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THE ELECTRICITY TRANSMISSION NETWORK



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4.1 OVERVIEW OF THE ELECTRICITY TRANSMISSION NETWORK (GRID)

The Grid is an integrated system comprising the 400kV and 220kV network, and the 110kV meshed network. The 110kV network within Dublin City is currently operated by the Distribution System Operator (DSO). The DSO licence is held by ESB. Details of the Dublin radial network are not included in this Forecast Statement.

Appendix A contains a geographical map of the existing network and another with the planned network developments to 2009. It also includes single line schematic diagrams of the network for each of the three years assessed.

Two 400kV overhead lines run almost the entire width of the country from the Moneypoint generation station on the west coast to the Dublin area, each terminating to the west of the city, at Woodland and Dunstown transmission stations. At present these two lines carry generation from Moneypoint directly to Dublin. However, the TSO has plans to integrate the Moneypoint-Woodland 400kV line further into the Grid.

The 220kV network is the backbone of the Grid and comprises a number of single circuit loops around the country. Typically large generation stations (greater than 100MW) are connected to the 220kV or 400kV networks. The 110kV network, which constituted the entire transmission system prior to the 1960s, is meshed and so provides parallel paths to the main 220kV system. The higher voltage networks have greater capacity and suffer lower losses.

The transmission system generally comprises overhead lines, except in limited circumstances, such as in the centre of Dublin and Cork cities, where underground cables are used.

Appendix B contains a detailed description of the circuits, transformers and reactive compensation devices that constitute the existing network and the planned network developments.

4.2 PARAMETERS AND CAPACITY RATINGS OF THE EXISTING NETWORK

Details of parameters and ratings of each part of the network are presented in tables in Appendix B.

Table B-1 lists the parameters of the existing overhead lines and underground cables. The ratings shown are the maximum continuous ratings (MCR) in MVA for winter and summer reference temperature conditions. The MCR is the maximum permissible power that the circuit can transport on a continuous basis. Reference ambient temperatures are:

- Winter 5°C;
- Summer 25°C.

The higher ambient temperature in summer results in a reduced rating for overhead lines, as is evident in Table B-1.

Table B-2 lists data for existing transmission transformers. The data includes impedance values, maximum continuous ratings and tap ranges. The voltage tapping range for each transformer is given as the percentage deviation from the nominal voltage ratio at the two extreme tap positions.

Table B-3 includes the Mvar capacity data for existing reactive compensation devices. Existing reactive devices connected to the Grid include shunt capacitors, static var compensators and shunt reactors. They are used to improve network voltages in local areas.

In Appendix B, the relevant parameters of the network equipment at the three nominal voltage levels are quoted at the following reference voltages:

Nominal Voltage Level	Reference Voltage
400kV	380kV
220kV	220kV
110kV	110kV

4.3 PLANNING THE TRANSMISSION NETWORK

The TSO plans the transmission network with the objective of achieving the co-ordinated development of a safe, secure, reliable, efficient, and economical system for the transmission of electricity. The planning process involves the consideration of many factors including:

- Users' connection requirements;
- Demand forecasts;
- Generation projections;
- Economics of alternative development options;
- Transmission operations, maintenance and protection;
- Co-ordination with generation and distribution functions;
- Strategic considerations;
- Environmental aspects;
- Interconnection.

Future Grid conditions are simulated, and evaluated against reliability standards. These standards, which are set out in the Transmission Planning Criteria, can be accessed on the EirGrid website, www.eirgrid.com. They include standards for voltage range and deviations, thermal overloads of Grid equipment, dynamic stability and short-circuit levels. A review of these criteria was carried out in 1997 by independent consultants and involved comparison with practices in other countries to bring them into line with international standards.

The requirement for Grid development is determined when future conditions indicate that the standards would be breached. The Grid must operate within specified standards for intact network conditions, and following an unexpected outage of any circuit or generator. This also applies during the maintenance outage of any other line, cable, transformer or generator. It is assumed that planned maintenance is carried out in the March to September period, when demand is lower than in the winter months.

4.4 PLANNED NETWORK DEVELOPMENTS

The TSO is implementing plans to develop and reinforce the Grid. The projects listed in these plans are required primarily to ensure compliance with the transmission planning standards, and also to facilitate new generation and demand connections. Reinforcements, required because of the connection of new generation or demand, are only considered for the purposes of this study where the connecting party has signed a connection agreement.

The planned developments include additional new stations and circuits, as well as reactive devices, line upratings and phase-shifting transformers that will enable greater use of existing assets. The following is an overview of the planned developments by type.

4.4.1 New Transmission Stations

Cashla-Oldstreet integrates the 400kV system into the Grid by looping the Moneypoint-Woodland 400kV line into a new 400/220kV station at Oldstreet in County Galway. A 220kV line from the new Oldstreet station to Cashla near Galway City will provide power into the north-west, a region that relies heavily on imports of power from other parts of the country. This project will greatly improve the quality and security of supply in the region, and will also help relieve congestion in Dublin.

There are a number of new 220/110kV stations planned that will enhance the capability of the higher capacity 220kV network to transport power into a "demand area", thus relieving the stretched 110kV network. These include stations at Cullenagh near Waterford, Gorman near Navan, Clashavoon near Macroom, and Srananagh in Sligo. The planned station at Corduff relieves the heavily loaded Finglas transformers and improves the reliability of supply to north Dublin.

4.4.2 New Circuits (overhead lines or underground cables) between Existing Stations

A number of new circuits are being added to the Grid, both at 220kV and 110kV

- A 220kV line from Aghada to Raffeen, in Cork;
- A number of 110kV circuits which include new lines from -
 - Cloon, near Tuam, to Castlebar in County Mayo;
 - Killonan, near Limerick, to Cahir in County Tipperary;
 - Looping of the Cushaling-Blake-Maynooth line into Newbridge, County Kildare;
 - A second line from Tarbert to Tralee in County Kerry.

4.4.3 Reactive Devices

Reactive devices such as shunt capacitors are utilised to improve network voltage in the local area where they are connected. A program to install capacitance to improve voltage performance in weak parts of the Grid is almost complete. Within the past two years a 60Mvar Static Var Compensator (SVC) has been installed in Castlebar, Co. Mayo, and shunt capacitors have been installed in Mayo (45Mvars), the Cahir area in Co.Tipperary (75Mvars), the Cork harbour area (60Mvars), and in the Tralee area in Co.Kerry (60Mvars). Another two 15Mvar shunt capacitors are planned for Wexford. These devices improve the performance of the Grid in achieving voltage standards.

4.4.4 Line Upratings

There are plans to improve Grid capacity in certain areas by increasing the rating of a number of existing 110kV lines that have below standard rating. This will be achieved by increasing ground clearances and/or replacing the conductor, together with any necessary changes to terminal equipment and support structures.

Uprating is not a realistic option for the majority of lines that are already at the standard rating.

4.4.5 New Transformers

New transformers are required to transfer power from the 400kV and 220 kV networks down to the 110kV network. There are eight such transformers currently planned for installation in the seven year period covered by this statement. These are listed in Tables B-5 (a) and (b) in Appendix B.

4.4.6 Phase-Shifting Transformer

A phase shifting transformer (PST) is a device that enables power flows on a circuit to be controlled. Such a device is required in Dublin to avoid the risk of overloads on the Poolbeg-Carrickmines 220kV cable.

All information presented on network transfer capabilities and opportunities is contingent on the completion of this investment programme in the assumed timeframe.

Under current forecast assumptions, further investment will be required before the end of the seven-year period to maintain standards in all parts of the network. While the TSO is considering other reinforcements, these are as yet tentative, and it is not appropriate to include them in this Forecast Statement.

4.5 CHANGES IN NETWORK PARAMETERS AND CAPACITY RATINGS

The parameters and capacity ratings of the planned network developments are included in the following tables in Appendix B:

- Table B-4 contains changes to line and cable data resulting from planned network developments. These tables include a column to indicate whether each listed item of plant is being added, amended or deleted.
- Table B-5 lists the details of the planned network transformers.
- Table B-6 lists the details of the planned reactive compensation additions to the network.

Tables B-4, B-5 and B-6 are presented in three sections; one indicating changes expected by the start of summer 2003, the second by winter 2006/7, and the third by winter 2009/10. Parameters of future transmission plant or parameter changes brought about by planned developments are indicative only. Parameters will be reviewed when the plant is commissioned.

Section B.3 in Appendix B lists and describes the planned Grid developments that have been proposed by the TSO and approved within ESB. These developments are included in all network analyses undertaken for this Forecast Statement.