7 NETWORK CAPABILITY FOR NEW GENERATION

This chapter describes the results of the incremental transfer capability (ITC) analysis, described in Chapter 6 and in Appendix G in more detail, which was carried out to determine the capability of the grid to accommodate changes in generation. Using these results it discusses the expected "opportunity" for generation development at various parts of the network.

"Opportunity" relates to the capacity available for greater use of the grid without the need for reinforcements beyond those already planned. The purpose of these studies is to indicate where connections would require deep[11] reinforcements. Appendix F provides additional information about the likely scale of developments required.

Where grid capability is shown as limited, this means that additional deep reinforcements will be necessary to facilitate the connection of new generation. It should not be interpreted as meaning that new generation may not be connected.

The TSO will initiate such reinforcement projects as necessary once a generator has signed a connection agreement. However, it should be noted that a connection that requires long lead-time deep reinforcements may have implications for the generator developer. Depending on access policy, the generator's ability to connect or to export all its power may be limited until such time as those reinforcements are completed. It would be helpful therefore to generator developers and the TSO if the developers would consult the TSO early in their development process to explore options relating to their proposal thus enabling them to make timely decisions.

7.1 ITC RESULTS FOR LARGE GENERATION AT SELECTED 220 KV STATIONS

This section presents the capacity for bulk power transfers on the transmission system from new generation connecting at selected 220 kV stations.

There are twenty-five 220/110 kV stations on the system. Fifteen 220 kV stations (comprising almost all 220 kV stations outside Dublin and a representative number in Dublin) have been selected to illustrate the capability of the grid to accommodate new power transfers between different areas resulting from the connecting of new generation. Figure 7-1 illustrates the locations of the 220 kV stations selected. The 15 stations are Louth and Gorman in the north-east, Maynooth, Finglas and Carrickmines in

[11] Network reinforcement, in addition to the shallow connection, that allows connecting generators to export their full capacity.

Dublin[12], Arklow, Great Island and Cullenagh in the south-east, Clashavoon, Knockraha, Killonan and Tarbert in the south-west, Flagford and Cashla in the west and Shannonbridge in the midlands.

Figure 7-1 220 kV Stations Studied for Generation Capability

The ITC results for generation at 220 kV stations are presented in Tables 7-1, 7-2 and 7-3, for the years 2007, 2009 and 2012 respectively. The levels of available ITC are classified as:

- Very high — more than 400 MW;
- High — between 250 and 400 MW;
- Medium — between 100 and 250 MW;
- Low — less than 100 MW.

The connection of new generation to the grid, additional to the current forecasts and assumptions, will alter the expected power flows. The figures in brackets in Tables 7-1 to 7-3 provide a cross reference between the medium or low ITCs and the tables in Appendix F which provides additional information regarding the likely scale of development required to increase the ITCs. Reference numbers prefixed with a “P” indicate that the TSO has initiated projects which will overcome the constraint; a “C”

[12] While Maynooth is in Co. Kildare, it forms an integral part of the grid supplying the load in Dublin.

indicates that plans are being progressed to deal with the constraint; an "F" means that further investigation is required before a solution is selected.

As described in Section 6.1 in Chapter 6, results for transfers to the "South" are drawn from the results of four different scenarios of generation reduction in the south, including that represented by transfers to the South-East in previous Forecast Statements. The results of these four different scenarios have been merged in Tables 7-1 to 7-3 for simplicity.

Table 7-1 Incremental Transfer Capability for Generation at 220 kV Stations in 2007

Transfer From	220 kV Station	Transfer To		
		Dublin	South	West
	Arklow	Very High	Low (P2)	Very High
	Carrickmines	Very High	Low (P1)	Medium (P4)
	Cashla	Low (P2)	Low (P2)	Low (P2)
	Clashavoon	Low (P5)	Medium (P5)	Low (P3)
	Cullenagh	Very High	Medium (C8)	High
	Finglas	High	Low (P1)	Medium (F1)
	Flagford	Low (P2)	Low (P2)	Very High
	Gorman	Very High	Low (P1)	Very High
	Great Island	Very High	Low (C1)	High
	Killonan	Low (P5)	Low (P5)	Low (P3)
	Knockraha	Low (P5)	Low (P5)	Low (P3)
	Louth	Very High	Low (P1)	Very High
	Maynooth	Very High	Low (P1)	High
	Shannonbridge	High	Low (P1)	High
	Tarbert	Low (P5)	Low (P5)	Low (P3)

Table 7-2 Incremental Transfer Capability for Generation at 220 kV Stations in 2009

Transfer From	220 kV Station	Transfer To		
		Dublin	South	West
	Arklow	Very High	Low (C1)	Very High
	Carrickmines	Very High	Low (P1)	Low (C3)
	Cashla	Medium (P2)	Low (P2)	Medium (P2)
	Clashavoon	Low (P5)	Low (P5)	Low (P3)
	Cullenagh	High	High	High
	Finglas	High	Low (P1)	High
	Flagford	Medium (P2)	Low (P2)	Very High
	Gorman	Very High	Low (P1)	Very High
	Great Island	High	Low (C1)	High
	Killonan	Low (P5)	Low (P5)	Low (P3)
	Knockraha	Low (P5)	Low (P5)	Low (P3)
	Louth	Very High	Low (P1)	Very High
	Maynooth	Very High	Low (P1)	High
	Shannonbridge	Medium (P5)	Low (P1)	Medium (P5)
	Tarbert	Low (P9)	Low (P5)	Low (P3)

Table 7-3 Incremental Transfer Capability for Generation at 220 kV Stations in 2012

Transfer From	220 kV Station	Transfer To		
		Dublin	South	West
	Arklow	Very High	Medium (C1)	Very High
	Carrickmines	Very High	Low (C3)	Medium (C3)
	Cashla	Very High	Low (C2)	Very High
	Clashavoon	Medium (C6)	Low (P3)	Low (P3)
	Cullenagh	High	Medium (C8)	High
	Finglas	Very High	Low (C3)	Medium (C9)
	Flagford	Very High	Low (C2)	Very High
	Gorman	Very High	Medium (C9)	Very High
	Great Island	Very High	Medium (C8)	High
	Killonan	Medium (F4)	Low (P3)	Low (P3)
	Knockraha	High	Low (P3)	Low (P3)
	Louth	Very High	Medium (C9)	Very High
	Maynooth	Very High	Low (C3)	Very High
	Shannonbridge	Medium (F3)	Medium (C2)	Very High
	Tarbert	High	Medium (C5)	Low (P3)

A sensitivity study was carried out to assess the impact of considering incremental transfers to Northern Ireland in addition to the Dublin, South and West generation groups. The results of the sensitivity showed that the 2009 ITCs from Cullenagh to the Dublin, South and West groups is “High” but the ITC to Northern Ireland is “Medium”. In all other cases the ITCs to Northern Ireland are the same or better than the most limiting ITCs.

The results of the ITC analysis are used to derive the opportunities for new generation, discussed in Section 7.3. The lowest ITC from a station is generally the transfer that determines the opportunity for generation at that station. It should be noted that the capability for each station is tested individually; the results are, therefore, not cumulative.

This Transmission Forecast Statement (TFS) includes reinforcements that have been selected and initiated as projects. In reality, additional developments are expected to be identified and, if implemented, are likely to further improve the incremental transfer capabilities in 2012.

7.2 ITC RESULTS FOR SMALLER GENERATION AT SELECTED 110 KV STATIONS

Thirty-five 110 kV stations were examined in the analysis of the grid’s capability to accommodate smaller generators. This compares with 33 stations analysed in *Transmission Forecast Statement 2005-2011*. The 35 stations were chosen on the basis

of feedback from interested developers. Figure 7-2 shows how these stations are widely dispersed and therefore representative of the entire country.

This section looks at the ability of selected 110 kV stations to accept generation. This information is useful in identifying opportunities for the connection of smaller generation stations, typically up to 100 MW in size. Generators larger than this would normally be connected at 220 kV.

The results of the studies are presented in Table 7-4. Stations are grouped in the table by electrical area. As in the case with the 220 kV results, the capability for each station is tested individually and hence the results are not cumulative.

Figure 7-2 110 kV Stations Studied for Generation Capability

The figures in brackets in Table 7-4 provide a cross reference between the low ITCs and the tables in Appendix F that provide additional information regarding the plans to address the constraints or the likely scale of development required to increase the ITCs. In summary, the TSO is progressing projects to address the constraints identified as “P1”, “P2” and “P3”, and has plans to address the “C2” constraint in the near future.

Table 7-4 Capability for New Generation at 110 kV Stations, MW

Region	Station	2007		2009		2012	
North-east	Drybridge	<10	(P1)	<10	(P1)	160	
	Dundalk	<10	(P1)	<10	(P1)	120	
	Meath Hill	<10	(P1)	<10	(P1)	110	
	Ratrussan	10	(F5)	<10	(P1)	10	(F5)
North-west	Bellacorick	<10	(P2)	<10	(P2)	10	(C2)
	Carrick-on-Shannon	<10	(P2)	<10	(P2)	10	(C2)
	Castlebar	<10	(P2)	<10	(P2)	10	(C2)
	Cathaleen's Fall	<10	(P2)	<10	(P2)	10	(C2)
	Corderry	<10	(P2)	<10	(P2)	10	(C2)
	Letterkenny	<10	(P2)	<10	(P2)	10	(C2)
	Sligo	<10	(P2)	<10	(P2)	10	(C2)
Midlands	Athlone	<10	(P2)	<10	(P2)	10	(C2)
	Mullingar	<10	(P2)	<10	(P2)	10	(C2)
	Portlaoise	<10	(P1)	<10	(P1)	140	
	Thurles	120		120		130	
	Tipperary	110		110		110	
West	Agannygal	50		50		30	
	Ennis	100		50		20	(C2)
	Galway	<10	(P2)	<10	(P2)	10	(C2)
South-east	Carlow	<10	(P1)	<10	(P1)	130	
	Crane	<10	(P2)	40		110	
	Doon	130		130		130	
	Dungarvan	<10	(C1)	120		120	
	Kilkenny	<10	(P1)	<10	(P1)	130	
	Waterford	<10	(P2)	60		120	
South-west	Charleville	<10	(P3)	<10	(P3)	<10	(P3)
	Clonkeen	<10	(P3)	<10	(P3)	<10	(P3)
	Cow Cross	<10	(P3)	<10	(P3)	<10	(P3)
	Dunmanway	<10	(P3)	<10	(P3)	<10	(P3)
	Macroom	<10	(P3)	<10	(P3)	<10	(P3)
	Mallow	<10	(P3)	<10	(P3)	<10	(P3)
	Marina	<10	(P3)	<10	(P3)	<10	(P3)
	Rathkeale	<10	(P3)	<10	(P3)	<10	(P3)
	Tralee	<10	(P3)	<10	(P3)	<10	(P3)
	Trien	<10	(P3)	<10	(P3)	<10	(P3)

A sensitivity study was carried out to assess the impact of considering incremental transfers to Northern Ireland in addition to the Dublin, South and West generation

groups. The results of the sensitivity showed that the capabilities at some of the midland and southern stations were reduced in 2009.

7.3 OPPORTUNITY FOR NEW GENERATION

Opportunities are largely dependent on the size and location of the connecting generation plant. The connection of a large 400 MW generation station (the size of some recent connection applications) has a much greater impact on power flows than smaller units or typical demand increases. 400 MW represents almost 10% of the peak demand to date. The connection of such a large generator is likely to dramatically alter power flows, and in most cases stress the network beyond its present capacity, requiring significant reinforcements to the grid. The results of the transfer studies indicate that there are no locations on the grid that a large 400 MW generator could connect without the need for network reinforcements. In general opportunities for smaller units to connect, without the need for further reinforcements, are more prevalent.

The opportunities described here are derived from the results of the transfer studies described in the previous section. For a given size of generator it is likely that connection in an area of higher opportunity will incur less reinforcement than connection of a similar generator in an area of a lower opportunity.

7.3.1 Opportunities for Large Generators Connected at 220 kV

The results from the 220 kV transfer studies show that there is limited spare capacity in the network for new large generators. Connection of a large generator is therefore likely to require some level of deep reinforcement to allow it full grid access. The best opportunities currently exist in the south-east. The ITCs for Cullenagh indicate that between 100 MW and 250 MW of generation can be accommodated there in all years with a somewhat higher capability of between 250 and 400 MW in 2009. The ITCs for Great Island, although low, could be improved within the lead-time of a new generation development.

The most significant limit impacting on opportunities is the constraint on power transfers into the south-west resulting from increased generation outside the area. However, the TSO's plans for network development will deliver improved opportunities towards the end of the seven-year period. Two major developments due for completion by the end of 2009 and early 2010 – the Moneypoint-Tarbert 400 kV circuit and the new 400/220 kV station near Nenagh – will create more paths into and out of the south-west.

While the 2012 ITC results still show that transfers to the south-west are limited following the expected completion of these projects, the information provided on constraints, in Tables 7-1 to 7-3 and in Appendix F, indicates that the TSO has plans to address these potential limits. Furthermore sensitivity analysis shows that the next

constraints on transfers into the south-west are such that they could be removed within the lead-time of a generation development. Opportunities in the south-west are lower than in previous Forecast Statements, reflecting the impact of increased generation capacity recently connected or planned for the area. This does not necessarily imply that there will be a high level of constraints in the south-west.

Opportunities in the north-west and the north-east in 2012 could be significantly improved if required by relatively short lead-time network developments. However, opportunities at Louth may be impacted by the existing high fault levels at the station, as discussed in Section 7.3.2.

7.3.2 Impact of Short Circuit Levels on Opportunity for Large Generators

The impact of new generation on short circuit levels was examined as part of the analysis to determine opportunity for new generation. As high short circuit levels constitute a safety issue it is important that problems are addressed before the connection of the new generator.

The study modelled the connection of a new 400 MW generator at each of the selected 220 kV stations in turn. The fault currents were calculated at all buses for each case for winter peak 2007, 2009 and 2012. The results indicate that adding 400 MW of generation at any of the 220 kV stations has some impact on the already high fault levels at Dublin, Tarbert, Cork or Louth, with generation connecting close to these stations having the greater impact. If a new generator wished to locate in any of these areas, more detailed studies of circuit breaker duty would be necessary, to determine if remedial action was required.

Closure of Tarbert generation plant, announced by the ESB after the data freeze for this TFS, will reduce short circuit levels at the station.

7.3.3 Opportunities for Smaller Generators Connected at 110 kV

Connection of small generation stations, with a capacity of the order of 100 MW or less, would usually be at 110 kV. Table 7-4 summarises the results of studies to determine the capacity of new generation that can be connected at selected 110 kV stations. The patterns are similar to the 220 kV results across the three years, with the same system constraints impacting on generation in similar areas.

The results for 2009 and 2012 are presented graphically in Figure 7-3. The results for 2007 are similar to those for 2009. The graphics indicate that in 2009 there is spare capacity for connecting additional generation at stations around Cahir and around Ennis. Connection of generation elsewhere is likely to require deep reinforcements.

As in the case of the 220 kV analysis, opportunities are limited by network constraints, particularly relating to power transfers to the south-west. The improved results for 2012 indicate the benefit of the network development programme. In addition to the Cahir and Ennis areas, opportunities are increased in the north-east and the south-east. The relatively low opportunities in the north-west in 2012 could be significantly improved within the lead-time of a typical generation development by uprating the limiting circuit.

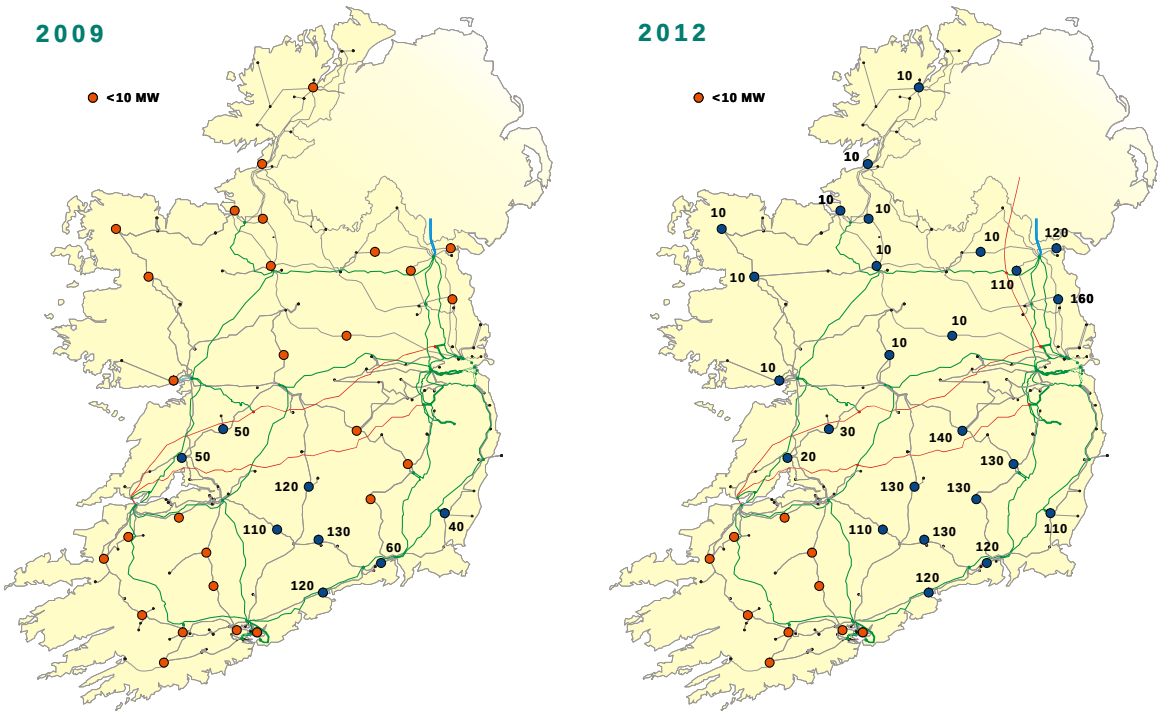

Figure 7-3 Capability for New Generation at 110 kV Stations in 2009 and 2012

The opportunities shown are relevant for generators connecting directly at the stations, where demand[13] connected locally at the station absorbs some of the output from the generator. This is not the case for generators looped into a 110 kV line, and so opportunities for such developments are likely to be more limited. Additional new generation embedded on the distribution system could limit opportunities further.

7.4 IMPACT OF CHANGES SINCE THE DATA FREEZE

Since the data freeze at the end of December 2005, a number of changes in projections have occurred.

A number of embedded wind farms are planned for Co. Donegal, Co. Cork and Co. Wexford. It is expected that the network will need to be reinforced to accommodate the increased wind generation, which may create additional capacity for other generation.

[13] The forecast of local demand for each station is included in the relevant tables in Appendix C.

The TSO has advanced its plans to refurbish a number of transmission lines which in some cases will result in increased line capacities. In particular, the increased rating of the Ardnacrusha-Killonan and Ardnacrusha-Limerick 110 kV lines will reduce a constraint on getting power out of the south-west. More information on this constraint is provided in Appendix F.

ESB has announced its intention to close Tarbert power station by 2010. This would remove 589 MW of generation capacity from the system. The impact on opportunities for other generation will depend on the sequence and timing of the Tarbert unit closures, other potential generation connections and the timing of planned network reinforcements in the south-west.

7.5 HOW TO USE THE INFORMATION FOR GENERATION

Although not every station was considered, the results presented can be regarded as a guide to opportunities at other stations in the same area. Those considering development of generation in the Republic of Ireland should consult the maps in Appendix A to find the nearest station to their proposed development for which opportunity has been assessed. For generation greater than 100 MW the nearest 220 kV station would be appropriate. Smaller generators should consider the 110 kV stations. The opportunity for generation at the relevant nearest station will provide a reasonable indication of whether the development under consideration is likely to necessitate network reinforcements.

The following example is presented as an illustration of how to use the information provided. Developers considering connecting a 50 MW generator in Carlow in 2010 would see by looking at the map that Carlow station is the nearest 110 kV transmission station tested for generation opportunity. The capability results presented in Table 7-4 show that the opportunity at Carlow is less than 10 MW in 2009 but 130 MW in 2012. This means that if planned network reinforcements are commissioned as expected, generation could expect to be connected in this period without the need for further development.

The results of the analysis described above are dependent on the assumptions made about generation and demand, and on the completion dates of transmission reinforcement projects as described in this statement. In evaluating the results and statements of opportunity, the generation developer should consider these assumptions. In addition they should be aware of any subsequent developments that may change these assumptions and hence the opportunity results. For instance, if other new generators sign agreements for connection in an area that are shown to have opportunity they will use up some or all available capacity. Up-to-date information on applications and new generation connection agreements is available on www.eirgrid.com under ‘Customers/Policy/Connection Offer Process’. Before making any commercial

decisions the developers should contact EirGrid for discussions on the proposed development.

There are a number of technical, commercial and timing issues relating to the connection of new generation to the transmission system that are specific to any individual proposal. EirGrid will discuss potential generation proposals with developers in the strictest confidence. In addition, EirGrid will analyse generation connections on a consultancy basis with the aim of identifying some of these issues before a developer proceeds to a formal request for connection to the transmission system.

A document entitled 'Process for Connection' can be found on www.eirgrid.com under 'Customers/Policy/Connection Offer Process'. This document sets out the method by which a formal offer of connection to the transmission system may be obtained by a generation scheme or demand developer. This TFS is published solely for the purposes of Section 38 of the 1999 Electricity Act and is not intended to have any legal effect in relation to the negotiation of contractual terms for connections to the transmission system.