mullingar 110 kV station

The Mullingar 110 kV station is connected to the Lanesboro station and the new Corduff 220/110 kV station. Low voltages could result at the Mullingar 110 kV station for a contingency involving the Lough Ree power generator and the Corduff-Mullingar 110 kV line towards the end of the Plan Period, around 2010. At present the most likely option is to support the voltage by installing a capacitor at Mullingar. This will only be put forward for approval when appropriate if no other option becomes more attractive in the interim.

5.1.3 West



Overloading of 110 kV lines and low voltages in Clare and Limerick

As the demand increases the 110 kV network linking the 220/110 kV stations of Cashla and Killonan via Ardnacrusha becomes stressed resulting in line overloading and low voltages under contingency conditions.

From around 2009, if generation output is low in the South, the Cashla-Ennis 110 kV transmission line could overload under certain contingency conditions as it tries to route additional power to the south.

From 2010, the same 110 kV line could overload during the summer for the trip-maintenance outages of the Ardnacrusha-Killonan and Ardnacrusha-Limerick 110 kV lines when there is little or no generation at the Ardnacrusha hydro power station. Similarly, from 2010, the outage of the Cashla-Ennis 110 kV line and one of the two above 110 kV lines to Ardnacrusha will result in the remaining 110 kV line overloading. These contingencies would also result in low voltages at the Ardnacrusha, Drumline and Ennis 110 kV stations. The connection of Gate 1 wind generators in the South-West will also increase the loading on these 110 kV lines.

There are potential refurbishment projects under consideration which could have an impact on these performance issues. The condition of the equipment in the Ardnacrusha station is poor and much has become obsolete. A project for the refurbishment of the entire station is being investigated. The timing of the refurbishment project will be co-ordinated with any new reinforcement projects.

Similarly the 110 kV lines out of Ardnacrusha station are relatively old and not in good condition. These lines are being reviewed and may require refurbishment. However as with the station, these refurbishment projects will be co-ordinated with any reinforcements that may be required for the area.

Overloading of Cashla-Cloon 110 kV line

The Cashla-Cloon 110 kV line forms part of the main infeed into the 110 kV network that supplies the Co. Mayo area. From around 2010, this 110 kV line may overload under certain conditions, which are dependant on generation patterns. The uprating of this 110 kV line is the more likely solution unless a new alternative becomes more attractive before the necessary approvals are required.

Transformer loading at Killonan 220/110 kV Station

There are three transformers in Killonan station, two 63 MVA and one 125 MVA units. The two 63 MVA transformers are the only ones of this size still on the network and are considered to be too small. These transformers will suffer heavy loading under certain conditions, especially from 2010, and are being carefully monitored with a view to replacing them with larger units.

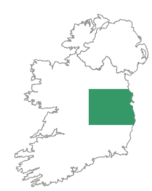
Line overloading of the Ikerrin-Shannonbridge-Thurles 110 kV line

The Ikerrin-Shannonbridge-Thurles 110 kV transmission line forms the northern leg of a 4-legged star network which is centred at Cahir 110 kV station in Co. Tipperary. Near the end of the Plan Period, around 2010, the 110 kV line could overload on the trip-maintenance contingency of two of the other legs forming this star network. This will place this whole star connected 110 kV network at risk. Some reinforcement will be required to strengthen the network in this area. The TSO is considering alternatives which would benefit the wider region.

Low voltages at Thurles and Lisheen 110 kV stations

From 2010, low voltages could be experienced at the Thurles and Lisheen 110 kV stations for certain contingency conditions involving an outage of the West Offaly power station generator. This would result in the loss of reactive support in the area. This problem is related to the Ikerrin-Shannonbridge-Thurles 110 kV line issue discussed above. These contingency conditions will eventually result in low voltages at the Barrymore station as well. A solution will be required to all the future network weakness in this area and several alternatives are under consideration.

5.1.4 East



Low voltages at Kilkenny 110 kV station

The Kilkenny 110 kV station is supplied by two 110 kV lines, one from the Kellis 220/110 kV station and one from the Great Island 220/110 kV station. The DSO has requested connection of a new 110 kV station called Kilmurry to supply some of the Waterford area demand. It is planned to connect Kilmurry into the Great Island-Kilkenny 110 kV line.

Increasing demand in the Kilkenny area will result in low voltages on this portion of the 110 kV network under contingency conditions around the end of the Plan Period, around 2009. In addition, depending on the amount of demand transferred from Waterford to Kilmurry, the security standard regarding the isolation of 80 MW of load for a trip-maintenance contingency may be exceeded by the end of the Plan Period.

The TSO is examining solution options which would provide long-term benefit to this and other parts of the network.

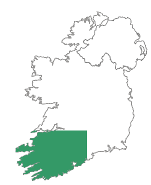
Line overloading of the Crane-Wexford 110 kV line

The establishment of the new Lodgewood 220/110 kV station (see Chapter 4.1.1) results in a power injection into the 110 kV network running in parallel with the 220 kV network between Arklow and Great Island. When there is no generation output from Great Island power station and a high level of generation in Dublin the resulting high power transfer to the south could lead to an overload of the Crane-Wexford 110 kV line under contingency conditions such as:

- loss of the Great Island-Lodgewood 220 kV as a single contingency, or
- loss of the Arklow-Lodgewood 220 kV and Great Island-Kellis 220 kV lines as a trip-maintenance contingency.

Uprating the Crane-Wexford 110 kV line has been identified as a short lead-time solution. This will be coordinated to coincide with the expected completion date of the Lodgewood 220 kV station project.

5.1.5 South-West



Voltage Stability issue

Two thermal generation units are frequently required to be in service in the Cork area to provide reactive power and thus prevent voltage collapse in case of contingencies. The voltage collapse could otherwise occur after contingencies involving one of the 220 kV lines into the south or one of the Cork generation units. As the demand increases towards the end of the Plan Period a third generation unit will be required to be operating at times to prevent voltage collapse. The potential costs of constraining generation on in Cork may lead the TSO to seek other measures of securing reactive power in the area.

Line overloading of the Tarbert-Tralee No.1 110 kV line

The Tarbert-Tralee No.1 110 kV line forms part of a 110 kV network in Co Kerry between Tarbert 220/110 kV, Tralee 110 kV and Trien 110 kV stations. The Tarbert-Tralee No.2 110 kV line is scheduled to be completed in 2006 as part of the reinforcement of this area of the network. However the existing Tarbert-Tralee No.1 110 kV line will then be the weakest link of this network and will be the first to overload under contingency conditions.

From around 2008, if output from generation stations in the South is low this 110 kV transmission line will overload under trip-maintenance contingency conditions. This could escalate to a single contingency problem soon after the Plan Period under the same generation scenario.

Security of Supply to West Cork 110 kV stations

The loads at three 110 kV stations in the West Cork area, Bandon, Dunmanway and Ballylickey are supplied via the same 110 kV transmission line loop. The trip-maintenance contingency on either end of this 110 kV loop will result in the loss of these loads which are expected to exceed 80 MW by around 2009. This is a violation of the security of supply criterion in the Transmission Planning Criteria. Shortly after the end of the Plan Period a section of line on this 110 kV loop could overload for a single contingency. Some 110 kV reinforcement will be required for this area and several alternatives are under investigation.

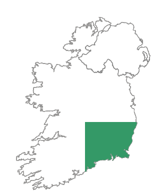
Low Voltages at Charleville and Glenlara 110 kV stations

From around 2010, if output from generation stations in the South is low the single contingency loss of Charleville-Killonan 110 kV line could result in low voltages at the Charleville and Glenlara 110 kV stations. A project to provide reactive power support is the more likely solution and will be submitted for approval at the appropriate time unless a new alternative becomes more attractive before then.

Overload of numerous 110 kV lines as a result of Gate 1 wind farm connections

All the transmission connected wind generators from Gate 1 have signed by the end of 2005. The Gate 1 integration studies identified a number of 110 kV lines at risk of overloading as a result of the increased generation in the South-West: Charleville-Killonan, Clahane-Tralee, Clashavoon-Clonkeen, Clonkeen-Knockearagh, Killonan-Limerick, Limerick-Rathkeale, Rathkeale-Tarbert, and Tarbert-Trien 110 kV lines. The TSO is preparing to bring forward network reinforcement projects to deal with these potential overloads.

5.1.6 South-East



There are no further network development needs expected in this area based on the expected demand growth and currently committed generation connections and on the completion of planned transmission projects.

5.2 DSO Plans for Further Connections

Most demand connections to the transmission system are sought by the Distribution System Operator (DSO) which applies for new station connections. The DSO has further development plans which are at various stages of preparation, several at an advanced stage.

The TSO is co-operating with the DSO on these expansion plans in order to bring them forward to project initiation when required. The TSO will initiate the necessary transmission connections when the formal notifications from the DSO to proceed are received. These plans include new additional transformers for the DSO at existing TSO supplied stations as well as new DSO 110 kV stations to be connected to the transmission grid. The list of the DSO connection plans that are currently being prepared in conjunction with the TSO are listed below.

5.2.1 Additional DSO Transformers

The DSO plans include connection of additional transformers at the following stations:

- Arklow 110 kV station;
- Athlone 110 kV station;
- Barnahely 110 kV station*,
- Binbane 110 kV station*;
- Ennis 110 kV station*;
- Gortawee 110 kV station*;
- Inchicore 220 kV station
- Moy 110 kV station;
- Mullingar 110 kV station*;
- Tralee 110 kV station** and
- Wexford 110 kV station.

** The formal notification from the DSO for these projects has been received and they are in the process of internal approval by the TSO.*

*** This project has received internal approval by the TSO subsequent to the release of the draft Development Plan in January 2006.*

5.2.2 New 110 kV Stations

The DSO plans include the construction and connection of new 110 kV stations at the following locations:

- Ballymurtagh, Shannon, Co. Clare;
- Carnmore, Oranmore, Co Galway;
- Carrowbeg, Westport, Co. Mayo;
- Donore Road, Drogheda Business Park, Co. Meath;
- Maudlins, New Ross, Co. Wexford;
- Moyglass, Maynooth, Co. Kildare;
- Singland, Co. Limerick
- Southgreen*, Kildare, Co. Kildare and
- Youghal, Co. Cork.

** The formal notification from the DSO for this project has been received and is in the process of internal approval by the TSO.*

5.2.3 Dublin Networks

The DSO has prepared a plan for the development of the distribution network in and around Dublin. The TSO is carrying out a detailed review of this plan in consultation with the DSO. This is expected to have a significant impact on the 220 kV network with respect to routing of power around the Dublin area and the need for new 220/110 kV infeed stations in the north and west of Dublin. Reinforcement developments are likely to commence within the period of this plan.

Other transmission considerations (see Section 5.3.11) will also impact on the further development of the Dublin area networks.

5.3 Possible Future Developments

There are areas on the network where as a result of new non-network developments or changes, such as new generation, new demand, closures or new interconnections, some form of network development would be required. If and when these future developments or changes are confirmed the TSO will be in a position to propose any required solutions or developments for the network. Until that time the TSO can only present the issues and the potential areas and factors that may impact on the future network development.

It should be noted these new developments or changes do not always result in network reinforcements being required. There may be some instances where new developments could benefit or improve the overall system performance.

The issues and potential areas and factors discussed in this section are as follows:

- Ireland-Great Britain Interconnector
- Significant Wind Generation on the Network
- New Thermal Generation
- Fuel Cost Constraints on Existing Generation
- Generation Plant Closures
- High Short Circuit Levels on the Network
- Station and Line Refurbishments
- Line Diversions
- Demand Connections
- High Loading of the Dublin 220 kV Cable Network

5.3.1 Ireland-Great Britain Interconnector

The project to establish up to two 500 MW electrical interconnections between Ireland and Wales has been previously discussed in Section 3.4.2. The import and export capabilities have been examined at nine potential points for an interconnection with Britain on the network in the recent *Transmission Forecast Statement 2005 – 2011*.

The results show that areas suitable for large demand connections do not coincide with areas suitable for large generation connections. Export capabilities are very high at Dublin and the north-east whereas import capabilities are high at Cullenagh in County Waterford. None of the locations examined would have the capacity to import and export 500 MW without investment in system reinforcement.

Substantial network investment is likely to be required to facilitate a 500 MW interconnector. The TSO is working closely with the CER to analyse a number of interconnection connection options and the required network reinforcements.

5.3.2 Significant Wind Generation on the Network

There has been a significant increase in the volume of wind generation that has been connected to and have applied for connection to the transmission system. As an indication of the level of the activity in the wind generation area the figures as at the end of April 2006 are given below:

- Connected wind generation: 579.6 MW
- Signed connection offers: 641.5 MW
- Connection offers issued: 62.6 MW
- Applications in process: 3,071.7 MW

The *signed connection offers* are firm offers to developers to connect to the grid that have accepted by the developers. The *connection offers issued* are offers that have been issued to developers, but have not yet been accepted. The *applications in process* are the applications that have been received. Up to 1,300 MW of these are likely to be included in Gate 2 group process.

The above figures give a total of 4,355 MW of wind generation that could potentially be connected to the power system (either directly to the Transmission System or to the Distribution System). This level of wind generation would equate to almost 80% of the forecast winter peak demand and over 200% of the summer valley demand for 2010.

Most of the wind applications are in areas remote from the main demand centres. In addition to the shallow connection, consideration has to be given to the routes along which the power will flow to the demand. This is complicated by the variable nature of wind generation which limits how it can be dispatched. In effect the only control available is that the wind output can be constrained off but not dispatched on when required. The transmission system must therefore be able to accept the wind power as it is generated and distribute it. It must also be able to import the power from available units in other areas to supply the local demand when the local wind generation is either off or at a low level.

An illustration of the complexities involved and which areas are more likely to require reinforcement can be seen from the map in Figure 5-2. This map indicates the areas where the existing and new wind generation are expected to be dispersed across the network. The system has been divided up into four areas for illustration purposes. The expected winter peak demands for 2010 for those same four areas have been indicated on the map.

The main area for new applications is in the south where the total is almost double that of the next highest area in the north-west. It should be noted that the total applications in the south and the north-west areas actually exceed the winter peak demand totals for 2010 in those same areas.

While it is not expected that all the wind applications will progress to completion, the map illustrates that the network will have to be able to balance large amounts of varying wind generation with the output of the thermal and hydro generation to meet the expected demand. The wind generation may also have a large variation over a relatively short period of time which the network must be able to cope with.

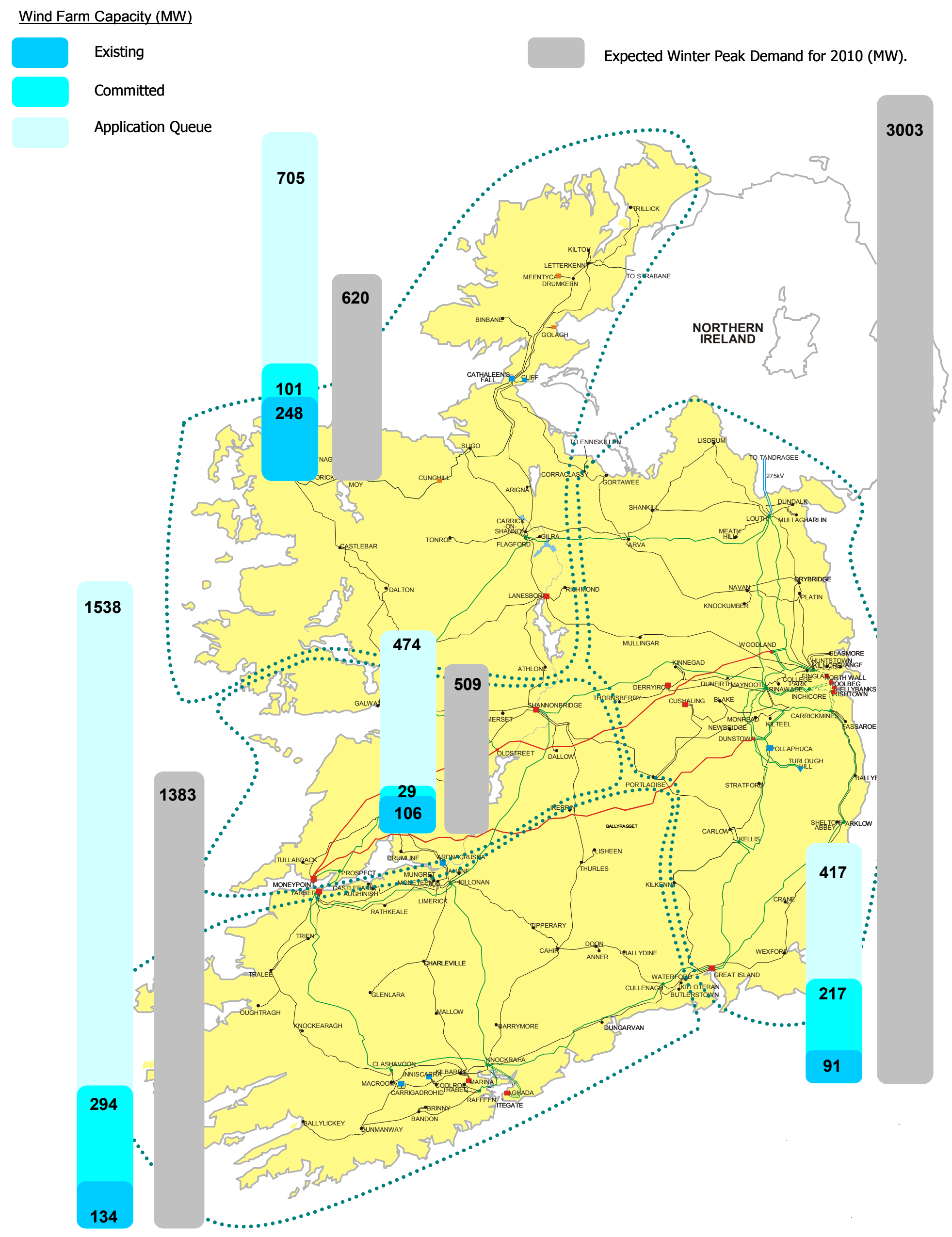


Figure 5-2: Map indicating the geographical profile of wind generation applications as at the end of April 2006

The transmission system will therefore have to evolve to be able to meet the changing operational demands on the network. It is likely that new reinforcement developments will be called for before the end of the Plan Period to facilitate increasing wind penetration. The decision by the Department for Communications, Marine and Natural Resources on the long-term targets for wind generation and the staging of those targets will provide the necessary context for the strategic development of the network to accommodate increased levels of wind generation.

5.3.3 New Thermal Generation

The requirement for additional generation capacity before 2010 has been highlighted in the *Generation Adequacy Report 2006-2012*. As stated in Section 3.3.1, two thermal generators have applied to the TSO for grid connections. It is, therefore, reasonable to expect that some new generation capacity will be connected to the transmission system before the end of the Plan Period.

In the *Transmission Forecast Statement 2005-2011* the opportunities for connecting new generation to the system were presented. The level of generation that could be connected without requiring transmission reinforcement was indicated at a number of different 220 kV and 110 kV stations across the network. Any new generator wishing to connect at a different location to those listed or exceeding the level at a particular station may require further deep reinforcement to be able to connect. The degree of that reinforcement can only be determined once the application has been submitted and the various solution options identified and studied.

5.3.4 Fuel Cost Constraints on Existing Generation

The cost of fuel for the existing generation on the system has proven to be very volatile over the past few years. The main area of concern from a transmission planning viewpoint would be the relative price differences between the different types of fuel. If there is a significant increase in the cost of one type of fuel this will make the units using that type of fuel comparatively more expensive to run.

Network constraints may dictate that these more expensive generator units are required to run in place of units using a cheaper fuel. The TSO would take this constraint cost into consideration when identifying new network reinforcements to remove the network technical constraint. Future fuel cost differences may lead to new reinforcement projects in the Transmission Development Plan.

5.3.5 Generation Plant Closures

The network has been designed to accommodate existing generators and known additions. These provide reactive power capability to the local network, which assists the system operator to maintain voltages within allowable limits. In certain locations the generation supplies the local demand, thus reducing the import of power from other parts of the network to meet the local demand. Closure of an existing generator, therefore, will remove reactive support and local power infeed. If not replaced with generation which provides similar active and reactive power capabilities in the same area it can lead to the requirement for network reinforcements.

Generation Adequacy Report 2005-2011 presented a table showing the age profile of the generation plant. The report indicated that by 2011, a third of the plant will be over 30 years old. The life of a thermal generation plant is typically 20 to 30 years at which stage a decision is made as to whether it should be refurbished or closed. Despite the current shortage of generation capacity in the Irish market, the age profile would suggest that there is a possibility of some plant closure before the end of the Plan Period.

5.3.6 High Short Circuit Levels on the Network

The connection of large generators combined with the meshed nature of the transmission network results in increasing short circuit levels. The more tightly connected a network becomes the lower the impedance of the system. While this may reduce system losses, it also enables more current from all the power stations to reach connected stations during a fault. This is particularly noticeable when there are parallel paths between sections at different voltage levels, such as 220 kV and 110 kV. High short circuit levels are a safety issue and measures must be taken prevent the catastrophic failure of high voltage equipment in stations.

Investigations for the connection of new power stations and transmission reinforcement take into account the impact of the development on short circuit levels. The two most common methods of resolving short circuit level problems are upgrading the station equipment with higher rated switchgear or reconfiguring the stations and network to reduce the number of parallel paths and thus decrease the short circuit level. In some cases the installation of fault current reducing reactors are considered. Options are considered that will provide the most practical and economic solution.

The *Transmission Forecast Statement 2005-2011* shows main areas of concern are around the Dublin area, due to the large number of generators already connected, and in the Shannon estuary around the major power stations in the area. The change in the short circuit level with every development is being monitored, but short circuit level reduction developments or network reconfigurations can only be considered once there is a degree of certainty regarding the connection of new generators.

5.3.7 Station Refurbishments

The condition of the equipment in transmission stations is constantly being reviewed and assessed as part of the regular maintenance, performance monitoring and condition assessment programmes.

Recently a detailed review was undertaken of all the 110 kV stations that are over 25 years old. As part of that exercise the condition of all the equipment and structures within these stations was examined and a condition assessment made. Based on these assessments a list was compiled of seven stations that would require further detailed investigation to determine if any refurbishment was necessary. The rest of the 110 kV stations were considered to be in acceptable condition at the time of the review. The detailed investigations are expected to be carried out in 2006 and any refurbishment works identified will be undertaken in 2007 and 2008.

The 110 kV stations identified for the detailed investigation are:

- Carlow
- Cow Cross
- Dundalk
- Moy
- Navan
- Rathkeale
- Whitegate.

Two additional stations are being investigated for refurbishment as a result of potential developments in the mid-west as discussed in Section 5.1.2 above. Some of the equipment is in poor condition and obsolete and the refurbishment of these stations may coincide with potential reinforcements in the area. The stations are:

- Ardnacrusha 110 kV station
- Killonan 220 kV station.

5.3.8 Line Refurbishments

The condition of the transmission lines is constantly being reviewed and assessed as part of the regular maintenance, performance monitoring and condition assessment programmes, as with the stations. The older transmission lines are spread across the country and they will only be refurbished or uprated if required. Once a line has been identified for refurbishment, consideration will be given to take the opportunity to uprate the capacity or thermal rating of the line.

Due to the relatively short lead times for projects involving existing structures, refurbishment and upgrading projects will only be initiated closer to the time of their implementation.

The transmission lines that are under consideration for refurbishment are listed below. The scopes of work are currently under investigation, including the possibility of uprating certain of the conductors. The lines are grouped into the possible period when the works, if required, could be undertaken.

Period 2006 to 2007:

- Ardnacrusha-Drumline 110 kV (18.2 km);
- Ardnacrusha-Killonan 110 kV (9.5 km);
- Ardnacrusha-Limerick 110 kV (11.7 km);
- Aughinish-Tarbert 110 kV (34.2 km);
- Bellacorick-Castlebar 110 kV* (37.2 km);
- Clashavoon-Knockearagh 110 kV (49.5 km);
- College Park-Mullingar 110 kV* (72.8 km);
- Cunghill-Moy 110 kV (40.7 km);
- Cunghill-Sligo 110 kV (20.0 km);
- Drybridge-Louth 110 kV (31.9 km);
- Dungarvan-Knockraha 110 kV (53.7 km);
- Killonan-Knockraha 220 kV (82.4 km);
- Killonan-Shannonbridge 220 kV Line (89.7 km);
- Maynooth-Shannonbridge 220 kV (105.6 km).

Period 2008 to 2009:

- Ballydine-Doon 110 kV (11.3 km);
- Ballydine-Cullenagh 110 kV (21.8 km);
- Cashla-Cloon 110 kV (22.9 km);
- Crane-Wexford 110 kV (21.3 km);
- Kilbarry-Macroom 110 kV (34.6 km);
- Tarbert-Tralee No.1 110 kV (42.0 km).

* *These projects have received internal approval by the TSO subsequent to the release of the draft Development Plan in January 2006.*

5.3.9 Line Diversions

There are a number of diversions of transmission lines that are currently under consideration. When the details are finalised approval will be requested. They are:

- Cashla-Galway 110 kV lines No.1 and No.2 near Ballybrit;
- Dunstown-Moneypoint 400 kV line for development of the M7/M8 motorway;
- Killonan–Shannonbridge 220 kV line for development of the M7/M8 motorway.

5.3.10 Demand connections

Major customers may apply to connect directly to the transmission grid. Applications for new demand connections made to the TSO are studied and once the best connection option is identified a connection agreement is issued which is signed by both the customer and the TSO. Due to client confidentiality these connection agreements can only be made public when the customer signs the agreement.

5.3.11 High loading of the Dublin 220 kV Cable Network

Recent network studies have indicated that the 220 kV cables within the Dublin area will experience very high loading during contingency conditions, towards the end of the Plan Period. This is as a result of the planned reconfiguration of the 220 kV and 110 kV networks and the introduction of an in-line series reactor which are necessary to reduce the rising short circuit level currents in the Dublin area following new generation connections. Although the loadings are within their emergency thermal limits these cables will have to be monitored to ensure that their integrity is not compromised. This will be reviewed in conjunction with the analysis of the DSO plans for the Dublin area, as discussed in Section 5.2.

It is possible that some reconfiguration of the 220 kV and 110 kV networks and/or some reinforcement will be required in the future to meet the DSO demands and avoid network constraints in the Dublin area.

6 Summary of Developments

From 2006 to 2010 electricity peak demand is forecast to increase by 20%. Signed generation connection agreements at the end of April 2006 include 737 MW of new capacity all of which is expected to be connected to the grid by 2010. This is in addition to the 532 MW of new thermal generation and 43 MW of wind generation that was connected between November 2005 and March 2006. Further development of the network is required to keep pace with these significant changes. The reinforcement developments included in this plan have been selected to ensure that the network remains within standards given the projections for demand growth and generation connections in the years up to 2010.

The development plan includes a total of 83 projects that are in progress, 60 of which are in the detailed design and construction phase. The totals of new equipment currently planned are presented in Table 6-1. These are estimates only because scopes, particularly circuit lengths, can change during the course of a project.

Table 6-1 Estimates of Planned New Transmission Assets

	400 kV	220 kV	110 kV
No of New Stations	3	2	15
No of Existing Stations extended	1	12	25
Total New Station Bays	9	22	97
Overhead Line, km	130	164	374
Underground Cable, km	10	14	53

	400/220 kV	220/110 kV
Transformers, number of	3	5
Transformers, Total MVA	1500	1250

There are a total of 14 220 kV and 62 110 kV station bays that are planned to be refurbished at eight stations in the Plan Period. There will also be a total of 420 km of 110 kV transmission lines that will be involved in refurbishment at some level, with the result that over 200 km of those transmission circuits will be able to have their thermal ratings increased.

In addition to those development projects that have been initiated, other developments are likely to be required in the Plan Period.

An assessment of future network performance based on current assumptions has identified a number of areas as likely to require network development. Most of these potential development needs are expected to emerge late in the Plan Period around

2009 and 2010, based on the expected demand growth. The TSO is considering network options to meet these emerging challenges. Development projects, some of which may have short lead-times, will be initiated at the optimum time to meet these network requirements.

Other development requirements will emerge depending on a number of factors including connections of demand, generation and interconnection, and on refurbishment requirements that will be identified as condition assessments are carried out. The potential drivers include:

- The proposed interconnection with Great Britain;
- Wind-farm applications totalling 3,144 MW as at the end of April 2006 (63 MW live connection offers and 3,072 MW in the application queue);
- Applications for the connection of thermal generation;
- Increasing Short Circuit Levels;
- DSO plans for new 110 kV / MV transformers and connection for new 110 kV stations;
- Closure of generation plant;
- A number of stations and overhead lines identified after initial condition assessments for more detailed refurbishment investigations.

It is expected that as the level of confidence in these potential drivers increases the necessary transmission projects to deal with them will feature in future development plans.

The TSO estimates that transmission development requirements will involve major expenditure between 2006 and 2010. However many projects are at a preliminary design stage, while others have not yet been initiated. Better expenditure estimates will evolve as project scopes become more certain.

The CER in its 2006-2010 Transmission Price Control Review Decision Paper has set a cap on capital expenditure on transmission at €520 million. The impact of this capital constraint will be continually reviewed as project designs and costs evolve.

With this development plan in place, coupled with the constant review of the transmission infrastructure and the changing environment requirements, the TSO is confident that the needs of a growing Irish economy will be met well into the future.

APPENDIX A DEMAND FORECASTS

Transmission interface stations are the points of connection between the transmission system and the distribution system or directly connected customers. Table A-1 lists the forecast demand at each interface station at the time of winter peak for each year from 2006 to 2010 inclusive. The demand values do not include transmission losses. However, an allowance for distribution losses is included in demand at stations that interface with the distribution system.

All transmission interface stations are 110 kV stations except for the four 220 kV interface stations that supply the Dublin City networks operated by the DSO. These 220 kV interface stations, Carrickmines, Finglas, Inchicore and Poolbeg, are included at the bottom of the table.

Table A-1 Forecast Demand at Transmission Interface Stations

Station Name	Winter Peak Forecast Demand (MW)				
	2006	2007	2008	2009	2010
Ahane	5.4	5.7	5.9	6.1	6.4
Anner	11.0	11.0	11.0	11.0	11.0
Ardnacrusha	71.4	74.4	77.6	80.8	84.0
Arigna	3.9	4.1	4.3	4.4	4.6
Arklow	31.4	32.7	34.1	35.5	36.9
Athlone	64.5	67.3	70.2	73.1	75.9
Athy	15.8	16.4	17.1	17.8	18.5
Ballybeg	17.6	18.4	19.2	20.0	20.8
Ballycummin	0.0	8.3	8.7	9.0	9.4
Ballydine	17.5	18.0	18.5	19.0	19.6
Ballylickey	10.5	10.9	11.4	11.9	12.3
Bandon	32.0	33.4	34.8	36.3	37.7
Banoge	15.9	16.6	17.3	18.0	18.8
Barnahely	46.3	48.3	50.4	52.5	54.5
Barrymore	24.2	25.2	26.3	27.4	28.4
Bellacorick	4.5	4.7	4.8	5.1	5.2
Binbane	26.7	27.8	29.0	30.2	20.5
Blake	31.3	32.6	34.0	35.4	36.8
Brinny	4.2	4.2	4.2	4.2	4.2
Bunbeg	0.0	0.0	0.0	0.0	16.1
Butlerstown	39.6	41.3	43.0	44.8	46.5
Cahir	27.7	28.9	30.1	31.4	32.6
Carlow	51.7	53.9	56.3	58.6	60.8
Carrick-on-Shannon	29.0	30.2	31.5	32.8	34.1
Castlebar	59.8	62.4	65.1	67.8	70.4
Castlefarm	44.0	44.0	44.0	44.0	44.0
Castleview	13.7	14.3	14.9	15.5	16.1
Cathaleen's Fall	17.0	17.8	18.5	19.3	20.0

Station Name	Winter Peak Forecast Demand (MW)				
	2006	2007	2008	2009	2010
Charleville	25.6	26.8	27.9	29.0	30.2
Cloon	24.9	25.9	27.0	28.1	29.2
College Park	16.0	16.0	16.0	16.0	16.0
Coolroe	9.1	9.5	9.9	10.3	10.7
Cowcross	30.1	31.4	32.7	34.1	35.4
Crane	22.1	23.1	24.1	25.1	26.0
Dallow	14.1	14.7	15.4	16.0	16.6
Dalton	23.3	24.3	25.4	26.4	27.4
Doon	30.3	31.6	32.9	34.3	35.6
Drumline	50.6	52.8	55.1	57.3	59.5
Drybridge	75.2	78.4	81.8	85.1	88.4
Dundalk	68.7	71.7	74.8	77.8	80.9
Dunfirth	4.7	4.9	5.1	5.3	5.5
Dungarvan	30.1	31.4	32.7	34.1	35.4
Dunmanway	23.9	24.9	26.0	27.0	28.1
Ennis	69.9	72.9	76.0	79.1	82.2
Fassaroe	67.4	70.3	73.3	76.3	79.3
Galway	145.9	152.2	158.7	165.2	171.7
Gilra	12.0	12.0	12.0	12.0	12.0
Glasmore	62.4	65.1	67.9	70.7	73.4
Glenlara	13.7	14.3	14.9	15.5	16.1
Gortawee	16.0	16.0	16.0	16.0	16.0
Grange	65.3	68.1	71.1	74.0	76.8
Grange Castle	23.5	24.5	25.5	26.6	27.6
Great Connell	0.0	10.7	11.2	11.6	12.1
Great Island	23.5	24.5	25.5	26.6	27.6
Griffinrath	74.8	78.0	81.3	84.7	88.0
Harnett's Cross	10.2	10.6	11.1	11.5	11.9
Ikerrin	27.4	28.5	29.8	31.0	32.2
Kilbarry	111.3	116.1	121.0	126.0	130.9
Kilkenny	71.3	74.3	77.5	80.7	83.8
Killoteran	11.4	11.9	12.4	12.9	13.4
Kilmore	15.4	15.6	15.7	15.9	16.0
Kilmurry	0.0	0.0	23.6	24.5	25.5
Kilteel	35.9	21.6	22.6	23.5	24.4
Kiltoy	0.0	0.0	0.0	0.0	0.0
Kinnegad	10.0	10.0	10.0	10.0	10.0
Knockearagh	37.5	39.2	40.8	42.5	44.2
Knockumber	22.0	22.0	22.0	22.0	22.0
Lanesboro	14.6	15.2	15.9	16.5	17.2
Letterkenny	61.0	63.6	66.3	69.1	66.5
Liberty Street	13.3	13.9	14.5	15.1	15.7
Limerick	81.1	76.2	79.5	82.7	86.0
Lisdrum	36.4	37.9	39.6	41.2	42.8
Lisheen	15.0	15.0	15.0	15.0	15.0

Station Name	Winter Peak Forecast Demand (MW)				
	2006	2007	2008	2009	2010
Macetown	26.0	26.9	27.8	28.8	29.7
Macroom	6.3	6.5	6.8	7.1	7.4
Mallow	25.3	26.4	27.5	28.7	29.8
Marina	25.1	26.1	27.3	28.4	29.5
Meath Hill	35.0	36.5	38.0	39.6	41.1
Midleton	31.6	33.0	34.4	35.8	37.2
Monread	0.0	15.8	16.5	17.2	17.8
Moy	33.7	35.2	36.7	38.2	39.7
Mullagharlin	8.0	8.0	8.0	8.0	8.0
Mullingar	42.1	43.9	45.8	47.7	49.5
Mungret	20.0	20.0	20.0	20.0	20.0
Nangor	26.0	26.0	26.0	26.0	26.0
Navan	72.7	75.8	79.1	82.3	85.6
Nenagh	19.8	20.7	21.6	22.5	23.3
Newbridge	50.5	42.0	43.8	45.6	47.4
Oughtragh	25.6	26.8	27.9	29.0	30.2
Platin	27.0	27.0	27.0	27.0	27.0
Portlaoise	36.7	38.3	40.0	41.6	43.2
Rathkeale	45.0	47.0	49.0	51.0	53.0
Richmond	31.1	32.5	33.8	35.2	36.6
Rinawade	16.0	16.0	16.0	16.0	16.0
Ringaskiddy	5.5	5.7	5.9	6.2	6.4
Ryebrook	91.0	91.0	91.0	91.0	91.0
Shankill	65.0	67.8	70.7	73.6	76.5
Sligo	58.3	60.8	63.4	66.0	68.5
Somerset	30.8	32.1	33.5	34.8	36.2
Stevenstown	13.7	14.3	14.9	15.5	16.1
Stratford	20.6	21.5	22.4	23.4	24.3
Thornsberry	35.0	36.5	38.1	39.6	41.2
Thurles	30.7	32.0	33.4	34.7	36.1
Tipperary	20.3	21.2	22.1	23.0	23.9
Tonroe	14.1	14.7	15.4	16.0	16.6
Trabeg	76.4	79.7	83.1	86.5	89.9
Tralee	52.5	54.8	57.1	59.5	61.8
Trien	23.1	24.1	25.1	26.1	27.2
Trillick	21.9	22.8	23.8	24.8	25.7
Tullabrack	10.7	11.2	11.7	12.1	12.6
Waterford	47.9	49.9	28.5	29.7	30.8
Wexford	55.4	57.8	60.2	62.7	65.2
Whitegate	7.0	7.0	7.0	7.0	7.0
Carrickmines	96.4	100.6	104.9	109.2	113.5
Finglas	318.8	332.5	346.8	361.0	375.1
Inchicore	338.6	353.1	368.3	383.4	398.3
Poolbeg	262.7	273.9	285.7	297.4	309.0
TOTAL	**4613**	**4795**	**4986**	**5175**	**5362**

APPENDIX B NETWORK MAPS

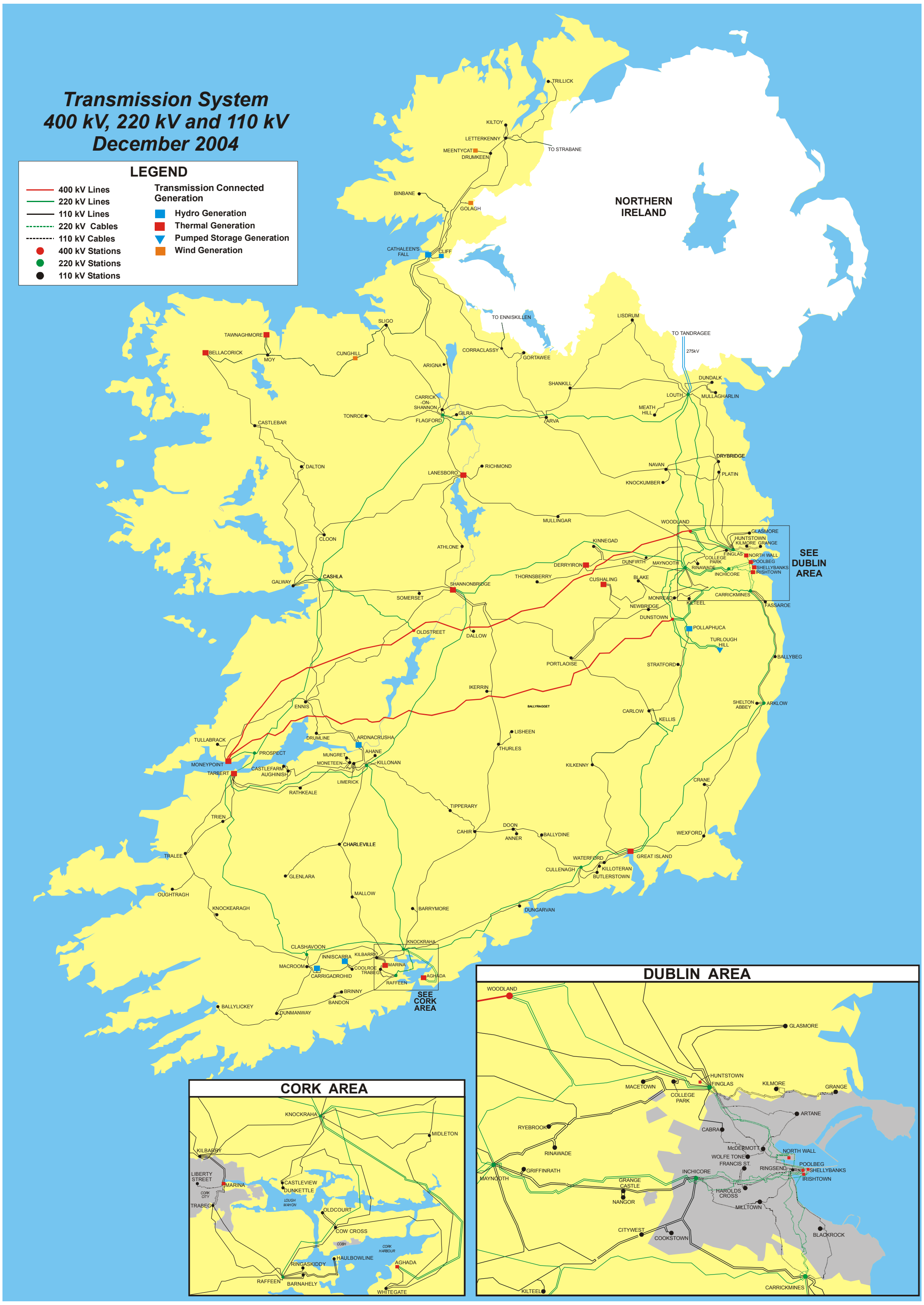


Figure B-1 Map of the Transmission System at December 2004

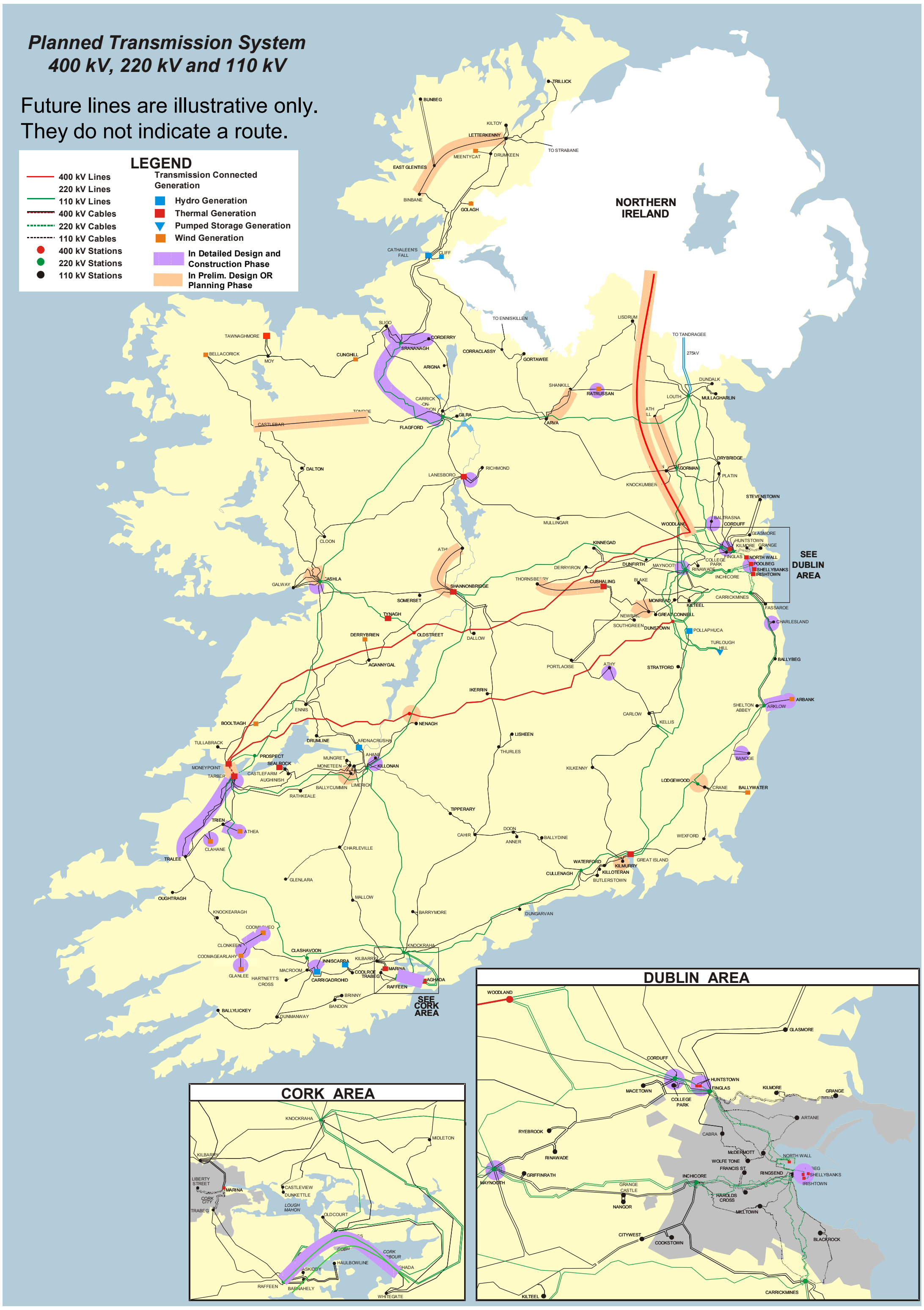


Figure B-2 Map Indicating the Planned Network Developments 2006-2010

APPENDIX C DETAILS OF MAJOR DEVELOPMENT PROJECTS IN THE DETAILED DESIGN AND CONSTRUCTION PHASE

Details are provided in this appendix for the following major development projects:

C.1 Aghada–Raffeen 220 kV circuit

C.2 Blake–Cushaling–Maynooth 110 kV line looped into Newbridge Station

C.3 Srananagh 220 kV Project

C.4 Tarbert–Tralee No. 2 110 kV line

C.1 AGHADA–RAFFEEN 220 KV CIRCUIT (CP 184C)

C.1.1 Description

The project involves construction of a new 220 kV circuit from Aghada generation station to Raffeen transmission station, consisting of 3.5 km of underground cable, 3.2 km of submarine cable and 7.9 km of overhead line. The project is due for completion in 2009.

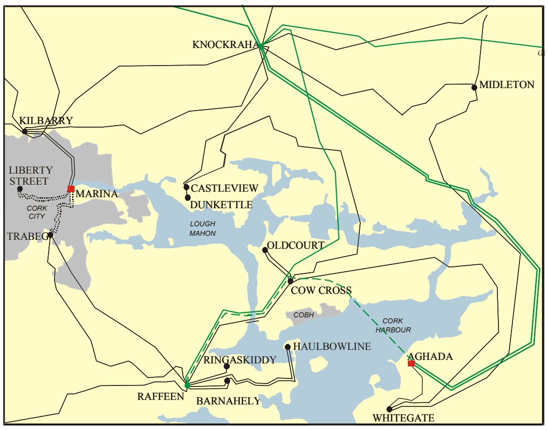


Figure C-1 Cork Area showing the Aghada–Raffeen 220 kV Circuit

C.1.2 Reason for Development

Most recent studies show that from 2009 onwards, a maintenance-trip combination of the Knockraha-Raffeen 220 kV circuit and one of a number of 110 kV circuits will overload the remaining 110 kV network in Cork City.

The Aghada-Raffeen 220 kV circuit is a robust solution which provides for the long-term development needs of the Cork city and harbour area which is a possible location for IDA development. In addition it improves security of supply from Aghada generation station, allows maintenance of transmission plant in the Cork area, and reduces the impact of any possible closure of Marina.

C.2 BLAKE-CUSHALING-MAYNOOTH LOOP INTO NEWBRIDGE (CP217)

C.2.1 Description

This project involves looping the existing Blake–Cushaling–Maynooth 110 kV line into Newbridge 110 kV station in Co. Kildare. This project is due for completion in 2008.

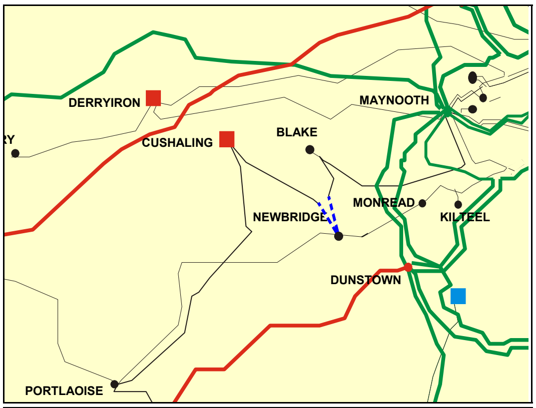


Figure C-2 – Proposed Blake-Cushaling-Maynooth loop into Newbridge

C.2.2 Reason for Development

For an outage of the line between Maynooth and Kilteel or Monread, the entire load in the area must be supplied from the Portlaoise end. This contingency leads to voltages below the minimum specified in the Transmission Planning Criteria.

Most recent load forecasts indicate that from 2008 over 80 MW of distribution load would be lost for the trip maintenance combination of Kilteel–Maynooth and Newbridge–Portlaoise 110 kV lines, therefore violating the Transmission Planning Criteria. This trip-maintenance combination would also lead to unacceptably low voltages.

The expansion plans of one of Co. Kildare's key industrial customers are subject to reinforcement of the existing network, including the completion of this project.

In addition two new 110 kV stations (near Newbridge and Portlaoise) are planned to provide additional infeeds to the local distribution networks from the main transmission system and meet the increasing electricity demand of industrial, commercial and domestic customers in the area. These essential stations cannot be connected until the two proposed transmission lines are completed.

The timely delivery of this project is a key element of the strategic long term plans to continue to provide Co. Kildare and west Co. Wicklow with an adequate electricity network to meet this growth.

C.3 SRANANAGH 220 KV PROJECT (CP211)

C.3.1 Description

This project involves construction of a new Srananagh 220 kV station, east of Sligo town, connected to the 220 kV network by 55 km of overhead line from Flagford, near Carrick-on-Shannon, thus extending the 220 kV network into the north-west. A number of 110 kV lines connected into the new station, makes Srananagh a new hub for power flows into the north-west. This project is due for completion at the end of 2006.

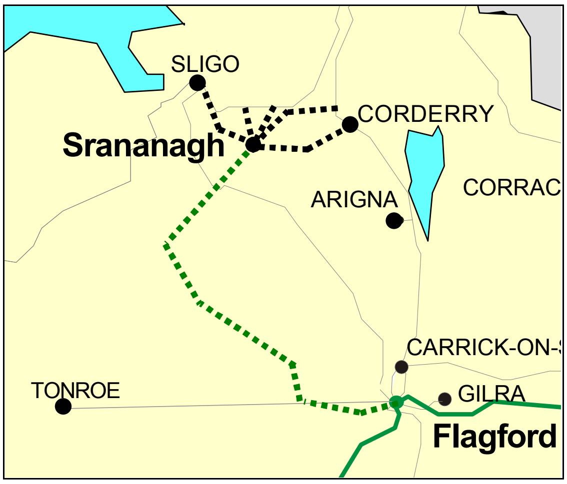


Figure C-3 New Srananagh 220 kV station and 220/110 kV lines

C.3.2 Reason for Development

From summer 2006, the Transmission Planning Criteria are violated under maintenance/trip conditions. Loss of any one of a number of 110 kV lines during an outage for maintenance of another leads to network overloads and/or voltage collapse in the North West.

The Flagford Srananagh 220 kV project is a major development which provides for the long term transmission needs in the area and provides a platform for future network development within the North West area. It also provides the network flexibility to accommodate developments envisaged by the National Development Plan and National Spatial Strategy.

C.4 TARBERT–TRALEE NO. 2 110 KV DEVELOPMENT (CP 246)

C.4.1 Description

A second line, approximately 47 km in length, from Tarbert to Tralee in County Kerry constructed to overcome line overloads and voltage collapse in the Tralee area. This project is due for completion in 2007.

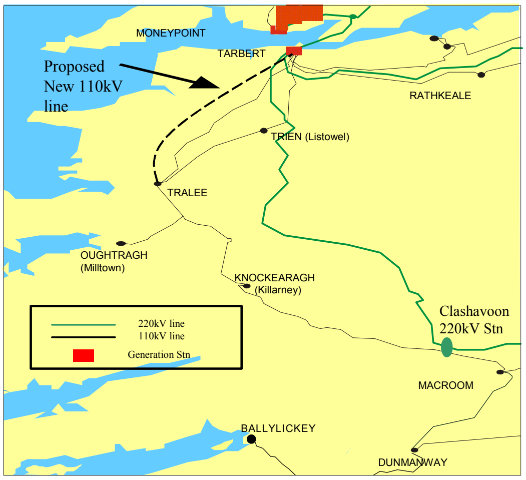


Figure C-4 Proposed new Tarbert-Tralee No.2 110kV line

C.4.2 Reason for Development

There are three 110kV lines supplying Listowel, Tralee, Milltown and Killarney. When one of these three lines is switched out (for maintenance or new works or third party work), a fault tripping of a second line at peak demand times, would result in immediate loss of supply to the area, or cause severe overloads or localised voltage collapse, again resulting in the disconnection of load in the area.

Consequently, there is a risk of seriously decreased standard of supply to all customers, including potential damage to customer equipment.

The Tarbert-Tralee No.2 110 kV line meets the needs identified and is consistent with the long-term strategy for development of the transmission system in the south-west. In addition this development is one of a number identified that will increase transmission capacity for generation export capability in County Kerry

APPENDIX D DETAILS OF MAJOR DEVELOPMENT PROJECTS IN THE PUBLIC PLANNING PROCESS

Details are provided in this appendix for the following major development projects:

D.1 Dalton–Galway 110 kV line looped into Cashla Station

D.2 Binbane–Letterkenny 110 kV line

Each project is shown on a map of the relevant part of the network. The proposed lines are for illustration purposes only and are not meant to indicate actual routes.

D.1 DALTON-GALWAY LOOP INTO CASHLA STATION (CP254)

D.1.1 Description

There are three 110 kV circuits between Cashla and Galway 110 kV stations. It is planned to loop the Dalton-Galway 110 kV line into Cashla station, thus providing a fourth 110 kV connection between Cashla and Galway. Dalton station will then be fed from Cashla instead of Galway. This project is due for completion in 2008.

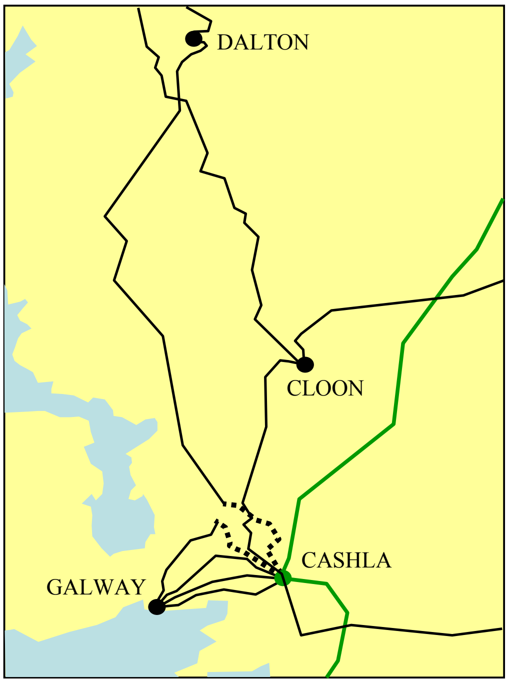


Figure D-1 – Illustration of Dalton-Galway loop into Cashla station

D.1.2 Reason for Dalton-Galway loop into Cashla

There are three 110 kV lines between Cashla 220 kV station and Galway 110 kV station. These 110 kV lines transfer power not only to Galway city and its surrounding area, but they also supply a significant proportion of power into Co. Mayo.

From summer 2004, the Transmission Planning Criteria are violated under maintenance/trip conditions of the transmission network in the North West. Loss of one of the existing three Cashla–Galway 110 kV lines, during an outage at summer peak for maintenance of another, leads to overloading of the remaining Cashla-Galway 110 kV line.

This will seriously decrease the standard of supply to all customers in the Galway area. Reinforcement is therefore required to reduce the risk of potential overloads.

The looping of Dalton – Galway into Cashla station provides for the long term needs of the transmission network in the area. It will separate the existing power transferred into Co. Mayo (via Dalton 110kV station) from Galway onto a direct feed from Cashla 220kV station. As a consequence, the load carried on Cashla-Galway 110kV lines will be reduced extending the life expectancy of this reinforcement.

D.2 BINBANE-LETTERKENNY 110 KV LINE (CP 421)

D.2.1 Description

A new 110 kV line, approximately 60 km in length, between Binbane 110 kV station and Letterkenny 110 kV station, in County Donegal will be linked to a new 110 kV switching station between Binbane and Letterkenny. The new 110 kV switching station is to facilitate 110 kV connections to the Derrybeg area. The DSO has indicated that it intends to phase these connections i.e., install the second connection at a later date.

This project is being prepared for submission for Planning Approval and subject to favourable outcome from this process it is expected to be completed in 2009.

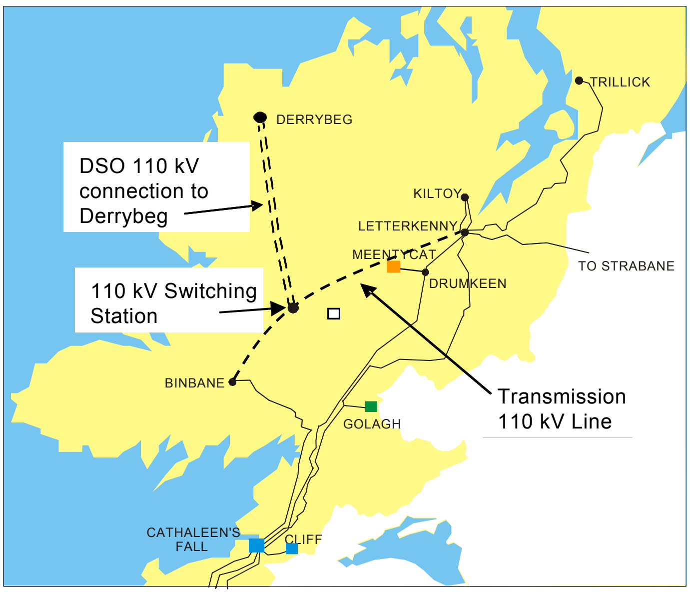


Figure D-2 Proposed 110kV option to reinforce Co. Donegal

D.2.2 Reason for Development

The DSO has requested a second connection to the existing Binbane 110 kV station and a connection to a new 110 kV station near Derrybeg to provide support in North West Donegal. A Binbane Letterkenny 110kV line provides a second connection to Binbane, while the proposed 110kV switching station, east of Glenties, will provide a connection point for the connection, and ultimately two connections to Derrybeg.

The proposed solution satisfies the DSO requests for the area. In addition it will facilitate both increased demand in Co. Donegal and increased generation export from the county. It also complies with National and regional development policies.

APPENDIX E REGULATION 8(6)

8 (6) (a) Within such time that the Commission may direct, the transmission system operator shall prepare a plan (in these Regulations referred to as the "development plan") for the development of the transmission system in order to guarantee security of supply, which shall relate to a period of 5 calendar years from the date on which the plan is prepared by the transmission system operator.

(b) The transmission system operator shall, at least once each year, revise the development plan, and the revised plan, which shall relate to a period of 5 calendar years following the date on which the plan is revised, shall be submitted to the Commission for approval.

(c) The development plan shall take account of-

(i) existing and planned generation, transmission, distribution and supply,

(ii) forecast statements prepared under section 38 of the Act of 1999,

(iii) interconnections with other systems, and

(iv) national and regional Government development objectives.

(d) The development plan shall indicate the manner in which the transmission system operator shall discharge its functions under paragraph 1.

(e) The development plan shall be submitted to the Commission for approval.

(f) The transmission system operator shall-

(i) engage in a public consultation process, including any other form of consultation that the Commission may direct, before submitting the development plan to the Commission for approval, and

(ii) report in writing to the Commission on the results of that process not later than when submitting the development plan to the Commission for approval.

(g) The Commission may from time to time give directions to the transmission system operator in respect of -

(i) the matters to be specified in the development plan, and

(ii) the review and revision by the transmission system operator from time to time of the development plan,

and the transmission system operator shall comply with directions given by the Commission under this subparagraph.

APPENDIX F GLOSSARY

Aluminium Conductor Steel Reinforced (ACRS)	A conductor consisting of aluminium wires wound around a steel core.
Bay	A bay in a connection point to a busbar, and comprises switchgear and measurement equipment.
Busbar	An electrical conductor located in a station that makes a common connection between several circuits.
Capacitor	An item of plant normally utilised on the electrical network to supply reactive power to loads (generally locally) and thereby supporting the local area voltage.
Circuit	A line or cable, including associated switchgear, which carries electrical power.
Circuit Breaker	A device used to open a circuit that may be carrying electrical current.
Combined Cycle Gas Turbine	A collection of gas turbines and steam units; waste heat from the gas turbines(s) is passed through a heat recovery boiler to generate steam for the steam turbines.
Contingency	An unexpected failure or outage of a system component, such as a generation unit, transmission line, transformer or other electrical element. A contingency may also include multiple components, which are related by situations leading to simultaneous component outages. The terms "contingency" and "loss" are used interchangeably in this Development Plan.
Current Transformer	Current transformers are commonly used in protection systems to facilitate the measurement of large currents which would be difficult to measure more directly.
Deep Reinforcement	Refers to network reinforcement additional to the shallow connection that is required to allow a new generator or demand to operate at maximum capacity.
Demand	The peak demand figures in Table 2-1 in Chapter 2 refer to the power

	that must be transported from grid connected generation stations to meet all customers' electricity requirements. These figures include transmission losses.
Demand-Side Management	The modification of normal demand patterns usually through the use of financial incentives
Dropper	Refers to a short piece of conductor used to connect an overhead line to a line bay.
ESB National Grid	A ring-fenced division of ESB currently performing the TSO and Market Operator roles.
EirGrid	As part of the EU's electricity liberalisation programme an independent electricity Transmission System Operator must be set up for each EU member state. ESB National Grid is currently performing the role of electricity TSO in Ireland. EirGrid Plc. will take over TSO role from ESB National Grid (ESBNG) at some point in the future.
Embedded Generation	Refers to generation that is connected to the distribution system or at a customer's site.
Gas Insulated Switchgear	A compact form of switchgear where the conductors and circuit breakers are insulated by an inert gas.
Generation Dispatch	The configuration of outputs from the connected generation units.
Grid	A meshed network of high voltage lines and cables (400 kV, 220 kV and 110 kV) for the transmission of bulk electricity supplies around Ireland. The grid, electricity transmission network, and transmission system are used interchangeably in this Development Plan.
Interconnector	The tie line, facilities and equipment that connect the transmission system of one independently supplied transmission network to that of another.
Plan Period	The five-year period covered by this Development Plan i.e., 2006 to 2010 inclusive.
Power Flow	The flow of 'active' power is measured in MegaWatts (MW). When compounded with the flow of 'reactive power', which is measures in Mvar; the resultant is measured in MegaVolt-Amperes (MVA)

Phase Shifting Transformer	An item of plant employed on the electrical network to control the flow of active power.
Reactive Compensation	The process of supplying reactive power to the network.
Reactive Power	Reactive power is that portion of electricity that establishes and sustains the electric and magnetic fields of alternating current equipment. It is utilised to control voltage on the transmission network.
Reactor	An item of plant employed on the electrical network to either limit short circuit levels or prevent voltage rise depending on its installation and configuration.
Supervisory Control and Data Acquisition systems	Used to monitor and control system equipment from the relevant control centre.
Shallow Connection	Shallow Connection means the local connection assets required to connect a customer to the transmission system and which are for the specific benefit of that particular customer.
Split Busbar	Refers to a busbar at a given station which is operated electrically separated. Busbars are normally split to limit short circuit levels or to maintain system reliability.
Static Var Compensator	Device which provides fast and continuous capacitive and inductive reactive power supply to the power system.
Summer Valley	The annual minimum that usually occurs in August. Annual minimum demand is typically about one-third of the annual maximum demand.
Summer Peak	The average week-day peak value between March and September, inclusive, which is typically 20% lower than the winter peak.
Switchgear	A combination of electrical disconnects and/or circuit breakers used to isolate equipment in or near an electrical station.
Tailed connection	A radial (single-circuit) connection into an existing station.
Tee connection	An un-switched connection into an existing line between two other stations.

Transformer	An item of equipment connecting equipment at two different nominal voltages.
Transmission Interface Station	A station that is a point of connection between the transmission system and the distribution system or directly connected customers.
Transmission Losses	A small proportion of energy is lost as heat whilst transporting electricity on the transmission system. These losses are known as transmission losses. As the amount of energy transmitted increases, losses also increase.
Transmission Peak	The peak demand that is transported on the grid. The transmission peak includes an estimate of transmission losses.
Transmission Planning Criteria	The set of standards that the transmission system is designed to meet. The criteria are deterministic as is the norm throughout the world. They set out objective standards which have been found to deliver an acceptable compromise between the cost of development and the transmission service provided.
Uprating	To increase the rating of a circuit. This is achieved by increasing ground clearances and/or replacing conductor, together with any changes to terminal equipment and support structures.
Voltage Transformer	Voltage transformers are commonly used in protection systems to facilitate the measurement of large voltages which would be difficult to measure more directly
Winter Peak	This is the maximum annual system demand. It occurs in the period October to February of the following year, inclusive. Thus for transmission planning purposes the winter peak in 2010, the final year of this plan, may occur in early 2011. The winter peak figures take account of the impact of projected Demand Side Management initiatives.