6 OVERVIEW OF TRANSMISSION SYSTEM CAPABILITY ANALYSES

This chapter describes the analyses carried out to determine the capability of the grid to accommodate changes in generation and demand at various parts of the network. The results of these analyses, together with information in other chapters, provide the basis for the statements of opportunity in Chapters 7 to 10.

The analyses were carried out for three specific years.

- **2007:** This is the second year of the seven-year period of the Transmission Forecast Statement (TFS). In previous Transmission Forecast Statements, capability in the first year was analysed. However, anyone using this statement for information prior to making an application for connection is unlikely to want to connect in the first year i.e., 2006. The information provided for 2007, therefore, gives developers a more useful indication as to the opportunities that exist in the short-term. This change in approach was approved by the CER.
- **2009:** This is the mid-year of the seven-year period. Because of typical lead-times for construction of generation or demand plant, this year represents the more realistic beginning of the period of interest for developers at a pre-feasibility stage wishing to connect to the transmission system.
- **2012:** This covers the final year of the TFS, which extends to winter 2012/13.

The summer and following winter of each year were studied. The base case dispatches used for the studies are presented in Table D-4 in Appendix D.

The locations analysed for new generation and demand have been carefully reviewed based on feedback from industry sources. The chosen stations have been tailored to match more closely the needs of customers. One set of stations has been chosen for the analysis of new generation, whereas a different set of stations was chosen for the analysis of additional demand, as illustrated in Chapters 7 and 8, which address network capability for new generation and new demand respectively.

It should be noted that the results of these studies are dependent on the assumptions made about generation and demand, and on the completion dates of network development projects as described in previous chapters. Factors that may influence the results are discussed in Section 6.5

6.1 TRANSFER CAPABILITY ANALYSES FOR NEW GENERATION

When a new generator connects to the grid its output displaces that of other existing generators, typically creating an incremental power transfer, additional to the

anticipated power flows, between the new generator and the displaced generation. This section deals with the analysis of the grid's capability to accommodate such increased power flows. The results of the analysis, presented in Chapter 7, set out the Incremental Transfer Capability (ITC), which is a measure of the transfer capability remaining in the physical grid for further activity, over and above already anticipated uses.

Incremental Transfer Capability is directional in nature. For instance, the ITC from Dublin to Cork is entirely different to the ITC from Cork to Dublin. In general, connection of generation in areas that are short of generation helps to reduce line loadings, and hence allow increased utilisation of the grid.

It is important to consider small localised increases in generation, in addition to the far-reaching effects of large new generator connections. Typically large generators greater than 100 MW connect to the 220 kV network while smaller generators connect at 110 kV. To capture these different levels of concern about grid capability, the TSO carried out analysis of generation connections to a large number of stations at diverse locations on both the 110 kV and 220 kV networks.

The method of analysis used to assess the transfer capability for connection of new generation at the selected stations is detailed in Appendix G. In summary, the method involves modelling a new generator at each selected station and assessing the resulting power transfer in turn between this new generator and the three blocks of existing generation, shown in Table 6-1. The maximum transfer level from each station to each generation block is reached when the first overload or voltage outside standards occurs. Only problems that are significantly exacerbated by the transfer are relevant to the analysis. The lowest ITC from a station is generally the transfer that determines the opportunity for generation at that station.

Table 6-1 Existing Generation Blocks

Existing Generation Block	Thermal Generation Stations
Dublin	Dublin Bay Power, Huntstown, North Wall, Poolbeg, Turlough Hill
West	Moneypoint Units 1 and 3, Tynagh, West Offaly Power, Lough Ree Power
South	Aghada, Great Island, Marina, Tarbert, Moneypoint Unit 2

In previous Transmission Forecast Statements transfer capability was tested to the south-west and south-east. Because generation capacity in the south-east is small and offers limited ability to test transfers to this area, this TFS combines the south-east and south-west into a larger "South" group. However, to capture the particular aspects of

the previous analysis, the ITCs to the South were calculated for a variety of dispatch scenarios:

- reducing generation in the south-east first, then Cork, then Kerry;
- reducing generation in the south-east first, then Kerry, then Cork;
- reducing generation in Cork first, then Kerry, then the south-east;
- reducing generation in Kerry first, then Cork, then the south-east.

A subset of the Transmission Planning Criteria (TPC) was tested in determining the ITCs. The results may, therefore, be optimistic in some cases. Among the standards not tested in this analysis are voltage, dynamic stability and trip-maintenance combinations i.e., contingencies involving an unplanned line outage during the planned maintenance of another circuit. The connection of new generation with reactive power capability does not generally cause a voltage problem. Dynamic stability difficulties on the Irish system that have arisen in the past have been overcome by the use of suitable control equipment. In the case where the new generator causes a trip-maintenance problem, it may be possible to constrain off generation during the maintenance outage or to carry out the transmission maintenance when generation in the area is out for maintenance or otherwise not running. It should be noted, however, that the arrival of new generation, interconnection or large clusters of wind farms could significantly change how dynamic stability issues would be addressed.

The impact on short circuit levels of new generation at potential sites is considered separately in Section 7.3.2 in Chapter 7.

6.2 TRANSFER CAPABILITY ANALYSES FOR NEW DEMAND

The grid is planned to meet forecast demands at all stations in the country. The demand forecast for each 110 kV station is a proportion of the overall system demand forecast based on historical demand distributions. Future demand customers that have signed connection agreements are also included in station demand forecasts.

While additional demands above the forecast levels are not explicitly catered for in network plans, there may be capacity for such additional demand inherent in the network at certain locations. New demands can generally locate in an area that has excess generation capacity as this will reduce power flows out of the area. Alternatively, the addition of transmission infrastructure generally provides a step increase in network capacity which may permit demands higher than forecast levels, as illustrated in Figure 6-1. The blue line represents the required capacity at a particular point in the network. The red line represents the installed network capacity. Changes in installed capacity generally come in discrete steps, thus providing spare capacity for a period of time.

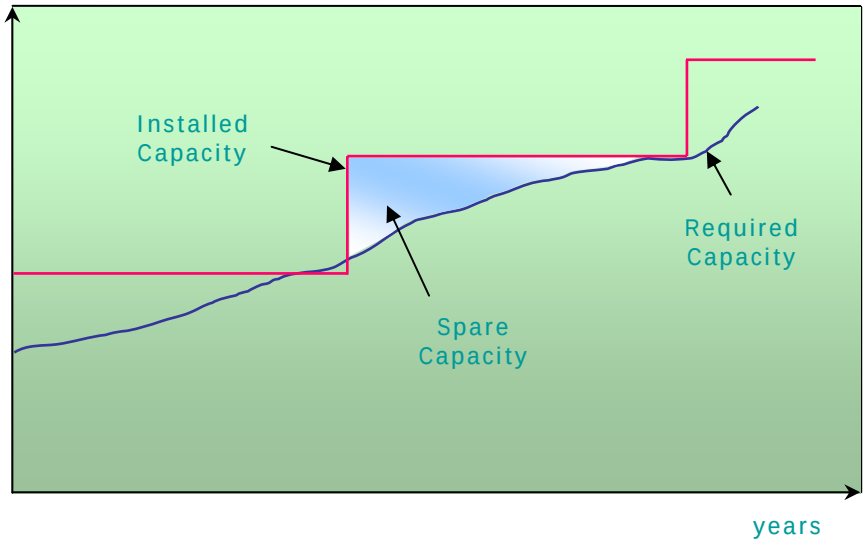

Figure 6-1 Illustration of Typical Step Change in Network Capacity

Figure 6-2 illustrates the demand profile for a representative station. The blue line represents the demand forecast at the station. The green bars represent a new step increase in demand. The analysis carried out for this TFS examines the grid's capability to accept such increased demand above forecast levels at selected 110 kV stations. The selected 110 kV stations, which feed principal towns and demand centres distributed throughout the country, are shown in Figure 8-1 in Chapter 8. The results of this analysis are useful in identifying opportunities for the connection of new or increased demand of a size typical of industrial development in the Republic of Ireland.

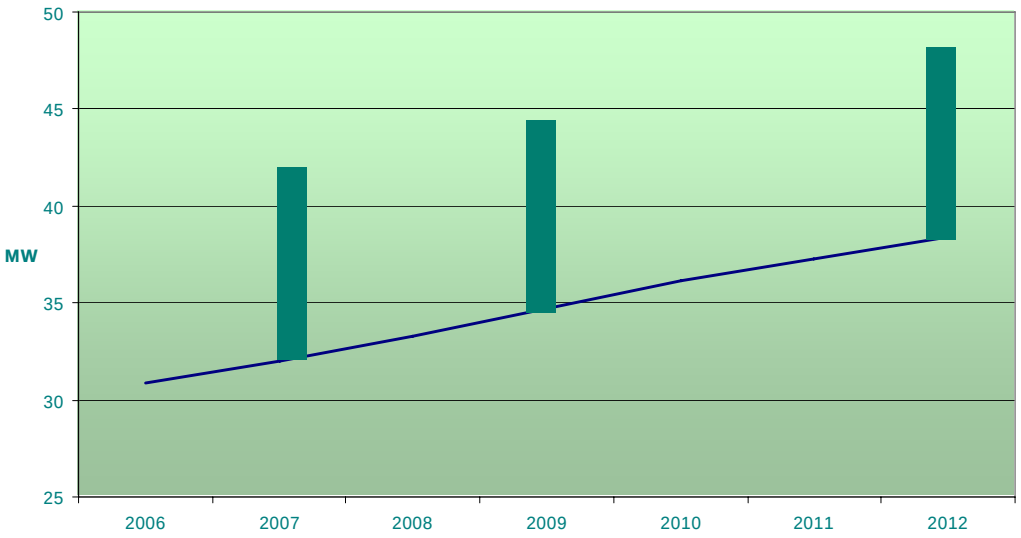

Figure 6-2 Demand Profile at Typical Station

The method of analysis is detailed in Appendix G. In summary, when demand in an area increases, it must be supplied by an increased output from generation units. An

incremental power transfer is created. The method for this study, therefore, involves modelling incremental power transfers between centres of existing generation and potential demand areas. The transfer level is reached when the first circuit overload or voltage problem occurs following a circuit or generator outage. Outages during the maintenance of key circuits were considered in these studies. Dynamic stability problems were not assessed. It should be noted that only problems that are significantly exacerbated by the transfer are relevant to the analysis.

In assessing opportunities for new demands, the TFS considers the capability of the transmission grid only. The capability of the distribution system is not addressed. The implications for generation adequacy of demand growth above the median forecast levels are dealt with separately in the TSO's *Generation Adequacy Report 2006-2012*.

6.3 TRANSFER CAPABILITY ANALYSES FOR TRANSFERS WITH NORTHERN IRELAND / SINGLE ELECTRICITY MARKET

The new trading arrangements for the Single Electricity Market are planned to take effect in 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. However, the current interconnection and the networks in each system could pose a constraint on required transfers. The planned second interconnector to Northern Ireland and the 400 kV line from Woodland to Cavan, described in Sections 2.3.6 and 2.3.7 of Chapter 2 respectively, are expected to alleviate these constraints thus providing increased capacity for transfers between the two jurisdictions.

This section deals with the capability of the grid to accommodate transfers between the two systems. The analysis in this TFS calculates the total transfer capability[10] (TTC), which is the total capability of the network to accommodate all transfer flows, including emergency flows that would occur after a contingency in either system.

Total Transfer capabilities from Northern Ireland are evaluated in the same way as new generation described in Section 6.1. Increased generation in Northern Ireland is matched by a reduction in the existing generation groups in the Republic of Ireland.

Transfers to Northern Ireland are achieved by an increase in generation in the Republic of Ireland. The network capability to accommodate transfers to Northern Ireland was tested by adding generation at the same 220 kV stations that were examined for generation to meet a net demand increase in Northern Ireland.

[10] The market data posted on the TSO's website (www.eirgrid.com) includes figures for the Net Transfer Capacity (NTC) for interconnector transfers.

As in the case of the generation analysis, a subset of standards was applied. Among the standards not tested in this analysis were voltage, dynamic stability and trip-maintenance combinations. The results may, therefore, be optimistic in some cases.

6.4 TRANSFER CAPABILITY ANALYSES FOR IRELAND-GREAT BRITAIN TRANSFERS

In February 2004, Minister Dermot Ahern TD, then Minister for Communications, Marine and Natural Resources, 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. The TSO understands that a decision in relation to the Ireland-Great Britain 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.

Part of the consideration of any new interconnector is the selection of suitable connection points on both sides of the Irish Sea. The capability of the Irish grid to accept imports and exports of 500 MW was tested at nine potential connection points located along the east and south coasts. These locations are shown in Figure 10-1 in Chapter 10.

Analysis of the capability to import power from Great Britain is equivalent to analysing the capability to accommodate new generation and was carried out using the same method that was used for generation ITC studies at 110 kV and 220 kV stations.

Exports are equivalent to large new demands. The analysis of export capability was carried out using the same method as for new demands at 110 kV stations, with the exception that trip-maintenance contingencies were not considered for this analysis. It is assumed that in certain cases exports over the interconnector could be reduced for short periods to allow essential maintenance.

6.5 FACTORS IMPACTING ON RESULTS

The results of the analyses described in this chapter, and in the appendices, are based on a set of assumptions about future demand growth, generation connections and transmission developments. The key forecast factors on which the results depend are dynamic and, therefore, the reality that emerges will not exactly match the forecasts. Consequently, the results, while reasonably indicative, should not be interpreted as definitive projections.

The factors likely to have an impact on the outcomes include:

- the signing of a connection agreement by a new generator - the “Gate 2” process is likely to result in connection offers for up to 1,300 MW of wind generation; in addition, the CER has directed that 800 MW capacity should be reserved in the south-west region for thermal generation;
- delays in connection of committed new generation;
- closure of existing generation plant;
- changes in the economy which give rise to consequential changes in the overall demand for electricity;
- changes in demand in a particular region or area, arising from new industry developments or closures;
- delays in the provision of network reinforcements;
- selection and construction of new reinforcement developments which may significantly increase network capacity.