6 OVERVIEW OF TRANSMISSION SYSTEM CAPABILITY ANALYSES

This chapter describes the analyses carried out to determine the capability of the grid to accommodate additional generation, demand and interconnection 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 9.

The analyses were carried out for three specific years:

- **2008:** This is the second year of the seven-year period of the Transmission Forecast Statement (TFS). The information provided for 2008 gives developers a more useful indication as to the opportunities that exist in the short-term.
- **2010:** 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.
- **2013:** This covers the final year of the TFS, which extends to winter 2013/14.

Studies were carried out for the summer and following winter of each year using information describing the existing and planned transmission system as known at the end of December 2006. The base case generation dispatch scenarios used for the studies are presented in Tables D-4 and D-5 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. The capability of the network to accommodate new or additional interconnection is addressed in Chapter 9.

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 6.4.

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 or 400 kV networks while smaller generators connect at 110 kV. To capture these different levels of concern about grid capability, the Transmission System Operator (TSO) carried out analysis of generation connections to a large number of stations at diverse locations on the 110 kV and 220 kV networks and at one location on the 400 kV network.

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 four blocks of existing and planned generation shown in Table 6-1. The existing Moyle interconnector between Northern Ireland and Scotland and the planned East-West interconnector between the Republic of Ireland and Great Britain form parts of the "Northern Ireland" and "Dublin" groups respectively. Wind generation also forms part of each generation block, assigned on a geographical and jurisdictional basis. The maximum transfer level from each station to each generation block is reached when the first overload 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.

Given that the large amount of generation that makes up the "South" group is distributed across a wide geographical area, 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.

Table 6-1 Generation Blocks

Generation Block	Generation Stations
Dublin	Dublin Bay Power, Huntstown Units 1 & 2, North Wall, Poolbeg, Edenderry Power, Turlough Hill, East-West Interconnector
Northern Ireland	Ballylumford, Coolkeeragh, Kilroot, Moyle Interconnector
West	Moneypoint Units 1 and 3, Tynagh, Lough Ree Power, West Offaly Power, Ardnacrusha Hydro, Erne Hydro
South	Aghada, Aughinish, Great Island, Marina, Moneypoint Unit 2, Tarbert, Lee Hydro, Liffey Hydro, Aghada CCGT, WhiteGen CCGT

In *Transmission Forecast Statement 2006-2012*, Chapter 9 was dedicated to reporting the Total Transfer Capability (TTC) for power transfers to and from Northern Ireland, treating the existing 275 kV and planned 400 kV cross-border circuits as interconnectors. In the context of the Single Electricity Market, all cross-border circuits will essentially become internal circuits in the new market. As such, the "Northern Ireland" generation block has been introduced into the ITC analysis this year in order to reflect the fact that generation will be dispatched on an all-island basis. The TTC information previously presented is no longer relevant. It is important to note that in assessing opportunities for new generation, the TFS considers the capability of the transmission system of the Republic of Ireland only. The capability of the transmission system of Northern Ireland is addressed in SONI's Transmission System Seven Year Statement.

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.

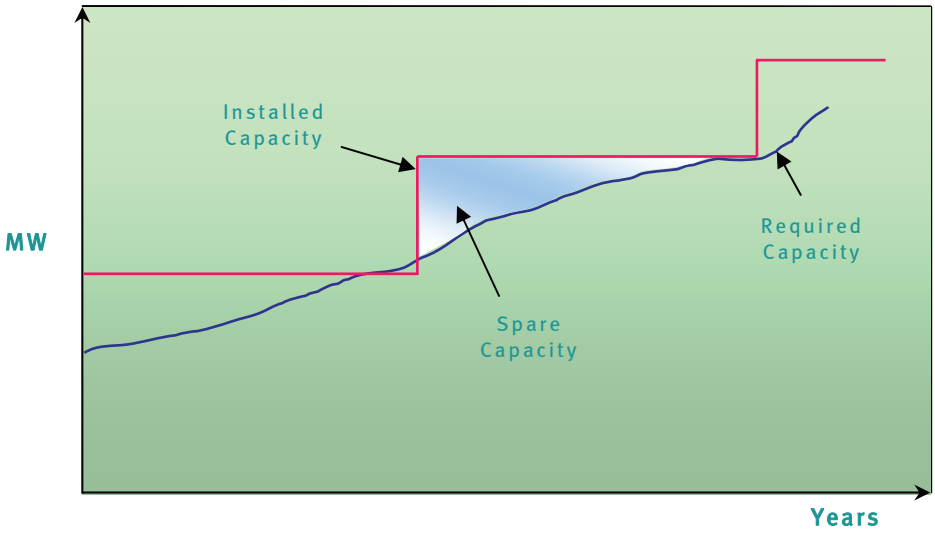

Figure 6-1 Illustration of Typical Step Change in Network Capacity

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.

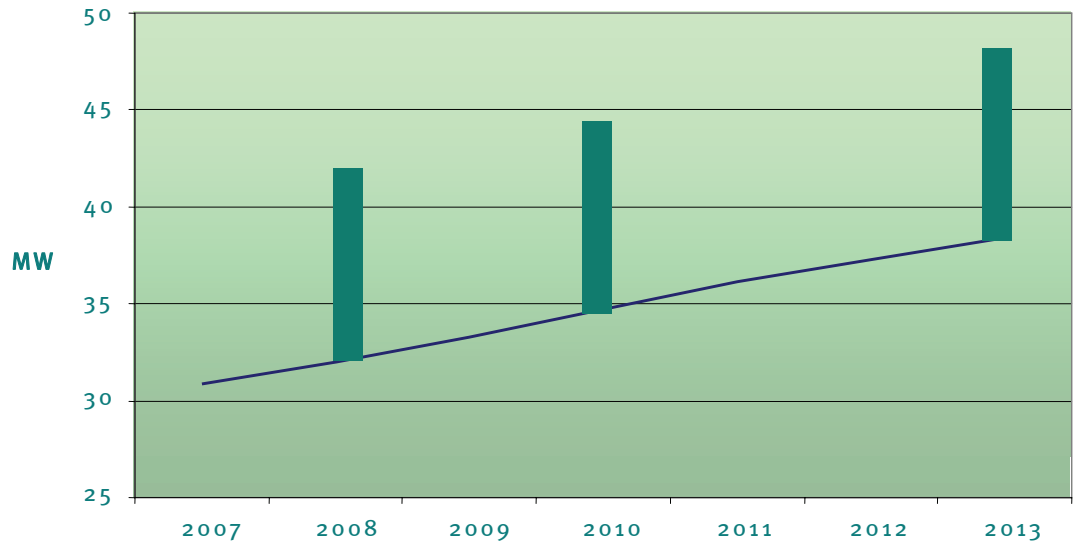

Figure 6-2 Demand Profile at Typical Station

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 limit 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 2007-2013*.

6.3 TRANSFER CAPABILITY ANALYSES FOR NEW INTERCONNECTION

In July 2006, Minister Noel Dempsey TD, then Minister for Communications, Marine and Natural Resources, requested the arrangement of a competition to secure the construction of a 500 MW East-West interconnector between Ireland and Great Britain. As recommended by the TSO, the Commission for Energy Regulation has since approved the choice of Woodland as the connection point on the Irish system for the interconnector. The

connection point to the British transmission system has yet to be finalised. The interconnector is expected to be in place by 2012.

The government White Paper entitled "Delivering A Sustainable Energy Future For Ireland", published in March 2007, states that the TSO will be requested to analyse the feasibility of potential further interconnection with Great Britain, additional to the planned East-West interconnector, or new interconnection with continental Europe. In this TFS, the capability of the national grid to accept further imports from and exports to other transmission systems i.e., additional to imports and exports across the planned East-West interconnector, was tested at nine potential connection points located along the east and south coasts. These locations are shown in Figure 9-1 in Chapter 9. Analysis was carried out for 2013, the final year of the period covered by this TFS.

Analysis of the capability to import power from another power system 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, 220 kV and 400 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.

6.4 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 being issued for more than 1,300 MW of wind generation;
- delays in connection of committed new generation;
- planned closure/divestiture of the Tarbert, Poolbeg and Great Island generation stations and decommissioning of the steam turbine at Marina;
- 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.