System Operator for Northern Ireland

SEVEN YEAR TRANSMISSION STATEMENT

2003/04 - 2009/10

DECEMBER 2003

Geo-maps and schematic diagrams have not been included in this document.

If required users should contact SONI where a procedure exists to verify all users of this sensitive information.

FOREWORD

The Transmission Seven Year Statement is required to comply with the Transmission and Public Electricity Supply Licence issued under the Electricity (Northern Ireland) Order 1992.

This is the eighth publication of the statement, the first having been issued in March 1993.

SEVEN YEAR TRANSMISSION STATEMENT

For the years 2003/04 to 2009/10

December 2003

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SYSTEM OPERATOR FOR NORTHERN IRELAND LTD.

TRANSMISSION SYSTEM SEVEN YEAR STATEMENT

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Prepared December 2003

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TRANSMISSION SYSTEM SEVEN YEAR STATEMENT

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1. INTRODUCTION

This Transmission System Seven Year Statement has been prepared by System Operator for Northern Ireland Ltd. (SONI) in accordance with Part IIIC, Condition 11, of the Transmission and Public Electricity Supply Licence Document issued under the Electricity (Northern Ireland) Order 1992.

Potential users of the transmission system should also be aware of the following main documents:

i) The NIE Grid Code;
ii) Licence Standards - Transmission and Distribution System Security and Planning Standards;
iii) Statement of Charges for Connection to NIE plc Electricity Transmission and Distribution System;
iv) Statement of Charges for Use of the NIE plc Electricity Transmission and Distribution System;
v) The Bulk Supply Tariff.

Copies of the above documents may be obtained direct from SONI on payment of the respective fees.

The purpose of the statement is to provide:

a) Such further information as shall be reasonably necessary to enable any person seeking use of system to identify and evaluate the opportunities available when connecting to and making use of such system including information on the status of transmission capacity and the anticipated future requirements of transmission capacity;
b) A commentary prepared by the transmission system operator indicating the transmission system operator's views as to those parts of the transmission system most suited to new connections and transport of further quantities of electricity.

The major changes to NIE's network highlighted in this statement are the introduction of:

a) An uprated Moyle HVDC interconnector (The NIE transmission system at Ballycronan More is connected to the Scottish Power System at Auchencrosh via the Moyle Interconnector) with installed capacity of 500MW;
b) Commissioning of new CCGT generation capacity at Ballylumford Power Station;
c) The planned introduction of a 275/110kV Grid Supply Point near Dungannon and 110/33kV Bulk Supply Points at Creagh and Newtownards;
d) Enhanced interconnection with ESB (ROI);
e) The planned introduction of new CCGT generation capacity at Coolkeeragh Power Station.

The format of the transmission capability matrix has been altered to better reflect present day operating characteristics and the Bulk Supply Point (BSP) demand data has been changed to indicate available substation capacity at each BSP. The latter has been introduced to assist network users in assessing connection opportunities and constraints.

2. MAIN TECHNICAL REQUIREMENTS OF THE SUPPLY SYSTEM - THE NIE GRID CODE

The transmission system must be planned and operated to provide secure and economic supplies of electricity with the quality of supply maintained at a satisfactory level.

The ability to supply customers during circuit outages is governed by Security and Planning Standard P2/5, as amended on 7th August 1992. The standard is complex but generally requires that the main transmission system will continue to supply all customers in the event of a single unexpected contingency in winter. In other seasons, the system should supply all or a defined percentage of load for an unexpected event during the maintenance of another circuit. The standard applies increasing security requirements as the group demand increases. In Section 11 of this Statement we consider a tower failure at 275kV to be a single event i.e. we look at the outage of two 275kV circuits on the same tower, to ensure that the system does not suffer catastrophic failure. The two most important characteristics which determine the quality of supply are frequency and voltage.

The Electricity Supply Regulations (Northern Ireland) 1991 set out the statutory obligations in relation to both frequency and voltage.

2.1 Frequency

The declared frequency is 50Hz and is normally controlled within the range 49.5Hz to 50.5Hz.

The frequency is maintained within the above range by balancing generation and demand. The NIE-ESB interconnected system is not synchronously interconnected with the European network and thus remains an "Island System"; as a result, the loss of a large generating unit could cause the frequency to fall below 49.5Hz for a few seconds. In such circumstances some system load may be shed automatically to assist in recovery of the frequency.

Interconnection of the NIE system with the ESB system via the Tandragee/Louth 275/220kV double circuit interconnector and two power flow controlled 110kV interconnectors, increases the inertia of the system. Under these circumstances, the loss of the generating unit impacts less severely than when the NIE system is isolated. Nevertheless, the loss of multiple generating units may in some circumstances still result in under-frequency load shedding.

There may be opportunities for the system operators to agree to use the Moyle interconnector to stabilise the system frequency for certain faults in the future.

2.2 Voltage

The voltage variation permitted (Electricity Supply Regulations NI) on the NIE 275/110kV transmission system is $\pm$ 10%.

The permitted step voltage changes are specified in the Transmission and Distribution System Security Planning Standards (PLM-ST-9).

The permitted step voltage changes are described below:

a) For secured single circuit outage - not greater than 6%
b) For secured double circuit outage - not greater than 10%.

(For a) and b) the 110kV voltage at Bulk Supply Points should not drop below 90%.)

The voltage at any point on the system is determined by the reactive power output of the generating plant, the tapping of the generator transformers and system transformers, the electrical characteristics of the system, and the level of load and its power factor. Voltage control is effected by providing automatic/manual control of the generator output voltage, altering transformer tapping positions and switching of shunt reactors or capacitors. These operational measures do not compromise the security standards imposed by the Licence Standards.

The main technical conditions to be met by users of the system are outlined in the Grid Code. The Grid Code sets out the principles governing NIE's relationship with users of the system. The code specifies procedures for both planning and operational purposes and covers both normal and exceptional circumstances.

The main sections of the Grid Code are as follows:

Planning Code
Connection Conditions
Operating Codes
Scheduling & Despatch Codes
Data Registration Code
General Conditions
Metering Code

(Note – Grid code changes to accommodate wind power generation are being prepared.)

3. LICENCE (SYSTEM SECURITY AND PLANNING) STANDARDS

The system is planned in accordance with the document entitled "Transmission and Distribution System Security and Planning Standards" which has been approved by Ofreg. The relevant standards applicable to the Transmission System are as follows:-

ER P2/5	Security of Supply, dated October 1978, and NIE amendment sheet Issue 2, dated 7 August 1992.
PLM-SP-1	Planning Standards of security for the Connection of Generating Stations to the System Issue 1, dated September 1975, and NIE amendment sheet Issue 2, dated 7 August 1992.
PLM-ST-4	CEGB Criteria for System Transient Stability Studies Issue 1, dated September 1975, and NIE amendment sheet Issue 2, dated 7 August 1992.
PLM-ST-9	Voltage Criteria for the Design of the 400kV and 275kV Supergrid System Issue 1, dated 1 December, 1985, and NIE amendment sheet Issue 2, dated 7 August 1992.
ER-P28	Planning limits for Voltage Fluctuations.
ER-P16	EHV or HV Supplies to Induction Furnaces.
ER-P29	Planning limits for Voltage Unbalance.
ER-G5/3	Limits for Harmonics. (shortly to be replaced by ER-G 5/4 -following UK practice)

EPM-1Operational Standards of Security of Supply, Issue 2, dated 30 June 1980.

(**Note** – the regulators and the relevant Government Departments in NI and RoI have placed an action on both NIE and ESBNG to determine to what extent Grid Codes and Licence Standards can be harmonised within the two domains.)

4. SYSTEM RELIABILITY, STABILITY AND QUALITY

4.1 Overall

The system is planned in accordance with the Licence Standards (see Section 3) where particular consideration is given to avoiding potential common mode failure problems. The location and connection arrangement of power sources is very important in this context.

As well as considering the reliability of circuits and load flows following circuit outages (overload situations), it is necessary to consider the electrodynamic performance of the system. When proposals for new generation or interconnection are being considered it is necessary to investigate transient stability (the resilience of the system to faults) and dynamic stability (resilience of the system to generator trips or circuit switching).

The installation of static compensators and the application of enhanced protection and control systems can usually prevent instability, which can result in loss of synchronism between generators, consequential tripping of circuits, mismatched pockets of generation and load, loss of supply and possible plant damage.

Having regard to the small size of the system, it is also necessary to consider the adequacy of the response characteristics of any significant generation capacity.

4.2 Interconnection with Scotland

The 500MW link with Scotland is described in section 6.0

HVDC links have the advantage over alternating current interconnection in that separate control of voltage and frequency can be maintained on each system. Power flow can be preset at a fixed value and in an emergency the link can provide additional support through its very rapid automatic response to system disturbances.

Although commutation failures, in import mode, can occur for faults on the Northern Ireland system, the effects are limited to a brief distortion of its 50Hz AC synchronous waveform. The rapid response means that the HVDC link can have a net stabilising effect on the Northern Ireland system in the event of generation loss.

Similarly an emergency action programme can immediately reduce import from Scotland or increase output to Scotland upon a sudden loss of load, e.g. all flows to RoI. This prevents severe over-frequency and plant trips.

5. THE NIE TRANSMISSION SYSTEM

5.1 The Existing System

The NIE Transmission System comprises some 2000 circuit kilometres of 110kV and 275kV overhead lines and cable. In the context of this statement the transmission system also includes the 33kV network in Belfast. This sub transmission system previously connected generation at Belfast West Power Station to the main transmission system. A geographic layout of the existing transmission system is shown in Map 1.

5.2 The Future Planned System – Developments Approved

As of 1 January 2003 system developments which have received capital expenditure approval by NIE for completion during the course of the seven year period are as follows:

a) Creagh 110/33kV Substation - a new 110/33kV substation (previously known as Bellaghy) will be commissioned by 2004;

b) Newtownards 110/33kV Substation - a new 110/33kV substation and associated 110kV feeders are proceeding through the pre-Planning Approvals consultation process. Subject to planning approval, it is estimated that the substation will be commissioned by 2005;

c) 275/110kV Tyrone Substation phase 1 - initially a new 275/110kV single 120MVA transformer substation is to be located close to the 275kV tower line and will supply Dungannon Main by a new 110kV circuit. The pre-Planning Approvals consultation process is ongoing. Subject to planning approval it is now estimated that the substation will be commissioned by 2006. Measures are being employed to reduce the risk created by the delay. A second phase described in 5.3 below will follow;

d) Coolkeeragh to Strabane 110kV circuit enhancement - work is underway to increase the rating of the existing circuits resulting in the two circuits having a winter rating of 166MVA. To achieve this, it will be necessary to uprate one circuit and parallel two other existing 110kV circuits. Balancing of mechanical forces also requires other circuits on the same towers to be similarly constructed. This will change the impedance of the other circuits but not their rating since only a small part of each circuit is reconstructed. This work will be completed by 2004.

A geographic layout of the system highlighting the above developments, where appropriate, is shown in Map 2.

5.3 The Future Planned System – Developments Unapproved

a) 275/110kV Tyrone Substation phase 2 - the final phase will involve the installation of a second 275/110kV 240 MVA transformer. This will be accompanied by 110kV circuit reconfiguration work. Dungannon 110kV mesh (age expired) will be removed, with Dungannon 110/33kV Bulk Supply Point substation being supplied by two 110kV transformer feeders (existing circuits which may be reconductered) out of the Tyrone 110kV Substation. This work is planned to occur by 2009. Other 110kV circuits in the region may be reconfigured to optimise the system performance.

5.4 Special Protection Schemes

a) 110kV Circuit Protection scheme Tandragee –Drumnakelly – Dungannon

Under certain 110kV circuit outage scenarios the Tandragee – Drumnakelly circuits can be significantly overloaded. To relieve the position a special protection scheme will be installed which involves a combination of tripping certain circuits and load shedding measures. The scheme should be operational for March 2004.

b) Coolkeeragh Under Voltage Scheme

At peak load times when there is insufficient operational generation at Coolkeeragh, under-voltage conditions may occur in the North West when an outage occurs on the Magherafelt to Coolkeeragh 275kV double circuit. To prevent this happening a special protection scheme will be installed which involves load shedding measures. This scheme is active at the time of issuing this Statement.

c) Coolkeeragh Generation Curtailment Scheme

A new CCGT (400MW) is to be installed at Coolkeeragh. If the CCGT (and OCGT) is operating with substantial export at times of low NI load and outage on the Magherafelt to Coolkeeragh 275kV double circuit, the 110kV local circuits would overload. Under these rare circumstances the CCGT output will be automatically curtailed (to about 190MW).

d) Ballylumford Generation Curtailment Scheme

In the 2001 SYS we stated that no more generation could be absorbed on Island Magee. Since then, an arrangement has been made to allow RoI generation capacity shortage to be relieved by utilising a generator otherwise due to be retired at Ballylumford. This could only be managed on a disconnectable basis as agreed by the parties. When an outage occurs on either Ballylumford 275kV circuits the unit supplying RoI is tripped.

6. INTERCONNECTION

6.1 Existing Interconnection

275kV Tandragee – Louth Interconnector

The system was re-connected with the RoI's Electricity Supply Board (ESB) system in March 1995. The interconnection is via a double circuit 275kV line between Tandragee and Louth terminated in two 300MVA 275/220kV transformers, both circuits were uprated to have a capacity of 600MVA. This was achieved by paralleling the existing 300MVA transformers on one circuit and the installation of a new 600MVA transformer on the other.

The 275/220kV interconnection provides the opportunity to share 'spinning reserve' and trade energy between the two systems.

The firm capacity of the interconnector plant is assessed as the emergency overload rating of one circuit – 660MVA summer rating. The NIE or ESB systems may from time to time impose more severe restrictions. Taking account of thermal, voltage and stability limitations in NI and RoI networks the 2004 N-S capacity auction offered 330MW and the S-N auction offered 0MW.

110kV Interconnection with ESB Network

110kV interconnection with ESB is as follows:

(a) Strabane-Letterkenny 110kV standby circuit - 110kV single circuit line crossing the border was commissioned in March 1995.

(b) Shankill/Cathaleen's Fall-Enniskillen 110kV standby circuit - as above.

In 2001, both standby circuits were converted into permanent interconnectors by being power flow controlled. The power flow controllers are rated at 125MW. The power flow controllers are normally adjusted to close to 0MW transfer but can be set to any desired flow to support either system during abnormal operation. The systems are not considered stable in the absence of 275kV interconnection and therefore the 110kV interconnectors are automatically removed from service in the absence of both 275kV interconnector circuits. In the event of a severe outage e.g. Cool-Mag D/C 275kV, the power flow controllers allow the immediate support from the healthy system to remain, pending manual control action.

Interconnection with Scotland

The Moyle interconnector, Northern Ireland - Scotland, was established in 2001 and is constructed as a dual monopole HVDC Link with two coaxial undersea cables from Ballycronan More, Islandmagee, Co Antrim to Auchencrosh, Ayrshire. The link has an installed capacity of 500MW. The present system constrains Scotland to Northern Ireland tradable capacity to 400MW. The converter station at Ballycronan More has been looped into one of the 275kV Ballylumford to Hannahstown circuits.

6.2 Future Interconnection Development

NIE and ESB have been exploring the potential for additional interconnection. The primary object is to further increase the security of trading and 400kV, 275kV and 110kV options are being considered. To date, technical appraisal favours additional 275kV interconnection however economic, stakeholder and routing studies are being undertaken.

6.3 Use of Interconnection

The NIE/ESB Joint Operating Panel agree operating procedures for NIE/ESB interconnectors. Under the Operation Agency Agreement with the asset owner, Moyle Interconnector Limited ("Moyle"), SONI operates the interconnector with Scotland in conjunction with its operation of the NIE System. As part of this arrangement, SONI manages the interface with the System Operator in Scotland through the Interconnector Operating Panel. Cross-border trade is in line with the EU IME Directive (concerning rules for the internal market).

Moyle

The total East-West Net Transfer Capacity (NTC) of the Moyle Interconnector is as follows (Winter meaning November to March and Summer meaning April to October):

- Winter 400MW
- Summer day 400MW
- Summer night 300 MW

Out of these capacities, there is a priority reservation of 125MW until late 2007 for the Capacity Agreement between Moyle and the NIE Power Procurement Business (PPB), which was an integral part of the agreement between NIE and Scottish Power under which the Moyle Interconnector was built. The reservation is to enable PPB to deliver its 125MW supply agreement with Scottish Power (interruptible by SP).

The remaining 275MW (175MW on summer nights) of the NTC has been offered to the market for energy trading and is fully contracted until March 2005 on 1 year, 2 year and 3 year contracts. Capacity will again be offered to the market as it comes out of contract, under arrangements to be agreed by Moyle, SONI and Ofreg.

West-East capacity is also available and has been offered to the market on successive occasions but the capacity has remained unsold.

NIE – ESB

Similarly the Available Transfer Capacity (ATC) on the Tandragee - Louth 275/220kV interconnector is auctioned annually. The Capacity Auction for 2002/03 was for 120MW North-South and 50MW South-North. The Capacity Auction for 2003/04 was for 300MW North-South (this was restricted for a period until a transmission project was completed in RoI). Due to system constraints the South-North capacity was reduced to zero for much of the year. The Capacity Auction for 2004/05 was for 330MW North-South. No transfer capacity was available for auction in the South-North direction 2004/05. Relevant considerations are the system voltage stability on the loss of a double circuit 275kV line and the frequency impact of a sudden loss of the interconnector.

To facilitate trades, a superposition trading product was introduced in 2003. A trader wishing to transit RoI – NI may nominate and will be guaranteed transit if linked to an NI – RoI trade (providing NI – RoI is the dominant flow). Other RoI – NI nominations may also be allowed, but are not automatic. This "netting-off" of trades allows further NI – RoI trades to take place.

Interconnection with Scotland and ROI offers opportunities to transfer power in either direction. The level of transit flows takes account of all operational aspects such as the impact factor on the NIE or combined NIE/ESB system and commercial aspects such as the cost resulting from any redistribution of spinning reserve. The ability to transit flows to RoI, especially at times of low indigenous NI load, is related to the ability to control frequency in the event of loss of interconnection. This is now managed in part, by a rapid reduction in the Moyle import.

7. EXISTING GENERATION

7.1 Generation Capacity Agreements.

7.1.1 Capacity Contracted to NIE through Power Purchasing Agreements (PPA's)

Plant contracted to NIE under pre-vesting contracts totals to a maximum of 1658MW measured as output capacity at generator terminals. These contracts contain expiry dates, though Ofreg may cancel contracts at earlier cancellation dates. The PPA's or Generating Unit Agreements cover availability, operating characteristics, payments, metering etc. Power Station Agreements cover matters such as outage planning, emmissions, fuel stocks.

The Kilroot Power Station (KPS) units will be available until at least 2010, and Coolkeeragh Power Station (CPS) units until 2002-2004. A number of contracts have already been cancelled at Power Station West and Coolkeeragh Power Station.

At Coolkeeragh this report assumes 2 x 60MW sets (G6 & G7) are available in winter peak, until the new Coolkeeragh CCGT plant is commissioned in Winter 2005/06.

This Seven Year Statement is based on generation information available at the freeze date (1 Jan 2003). At that date NIE had entered into agreements relating to replacement of the three 200MW units at Ballylumford by two CCGT units with capacities of circa 500MW and 100MW. This newly contracted plant will be available until at least the year 2012. The 500MW CCGT unit, is connected to the 275kV system, comprises of two GTs of capacity 160MW and one steam turbine of capacity 180MW. A further 106MW CCGT is connected to the 110kV system. Each unit is equipped with distillate fuel back-up. Plant commissioning was complete by Winter 2003/04. The existing 120MW steam plant Unit 1 was also to be retained.

The NIE Power Procurement Business (PPB) has subsequently contracted with parties to be a virtual power producer. To deliver obligations to ESB, Unit 6 at Ballylumford is now retained in addition to the new CCGT. This capacity, reduced to 180MW sent-out, is not counted in the calculation of capacity available for NI. At the same time, Unit 1 at Ballylumford has been withdrawn and is replaced until 2012 by Unit 4 at a maximum sent-out capacity of 180MW. Unit 5 can be used only as a replacement for units 4 or 6. Units 2 and 3 have also been decommissioned and they will not be replaced. The power stations, generating units and contracted capacity are shown in Table 1A and reflect the position known in December 2003.

7.1.2 Independent Power Producer (IPP) Generation Capacity

Ofreg has a duty to promote competition in the generation and supply of electricity. Competition in wholesale electricity trading, in line with the EU IME Directive (concerning common rules for the internal market in electricity 2003/54/EC), was introduced in July 1999. Moyle is currently the main facilitator of IPP capacity. Coolkeeragh CCGT (400MW) will operate as an Independent Power Producer and will be on line before Winter 2005/6.

Each generator who wishes to participate in wholesale electricity trading must enter into a System Support Services Agreement with the Transmission System Operator (SONI).

This agreement covers items such as black start, operating characteristics, outage planning, and the provision of system support services. IPPs also pay transmission use of system tariff (TUOS) to NIE.

Market opening was extended in April 2001 to approximately 35% of total energy sales. The market is open to customers whose annual consumption is equal to or greater than 0.79GWh. This equates to a peak demand for the eligible market in 2003 of approximately 400MW. To gain the true benefits of market opening requires competition in the energy production sector. The opportunity to supply this sector of the market should provide the necessary incentive for the introduction of additional generating plant. Readers should note that:

- the new IPP generation at Coolkeeragh is 400MW (planned for operation in 2005)
- a stage of further Market Opening takes place in April 2004
- all non-domestic customers will be eligible to change supplier from early 2005.

7.1.3 Non Fossil Fuel Obligation (NFFO) Capacity

Under the Non Fossil Fuel Obligation (NFFO), NIE signed contracts for approximately 15 MW DNC (Declared Net Capacity) of Non Fossil Fuel Plant on 1 April 1994 (NFFO1) and 16 MW DNC on 4 September 1996 (NFFO2). These are detailed in table 1C. These contracts will start to expire in 2009. Under NFFO1 and NFFO2, a total of approximately 14.5 MW DNC and 2.9 MW DNC respectively was commissioned at 1st August 2001. The NFFO schemes are displayed in table 1B.

7.1.4 Additional Renewable Generation

Wind generating units are generally connected to the Distribution network (33kV and 11kV) and network analysis/design takes into consideration the variability of this source of energy. Three projects are listed in Table 1C, they have a total maximum power output of 47.7MW.

DETI intend to consult in May 2004 and again in Autumn 2004 on the introduction of a NI Renewable Obligation Certificate system. The certificates are proposed to be tradable in a UK market. An obligation based on consumption is to be directed at suppliers. This will increase incrementally until 2012 when a 6.3% consumption target is reached. DETI also propose an aspirational target of 12% by consumption for the year 2012.

7.1.5 NIE SMART Programme

NIE is incentivised to support emerging renewable technologies and seek embedded/renewable generation which can provide a contracted level of support to the distribution system. Areas of network opportunity are detailed at nie.smart.co.uk

7.1.6 Potential Schemes

NIE have a duty to retain as confidential, information on applications, however two projects have been widely reported and consulted upon. They are a lignite fired station near Ballymoney and a large off-shore wind farm located in the sea around the north coast. NIE have studied both generation connections but are not aware that either is proceeding at present.

7.1.7 Customer Private Generation

A number of customers have been reducing their energy consumption at peak demand times by load shifting or by running private generation. NIE has tended to view this generation as non-permanent due to a number of factors.

a) The operation of this plant is not as reliable as conventional contracted plant;
b) Variable generation costs (diesel/hire charges); and
c) Variable tariff price signals.

Levels of this generation on the network are significant and are estimated at circa. 118 MW. If and when embedded generation levels increase, a probabilistic approach will be developed. NIE also plans to examine Table 2 in licence standard P2/5 to allow greater distribution system reliance to be placed on embedded generation. This in turn effects the expected demand at transmission Bulk Supply Points (BSP).

7.2 Generation Operation

The scheduling of generating plant to meet the demand is carried out with the nominated IPP generation dispatched first and the remaining capacity on a merit order cost basis. Low marginal cost plant will be called before high marginal cost plant and any spare IPP capacity will be taken on an economic basis. Exceptions to this rule can occur in respect of (a) providing security to the North West or (b) during scheduled outages of transmission circuits for major construction projects, refurbishment and/or maintenance. Further exceptions to the rule can occur in respect of government imposed limitations on power station flue gas emissions.

7.3 Spinning Reserve - Load shedding

When isolated, the NIE system is operated with a minimum of four generating units carrying spinning reserve covering at least 68% of the largest infeed to the system. For a sudden loss of generation the balance is restored by shedding load via a low frequency selective tripping scheme. Should one generating unit trip the remaining three provide the spinning reserve cover as above and load shedding may take place. The 275/220kV Tandragee - Louth interconnector enables spinning reserve to be shared between the two systems. The total combined utility spinning reserve requirement is based on 80% of the largest island infeed. The inter-utility mechanism for sharing spinning reserve is kept under review for optimal economic and secure operation of the combined systems. Currently NIE provides no less than one third of the total spinning reserve requirement. When interconnected NIE will operate with a minimum of four generating units as described above.

8. TRANSMISSION SYSTEM DATA

8.1 Forecast of System Maximum Demand

The Transmission & Distribution system maximum demand data is based on totalised data from power stations, interconnectors, NFFO and other renewable generators, and customer private generators.

Temperature has been found to have the greatest effect on demand compared with other meteorological factors. Temperature correction in the form of average cold spell (ACS) analysis is necessary to remove the demand variation caused by temperature, thus enabling the underlying demand growth-rate to be determined more accurately.

8.1.1 System Maximum Demand

The actual 2001/02 NIE system peak demand was 1677MW (1532MW centrally despatched, NFFO 27MW and customer private generation 118MW) and occurred on 6th December 2001 at 17.30hrs. When adjusted to Average Cold Spell (ACS) conditions the peak demand was 1702MW.

The generated profile including NFFO for 6th December 2001 is shown in Figure 1 below. Network utilisation is at a maximum around 17:30hrs; this maximum demand is as a result of coincidental usage patterns, for example domestic cooking load, lighting load etc. The graph (Figure 1) does not include the demand that was suppressed by customer private generation. At a nodal level, no simple relationship between winter and summer daily load patterns can be ascribed. At some nodes the summer peaks appear early in the day whereas others continue to occur around the evening meal time. This variance is the result of the mix of commercial, industrial, and domestic load at a particular node.

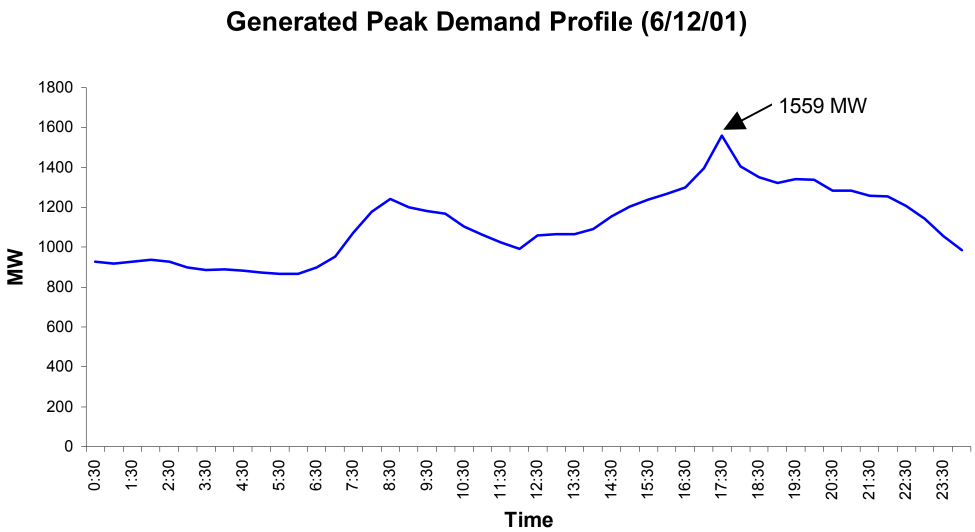

Figure 1

8.1.2 System Maximum Demand Forecast

The forecast (Figure 2) used in this statement is based on data up to and including the 2001/02 winter period and is corrected for ACS conditions. Customer Private generation demand data (Section 7.14) is also included.

2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10
1787	1817	1849	1881	1914	1947	1981

Fig. 2

Note: The above figures include private generation whereas the Generation Seven Year Statement is net of private generation.

Within the context of a global slowdown, the NI economy has performed reasonably well. Northern Ireland's relatively greater dependence on the public service sector and public expenditure has sheltered it to some degree from this global slowdown. Unemployment is now at low levels, however the Q1 2003 estimates for manufacturing output show there was a fall of 1.4% from the previous quarter, and a decrease of 1.9% compared to the same period a year earlier. The overall network demand growth predictions are reduced from growth rates in excess of 2% in the late nineties to a current prediction of 1.8%. NIE demand predictions take into consideration exogenous factors such as the impact of Natural Gas and Energy Efficiency Initiatives.

Fig.3 plots historic system peak demands for the past 33 years. Demand growth has been steady throughout this period though it is significant that for the last 5 years the trend line has been exceeded.

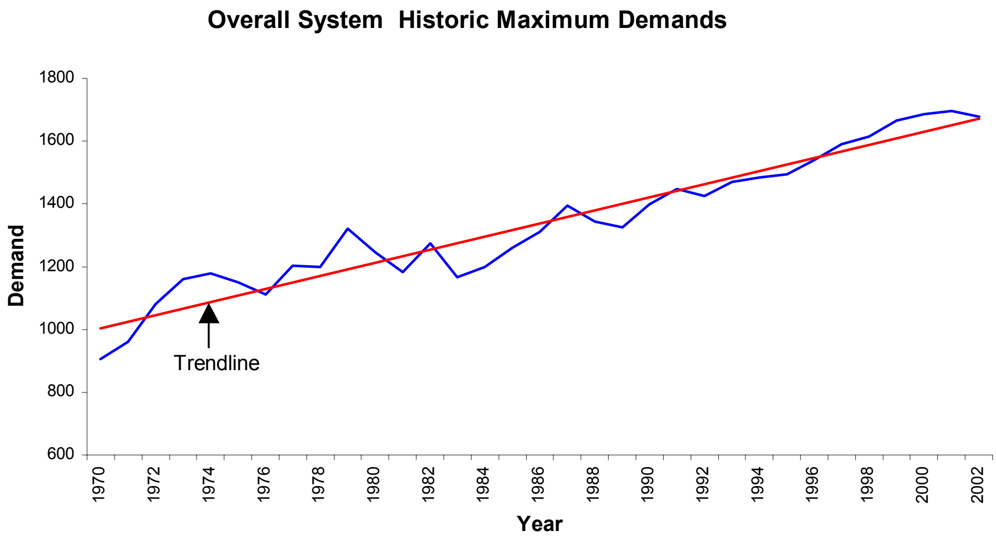

Fig.3

8.2 110/33kV Bulk Supply Point (BSP) Loadings

The BSP installed transformer capacity, substation firm capacity and predicted demands are given in Table 2.1. Those substations whose firm capacities are exceeded are highlighted (notes indicate how this will be managed). The geographical location and connectivity of BSP's can be determined from Maps 1&2. NIE have plans in place to ensure compliance with licence standards for example to increase substation firm capacity, to obtain load relief through commissioning new BSP's (Newtownards/Creagh) or to carry out small amounts of load shedding as permitted in licence standards.

Developments, which have been approved, are described in Section 5.2.
Table 2b indicates available capacity at each BSP. This Table is drafted on the basis of not extending load shedding and has been introduced to assist network users in assessing connection opportunities. It will be necessary to carry out further analysis depending on the magnitude and type of load to be connected, to establish if a connection is viable.

8.3 Busbar Data

The data for base year 03/04 is given in Table 3. The data comprises the node definition, voltage, active and reactive load.

8.4 Circuit Capacities and Parameters

The continuous thermal rating of a circuit is the maximum power flow that can be passed through the circuit on a continuous basis. On overhead lines, the circuit rating ensures that conductor sag does not infringe statutory clearances and that circuit damage is avoided. There may be instances where protection system characteristics produce a limitation. The thermal rating varies for each season of the year, due to the impact of differing climatic conditions on equipment performance. The data for the base year 03/04 are given in Table 4. The data comprises the identification information, resistance, reactance, susceptance and seasonal ratings of overhead line and cable circuits. Table 5 provides the data for changes to the system over the seven year period.

8.5 Transformer Data

The 110/33kV Bulk Supply Point (BSP), interconnectors and generator transformer data for base year 03/04 are given in Table 6. The data comprises the transformer upper and lower tapping ratios, the number of tap steps, resistance, reactance and ratings. The ratings are maximum continuous values and do not allow for short term enhancement. Table 7 indicates transformers added over the seven year period.

8.6 275/110kV Interbus Transformer and Capacitor Data

The interbus transformer data is displayed in Table 8. This comprises the transformer upper and lower tapping ratios, the number of tap steps, winding resistance/reactance, and rating information. Interbus transformers added to the system over the seven year period are also indicated. Table 8 highlights the location, voltage level and the magnitude of installed fixed capacitance. The operation of this equipment will be variable and dependant on network operating conditions, configuration etc.

9. TRANSMISSION SYSTEM POWER FLOWS

9.1 Introduction to the Power Flows

The previous sections have described the background to the NIE transmission system and how it is designed and operated. This section of the report presents, and discusses, the results of studies on system performance over the next seven years.

The power flows on the NIE transmission system in the financial years from 2003/04 through to 2009/10 are represented as follows:

a) Figures 1 – 2 busbar layouts year 2001 and year 2009.
b) Figures 3 – 5 network load flows for summer, autumn and winter 2003/04.
c) Figures 6 – 8 network load flows for summer, autumn and winter 2009/10.

The report provides detailed information for those years where intended system developments impact on the load flows.

In any one year, the power flows on the transmission system vary on a seasonal basis with changing demand and with changing generation profile. To give an appreciation of the effect of these different load and generation combinations, the report considers three representative seasonal power flows for each of the years above. The seasons and load conditions are:

winter, peak load condition;
autumn, peak load condition; and
summer, peak load condition.

Analysis of system demand levels has led to an assessment that summer and autumn peak load conditions equate to 69% and 75% of winter peak demand levels respectively.

The power flow studies represent normal system conditions with no fault or maintenance transmission plant outages. Some transmission circuits are run open where this is a normal running arrangement for the season being studied. The effect of fault or maintenance outages is normally assessed in Section 11 on 'Transmission System Capability'.

The changes to the transmission system that are used in the power flow models are those authorised projects which are listed in Section 5.2 and an unapproved but expected reinforcement described in section 5.3. In the power flow studies, the 110kV interconnections with ESB are assumed to run with zero power transfer due to the normal operational practices. The 275kV Tandragee - Louth ESB interconnector is assumed to have a zero transfer initially in 2003/04 powerflows. After the new Coolkeeragh CCGT Power Station is commissioned by Winter 2005/6 the interconnector transfer north to south is increased to circa 200MW. The Moyle Interconnector is operating throughout the Statement Period (2003/04 – 2009/10) with varying transfers to meet the Northern Ireland system maximum demand.

In the power flow diagrams (Figures 3 to 8), the MVA flow on each circuit is shown above the line with the direction of flow being indicated by the arrow. The percentage loading in the circuit is shown below the line. The figure is the MVA flow, divided by the appropriate MVA line rating for the season being studied.

An overhead line, in common with other equipment on the transmission system, has a maximum continuous rating which is set by the heating effect of the current passing through the circuit. For ease of interpretation the current limit is normally converted to an equivalent MVA rating. This rating varies with ambient temperature, so a given circuit will have different seasonal ratings. Some terminal equipment may need to be modified or replaced to enable the full circuit rating to be achieved.

In the schematic of the powerflow results (Figures 3-8), the percentage shown is at the seasonal rating, for example the summer peak powerflow drawings show the percentages of summer ratings for each circuit. The Voltage (p.u.) is displayed beside each busbar.

The 2003/04 Winter powerflow (Figure 5) assumes 2 x 60MW sets (G6 &G7) are available at winter peak, until the new Coolkeeragh CCGT plant is commissioned Winter 2005/06. The Coolkeeragh G6 and G7 units are not connected in Autumn or Summer as a special protection scheme will be commissioned to safe guard against a Coolkeeragh – Magherafelt 275kV double circuit outage.

At the report freeze date (Jan 2003), the contracted plant at Ballyfumford was the new CCGT plant (GA-GD figures 1- 8, 600MW total) Unit 1 (1 X 120MW) and Units 7 & 8 (2 x 60MW) open cycle gas turbines. *Since that date Unit1 has been withdrawn and replaced with Unit 4 (1 x 200MW). Unit 6 has been contracted to meet ESB obligations. These arrangements are described in more detail in section 7.*

The 275/220kV Tandragee - Louth interconnector impacts on the generation dispatches used for the power flows. The sharing of spinning reserve can result in less generating units being required to meet the peak demand. In the final years of the statement, an acceptable generation dispatch has been achieved despite the retirement of generating plant at Coolkeeragh and Belfast West power stations. The system spinning reserve requirements have been met by operating open cycle gas turbines at Ballylumford and Coolkeeragh Power Stations. The Seven Year Generation Capacity Statement 2003 offers a detailed review of future generation capacity adequacy.

In the following subsections, the power flow studies for each of the study years are discussed.

9.2 Power Flows for 2003/04

The three seasonal loadflows for 2003/04 are presented as follows:

Figure 3 - Summer Peak Flow 2003
Figure 4 - Autumn Peak Flow 2003
Figure 5 - Winter Peak Flow 2003/04

There are a number of changes in the Winter 2003/04 base year load flow file (Figure 5) when compared to previous Transmission seven year statements:

Newry & Ballynahinch 110/33kV Substations - The transformer capacity has been increased with the introduction of two new 90MVA units.

Interconnection – Significant interconnection projects have been completed (see Section 6 for detail).

a) 110kV powerflow controlled interconnectors from Enniskillen and Strabane to RoI.

b) Tandragee/Louth 275kV interconnector enhancement (see Section 6 for details).

c) Moyle HVDC Link between N. Ireland (Ballycronan More) and Scotland (Auchencrosh). In the 2003/04 Winter loadflow Moyle is importing 450MW (Figure 5).

Network Capacitors – The diagram (Figures 3-8) includes mechanically switched capacitance to manage certain critical 275kV double circuit outages. Capacitance is installed at Castlereagh, Tandragee and Coolkeeragh. The Load Flows (Figures 3-8) show the Castlereagh to Carnmoney and Ballyvallagh to Kells 110kV circuits switched out to avoid overloads under certain critical 275kV double circuit outages.

Creagh 110/33kV Substation - A new 110/33kV Substation (previously known as Bellaghy) will be commissioned by Winter 2003/04 (Figure 5). This Substation will relieve Ballymena 110/33kV BSP where the firm capacity is exceeded. The initial commissioning load on Creagh will be increased when Tyrone 275/110kV Substation is commissioned by Winter 2005/06.

Ballylumford CCGT Generating Plant – The new CCGT plant (GA –GD) are shown connected to Ballylumford (Figures 3-5 busbars 70520 & 70510)

Power Station West retirement – The final 2 x 60 MW sets were decommissioned in 2002. This has resulted in increased power flow into Belfast on the interbus transformers at Castlereagh and Hannahtown, the Hannahtown transformer loadings have increased by circa 60MW comparing Winter 2001/02 with 2003/04 (Figure 5).

In all three powerflows, summer, autumn and winter, the transmission circuit loadings remain within circuit rating, except for Tandragee to Drumnakelly 110kV circuits whose ratings can be exceeded for some secured contingencies. Maintenance management regimes are presently in place to prevent overload of these circuits and a special protection scheme is due to be commissioned 2003/04.

9.3 Power Flows for 2009/10

Seasonal loadflows have been prepared to show the effects of significant developments. The three seasonal loadflows for 2009/10 are presented as follows:

Figure 6 - Summer Peak Flow 2009
Figure 7 - Autumn Peak Flow 2009
Figure 8 - Winter Peak Flow 2009/10

In addition to the changes detailed in Section 9.2 above these loadflows represent the effects of some additional future developments described in Section 5.
Creagh 110/33kV Substation – As described in Section 9.2 a new Creagh 110/33kV Substation will be commissioned by Winter 2003/04 (Figure 5). This Substation will

support additional load after 2005/06 when Tyrone 275/110kV Substation is commissioned. A total of circa 36MW will be transferred from Ballymena 110/33kV mesh where the firm capacity is exceeded. Comparison of Winter 2009/10 (Figure 8) and 2003/04 (Figure 9) shows a reduction in flow on the Kells – Ballymena 110kV feeders.

Newtownards 110/33kV Substation – A new 110/33kV Substation and associated overhead line feeders will be commissioned by Winter 2004/05. This development will relieve the load at Rathgael and Rosebank BSP's. In Figure 5, the 2003/04 winter file, the demand on the Rathgael circuits is approaching 50% utilisation. This exceeds their autumn and winter ratings under single circuit outage conditions. To safeguard the North Down system, NIE has installed a 33kV load shedding scheme until Newtownards is commissioned. When comparing the 2003/04 (Figure 5) and 2009/10 (Figure 8) winter files, the effect of the Newtownards 110/33kV Substation is to reduce the load on each Rathgael circuit by circa 10MW. Further Permission related delays may require additional load shedding schemes to be commissioned.

Tyrone 275/110kV Substation Phase 1 – The initial plan is to install a new 275/110kV single transformer (120MVA ex-Coolkeeragh) Substation. The node will be supplied by one of the 275kV circuits from Tandragee to Magherafelt and will be physically located close to the 275kV tower line. Tyrone 275/110kV Substation will supply Dungannon Main by a new single 110kV circuit. It is anticipated that the Substation will be commissioned by Winter 2005/06.

275/110kV Tyrone Substation phase 2 - The final phase will involve the installation of a second 275/110kV 240 MVA transformer. The reconfiguration of the 110kV network, will result in the Tyrone 110kV node being connected via two 110kV circuits to Omagh and Drumnakelly 110kV nodes. Dungannon 110kV mesh (age expired) will be removed, with Dungannon 110/33kV Bulk Supply Point Substation being suppied by two 110kV transformer feeders out of the Tyrone 110kV Substation. This work is planned to occur by 2009.

A comparison of Figure 5 and Figure 8, winter maximum files for the years 2003/04 and 2009/10 respectively, indicates a reduction in utilisation on heavily loaded circuits feeding the west of the province (Coolkeeragh – Strabane & Tandragee – Drumnakelly). The voltage on the Omagh 110kV mesh is enhanced by 2% as a result of this project.

Coolkeeragh CCGT Generating Plant – The new CCGT plant comprising GT 260MW and ST 140MW are shown connected to the Coolkeeragh 275kV and 110kV busbars respectively (Figures 6-8). A comparison of the Winter 2003/04 (Figure 5) and 2009/10 (Figure 8) loadflows highlights a considerable change in the load flows into the North West of the province. For example power reversal occurs on the Coolkeeragh – Magherafelt circuits. The North West now exports 100MW onto the 275kV network rather than previously importing 160MW.

Again in all three systems normal power flows. The transmission loadings remain within circuit rating. Section 11 of this Statement examines the effect of outages under a range of scenarios.

10. TRANSMISSION SYSTEM FAULT LEVELS

In this Section the three phase and single phase to earth fault levels at the 275/110kV busbars on the NIE transmission system are considered. Fault levels are calculated for the 2006/07 Winter and displayed in Table 9. By displaying fault levels for this year we have included the effects of the new generation at Coolkeeragh.

The fault studies have been conducted with the combined ESB and NIE systems. This fully interconnected all-Ireland model simulates fault conditions more accurately than using a NIE model solely with a single equivalent generator representing ESB. The fault studies are carried out using a pre-fault load flow fault current assessment technique using generator sub-transient reactances.

The calculated system fault levels are based on the 2006/07 Winter maximum system with typical generation in the NIE system including:

Ballylumford	G4, G6, G7, G8, GT21, GT22, ST20 GT10
Coolkeeragh	G4, G6, G8 (G4 & G6 planned CCGT plant)
Kilroot	G1 & G2
Moyle	

Power Station West has been decommissioned.

The HVDC link is assumed to be in service in the studies with an import of 250MW. The link has no significant fault level contribution. The 275kV Tandragee to Louth Interconnector is upgraded to 600MVA rating with a North to South transfer of circa 300MW.

The fault level on the NIE transmission system has generally increased compared with previous statements. This is a result of the installation of new CCGT generation capacity at Ballylumford and the planned introduction of capacity at Coolkeeragh Power station. High fault levels have to be managed at generation nodes.

11. TRANSMISSION SYSTEM CAPABILITY - MATRIX STUDY

By 2009, we anticipate having a full specification 275/110kV substation at Tyrone/Drumkee. Nonetheless, by this time, load growth is starting to stress the remaining transmission system. This is most obvious in a thermal sense for double circuit outages in summer in the area around Ballylumford. In winter when the load is higher, the system voltage becomes threatened during some double circuit 275kV outages.

It is envisaged that a small amount of static reactive support will be fitted in the intervening period, primarily to support the north west voltage. Our present assumption is that 48 MVARs is required. Thermal issues may be managed by re-configuration and special protection schemes. In particular, we have in mind to operate the system so that the Lisburn load becomes radially supplied from Tandragee which will reduce loading on the Hannahstown interbus transformers. These would however need to be closed during Hannahstown transformer maintenance, in case the other transformer became unexpectedly outaged. We also expect to normally operate the 110kV circuits between Castlereagh and Ballylumford and between Ballylumford and Kells closed but with special protection schemes designed to automatically open at Castlereagh and beyond Ballyvallagh when contingency overloads appear. We have also noted that the configuration at Kells 275kV mesh Substation leads to overloads on the Ballyumford to Ballyvallagh circuits and we intend to reconductor these or to introduce a third interbus transformer at Kells.

In previous statements we have attempted to estimate the cost of work for each element of the matrix because each transmission project is unique, the work needs to be estimated specifically, and we believe it may be misleading to use generic cost figures as guidance. We therefore now prefer to leave costing until specific projects are identified. Recognising that readers need some scale, in this text, we have tried to point to the order of magnitude of costs. We believe that indicating the work involved is likely to give guidance as to the achievability of projects.

11.1 New Generation Supplying Existing Load

In this set of studies we explore the effect of increasing generation by up to 400MW at each node without increasing the overall traffic on our network i.e. we do not increase demand, rather we reduce generation in other places. This helps readers to become aware of pure generation location issues.

There are limits to what we can check in this study and to avoid giving misleading information we will also refer to other work. The primary limitation of the study is that, in summer, we would not have sufficient NI load to allow full output from Ballylumford and Moyle including a further 400MW generator at either location. We have however separately explored the issues and the result is similar to the section on transfer to ESB in that Ballylumford-Kells (33km) and Ballylumford-Hannahstown (44km) 275kV circuits both overload and need uprated.

We have been told that the pure conductor costs lie around £200,000 / km but believe that site obstacles could lead to a doubling or more of this Figure. We believe that we are also coming close to the margin of voltage collapse in this situation and it is prudent to allow for 30-50 MVAr of Static Var Compensation (SVC). As guidance only, SVC's of this level have a cost around £7m. No other generation locations give rise to network problems except for Coolkeeragh where the node is generation saturated. A further 275kV circuit between Coolkeeragh and Magherafelt would be required. We previously estimated this at around £25m.

11.2 Additional Generation Supplying Load in ESB

Recent history of energy flows indicates that there is a requirement to transmit about 200MW to the RoI. We have considered this as a base position for our studies, therefore when we describe a new 400MW generator exporting to ESB we imply a transfer of a total of 600MWs but with no reactive power. To save confusion, all recent transmission studies have been based upon Total Transfer Capacity. Therefore this 200MW is not considered at the same time as with a rescue flow from north to south. Net Transfer Capacity would therefore be less (by about 110MW based upon current rules). Our studies have taken no account of stability issues but readers should understand that a sudden loss of all North/South interconnection will need to be managed to avoid frequency violations. Two sets of issues emerge from our studies. These are:

(1) Generation Location
(2) Increased Network Traffic

11.2.1 Generation Location

The Islandmagee area is saturated as a generation source. The complete outage of a 275kV power line from Ballylumford or Moyle exposes other circuits to overload. The worst outage results in a 118% overload on the 275kV circuit to Kells. This could be reconductored to a twin 700 sq mm circuit. The next worst outage results in an overload on the Ballylumford to Hannahstown 275kV circuit.

Coolkeeragh node is also saturated as a generation source. The worse outage is the Coolkeeragh-Magherafelt double circuit tower line which exposes the underlying 110kV network to heavy overloads and can result in voltage collapse. A further single 275kV circuit into Coolkeeragh would be required.

Generation located in the West (Magherafelt and Tyrone) would give rise to overloads on the underlying 110kV network for the outage of some 275kV circuits out of Tandragee and Magherafelt. The re-conductoring of the circuits from Drumnakelly to Tyrone should resolve these issues

11.2.2 Increased Network Traffic

To some degree the worsened voltage problem resulting from increased traffic to Louth depends upon where additional generation is located. At Tandragee, the additional traffic is minimised. If located at Castlereagh the additional generator, de facto, supplies the Belfast load which reduces longer routed inflows. The studies show that generation located at Castlereagh is the least onerous case followed by generation at Tandragee and the worst is when additional generation is located at Islandmagee. While we have been able to solve the load flows, we feel that the margin is too little and we believe that to manage this additional traffic would require an SVC which for the purposes of these studies we have located at Hannahstown. The size of the SVC, varies between 70MVAr and 150MVAr depending on generation location as described above. (We are told that a

150 MVAr on one site, which may not be optimal, would cost about £11m).

11.3 Additional Generation Backing off Supply from Scotland

In previous Sections we relied upon capacity from Scotland through Moyle interconnector to meet load requirements in NI, and to some degree in RoI. In this study, we introduce a further generator in NI and a load at Moyle which effectively reduces the input from Scotland by 400MW. While in summer this may result in a net transfer to Scotland, in winter it is tantamount to NI being self sufficient in capacity without Scotland and yet also able to supply 200MW to RoI.

The most severe issue results from locating generation at Coolkeeragh when a further 275kV Coolkeeragh to Magherafelt circuit would be required. We have also noted that generation located in the west or north will cause a summer case overload on the 110kV circuits from Tandragee to Lisburn if both transformers at Hannahstown are outaged (readers are referred to the opening paragraph of this section in which we drew attention to the need to re-close these circuits during transformer maintenance).

11.4 Renewable and Embedded Generation

The evidence is that most embedded generation between now and 2009 is likely to be in the form of wind farms. Applications and enquires to us indicate that there is a heavy concentration of desire to connect in the north and west of the province, including some units physically located just inside RoI. We anticipate between 200 and 400MW of plant will be wind sourced generation by 2009. Wind farms seem to be becoming bigger in size; while 5MW was the norm a few years ago, connections of over 20MW are now common. It is not the purpose of this statement to discuss the energy management issues, but there is work to do to understand the connection conditions for plant which is intermittent. The interaction between this and other generation and loads, and the resulting impact on the network, will be the subject of much work and debate in the coming years. It is envisaged that by the next matrix analysis we will have a methodology for assessing the network impacts of wind. In this work, we are still hampered by lack of reliable wind generator models.

11.5 Conclusion

The transmission network in Northern Ireland was originally built to a high standard, with many years of capacity, but the effects of over 40 years of load growth, together with electricity markets and open access are starting to stress capability. In particular, the continued increase in concentration of energy in-feed in the east of the province (driven partly by gas availability), the market and reserve traffic to RoI together combine to increase thermal and stability difficulties. It is our view that while we have attempted to facilitate development to the maximum, in the interests of supporting the competitive market, the day is not far removed when we will need to say that substantial investment will be required to support voltage and prevent thermal problems. To get this far, in some cases we have had to seek the support of generators to automatically reduce output or trip off machines during critical network conditions. We are also aware that fault levels are approaching equipment ratings.

Having said that, we believe that the major issue facing the network relates to voltage stability, which is worsened for transfers to RoI and may be further worsened by a high penetration of wind powered generation.

In thermal terms, we need to restate that the Islandmagee and Coolkeeragh areas are generation saturated but by backing off transfers from Scotland in favour of more generation located in the west (perhaps wind) can give rise to some overloads on the 110kV system.

Apart from that, we have concerns that high penetrations of wind energy could be destabilising, following system disturbances and we plan to bring forward new connection requirements to control the performance of such machines. These will form part of our Grid Code and co-operation will be sought with manufacturers and suppliers of wind farms.

12. DEVELOPMENT OPPORTUNITIES

When NIE considers major generation development projects, there will be a wide range of technical considerations to be taken into account. This will include factors such as System transient stability (the ability of the system to remain in synchronism during a system fault) System dynamic stability (the ability of the system to cope with the loss of a generating unit) and security of supply. The impact of a project on fault level and the ability of equipment to withstand or interrupt fault current may be a significant factor. There is also a range of operating regime considerations, which would need to be assessed when looking at new developments. These would include load factor, maximum and minimum export/import and project lifetimes. It is therefore impossible to be specific about where the best locations are for the development of generation or new major loads. However, from the studies, certain general points can be made as to where there is most spare capacity on the system.

It is simpler to deal separately with three general areas of development: new load, new generation and transmission system developments.

12.1 Opportunities for New Loads

For new loads of significant size, the primary system consideration will be the thermal capabilities of the existing system (local voltage issues may also have to be addressed). System power flows indicate that the 110kV system is heavily loaded in the west. New load would be more easily accommodated in the east, particularly close to the existing generation and the Moyle Interconnector, however an increase in load in the Belfast area might need additional voltage support.

With the exception of Coolkeeragh, the 275kV system is based mainly on a 'ring' structure. This provides a strong 'backbone' to the system and allows for alternative feeding arrangements under outage conditions. Seven Year Statements prior to 2001 noted that the 275kV system had considerable redundancy. In 2001 it was noted that this is no longer true for the circuits leaving Islandmagee. It still remains the case that new load development close to the main part of the 275kV system is less likely to incur 275kV reinforcement costs since the constraints involve only the generation nodes, which have been noted.

The 110kV system is generally more heavily loaded than the 275kV and connection of significant new load at 110kV is likely to require system upgrading. This is especially true in the west of the system and within and around Belfast. New generation is planned for Coolkeeragh and significant load can be accommodated there.

Providing that generation exists at the Coolkeeragh node and with uprating of the Coolkeeragh-Strabane circuits which is an approved development, approximately 100MW transfer can be accommodated to ESB in Donegal. Transfers from ESB to NIE in the North West are very dependent upon the generation profile in Donegal.

In summary, new load can be connected relatively easily near the major generation sources at Coolkeeragh and in the east and adjacent to the Moyle Interconnector. In the west of the system or in and around Belfast on the 110kV system, significant system upgrading may be required to accommodate new large loads.

12.2 Opportunities for New Generation

When considering new generation infeeds, the technical factors involved tend to be more complex than with new load developments. However, assuming that the dynamic effects of new generation have been taken into consideration, it is possible to identify general characteristics of the system which would indicate where new generation is most suited.

Adding additional generation depending on location may increase the fault level above rating at a few nodes. For any new generation proposal, it would be important to identify whether there is a requirement for switchgear upgrading as this can add significantly to project costs.

With respect to thermal considerations, significant new generation can be accepted at any of the 275kV nodes except those on Island Magee and around Coolkeeragh.

The power flow diagrams give an indication of the predominant flows and ratings on the 110kV system. Using these, it is possible to identify whether new generation connected to the 110kV system will add to or subtract from the existing system loadings.

It may be important also to consider the impact of possible displacement of generation. Power station location has a significant impact on voltage support both in relation to local networks and to the overall post-fault voltage profile. Generation at Kilroot is particularly beneficial in maintaining post-fault network voltage profiles, since the station has direct connection to Kells, Castlereagh and Tandragee.

In summary, the bias of the existing generation is to the east of the system, particularly when the Moyle Interconnector is operating. New generation is most easily accommodated near the 275kV system. There is a continuing role for generation in the north of the province and some scope in Belfast, although the need for the latter is lessened by Belfast Central Main substation. There is also some scope for generation in the west. The new plant at Coolkeeragh saturates the present capacity at the node.

12.3 Possible Transmission Development Scenarios

As has been highlighted in the previous sections, there are defined areas of the transmission system where system loading is such that little spare transmission capacity exists. These are predominantly in the Island Magee area. The network voltage profile is also of concern for faults in this area.

Retiring generation at Coolkeeragh is being replaced by gas fired plant. Even with a replacement plant there will be periods when generation is unavailable. The decision is whether to carry out network development or find other ways to manage the risk. A special protection scheme has been introduced to shed local load in rare worst-case outage conditions.

The power flow controlled circuit and capacitive support at Enniskillen maintains the voltages at Omagh and Enniskillen within limits, under peak loading conditions. The addition of a third transformer at Enniskillen as an alternative to changing the existing two units for larger transformers has improved both the capacity and voltage at the node. The new bus arrangement at the node improves flexibility for the power flow controlled interconnection with the Republic of Ireland.

The powerflows highlight a problem with loading on the Tandragee to Drumnakelly 110kV circuits. This problem has been addressed by a special protection scheme to be provided before Tyrone Main is commissioned.

110kV re-supply to Creagh is heavily dependant upon the commissioning of the new 275/110kV substation (Tyrone) near to Dungannon. Until that time, a failure in the Kells-Creagh 110kV circuit at periods of high load will result in load shedding in order to avoid unacceptable low voltage conditions. Limited load had been transferred to Creagh and operational measures will be taken to minimise the effects.

12.4 Conclusion

The existing 275kV transmission system is relatively robust with the exception that the increased in-feed requirement at Island Magee can give rise to heavy post-fault loading on this and parallel 110kV networks. The 110kV network towards the west and around Coolkeeragh remains heavily loaded. The introduction of the new Tyrone 275/110kV node at Dungannon will reduce the loading between Tandragee and Dungannon, improve resupply to Creagh, and this will generally stabilise system voltage in the area. New generation at Coolkeeragh creates a generation saturation condition at Coolkeeragh node.

Taking account of the planned developments detailed in Section 5.2, the existing NIE transmission system, as indicated by the power flows, is compliant with planning standards. However, the loading and generation profiles on the system are constantly evolving and it is inevitable that system modifications will be required as changes take place.

List of Tables 1 – 10

Existing Generation - Table1A

Station	Fuel Used	Contracted Capacity MW (at peak)	Contract Expiry Date	Earliest Cancellation Date
Kilroot Unit 2[2]	HFO/Coal	260	31-03-2024	1-11-2010
Unit 2[2]	HFO/Coal	260	31-03-2024	1-11-2010
GT 1	Gas Oil	29	31-03-2024	1-11-2010
GT 2	Gas Oil	29	31-03-2024	1-11-2010
B'ford Unit 4 [1]	Gas/HFO	180[1]	31-03-2012	1-11-2010
Unit 5 [1]	Gas/HFO	0 [1]	31-03-2012	1-11-2010
Unit 6 [1]	Gas/HFO	[1]	31-03-2012	1-11-2010
GT 1	Gas Oil	58	31-03-2020	1-11-2010
GT 2	Gas Oil	58	31-03-2020	1-11-2010
GTA	Gas/Gas oil	250	31-03-2012	
GTB	Gas/Gas oil	250	31-03-2012	
GTD	Gas/Gas oil	106	31-03-2012	
C'Keer Unit 6	HFO	60	31-03-2003	1-04-2003
Unit 7	HFO	60	31-03-2004	1-04-2004
GT 1	Gas Oil	58	31-03-2020	1-11-2010

[1] During 2002/3, units 4 5 and 6 at Ballylumford were decommissioned and replaced by a new CCGT plant of similar total capacity, The NIE Power Procurement Business (PPB) subsequently contracted with parties to be a virtual power producer. To deliver obligations to ESB, unit 6 at Ballylumford is now retained in addition to the new CCGT. This capacity, reduced to 180MW sent-out, is not counted in the calculation of capacity available for NI. At the same time, Unit 1 at Ballylumford was withdrawn and is replaced until 2012 by Unit 4 at a maximum sent-out capacity of 180MW. Unit 5 can be used only as a replacement for units 4 or 6. Units 2 and 3 were also decommissioned and they were not replaced.

[2] The Kilroot units normally operate with coal firing however their capacity can be increased by oil firing.

Non Fossil Fuel Obligation (NFFO) Capacity – Table 1B

Scheme Name	Technology	Capacity DNC kW	Contract Expiry Date
NFFO1			
Rigged Hill	Wind	2142	31-03-2009
Corkey	Wind	2142	31-03-2009
Slieve Rushen	Wind	2086	31-03-2009
Elliott's Hill	Wind	2142	31-03-2009
Bessy Bell	Wind	2098	31-03-2009
Owenreagh	Wind	2054	31-03-2009
Harperstown	Hydro	250	31-03-2009
Benburb	Hydro	75	31-03-2009
Carrickness	Hydro	155	31-03-2009
Park Mills	Hydro	30	31-03-2009
Randalstown	Hydro	500	31-03-2009
Blackwater	Hydro	100	31-03-2009
Sion Mills	Hydro	780	31-03-2009
Oakland's WTW	Hydro	49	31-03-2009
Silent Valley	Hydro	435	31-03-2009
NFFO2			
Lendrum's Bridge	Wind	2141	31-08-2013
Slievenahanaghan	Wind	426	14-11-2012
Blackwater Museum	Biomass	204	30-06-2013
Brook Hall Estate	Biomass	100	31-10-2012
Benburb Small Hydro	Hydro	75	30-04-2012

Additional Renewable Generation – Table 1C

Scheme Name	Technology	Maximum Capacity (MW)	Date Commissioned
Altahullion	Wind	26	April 2003
Lendrums Bridge	Wind	8.2	October 2002
Snugborough	Wind	13.5	October 2003

NORTHERN IRELAND TRANSMISSION SYSTEM											TABLE 2.1
SEVEN YEAR STATEMENT 2003											
Transformer Capacity and Loadings at Bulk Supply Points											
Location	Total Transformer Capacity (MVA)	Substation Firm Capacity(MVA)	Forecast Loading (MVA)								
			03/04	**04/05**	**05/06**	**06/07**	**07/08**	**08/09**	**09/10**	***NOTES***
Antrim	90.0	45.0	42.20	43.05	43.90	44.74	45.59	46.44	47.31	***1&3***
Ballymena Rural	90.0	45.0	64.05	65.69	40.94	42.22	43.50	44.78	46.07	***1&2&7***
Ballymena Town	120.0	72.0	44.75	45.13	45.53	45.91	46.29	46.69	47.09	
Ballynahinch	180.0	71.4	57.14	62.28	63.70	65.10	66.51	67.93	69.37	
Banbridge	120.0	55.3	41.97	43.19	44.41	45.62	46.84	48.06	49.30	***1***
Creagh	120.0	78.0	9.07	9.34	36.03	36.68	37.34	38.02	38.71	***4&6***
Coleraine	120.0	78.0	44.38	45.28	46.20	47.09	48.00	48.91	49.83	***6***
Coolkeeragh	180.0	116.6	73.06	74.15	75.26	76.35	77.44	78.55	79.68	
Drumnakelly	180.0	111.2	94.13	96.97	99.83	102.65	105.46	108.29	111.13	
Dungannon	180.0	117.0	91.49	93.68	95.90	98.09	100.29	102.51	104.76	
Eden	90.0	37.4	33.11	33.90	34.70	35.49	36.28	37.08	37.89	***3&1***
Enniskillen	150.0	117.0	63.67	65.17	66.68	68.18	69.67	71.19	72.72	***6&1***
Finaghy	90.0	58.5	40.34	41.36	42.52	43.67	44.82	45.98	47.15	
Larne	90.0	58.5	39.62	39.98	40.35	40.71	41.07	41.43	41.81	***1***
Limavady	47.0	22.5	28.07	28.82	29.57	30.31	31.05	31.81	32.57	***1&3***
Lisaghmore	90.0	58.5	52.18	52.96	53.76	54.53	55.31	56.11	56.91	***6***
Lisburn(N+S)	180.0	117.0	61.42	61.93	62.66	63.36	64.07	64.79	65.52	***1***
Loguestown	90.0	55.3	40.16	40.53	40.91	41.28	41.65	42.03	42.42	
Newry	180.0	74.0	79.91	81.85	83.83	85.80	87.78	89.80	91.86	***3***
Newtownards	120.0	78.0	0.00	43.82	44.19	44.57	44.95	45.35	45.75	***4&6***
Norfil	90.0	58.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Omagh	120.0	78.0	56.11	57.57	59.04	60.50	61.96	63.44	64.93	***6***
Rathgael	180.0	85.0	90.70	65.83	65.79	66.42	67.03	67.64	68.25	***1&2&7***
Rosebank	180.0	111.2	66.07	36.85	36.44	36.26	36.48	36.72	36.98	***2***
Strabane	90.0	38.0	40.23	41.45	42.68	43.89	45.12	46.35	47.59	***3***
Waringstown	90.0	58.5	52.57	52.84	53.12	53.38	53.65	53.92	54.21	
West	150.0	267.0	133.01	133.92	134.88	135.80	136.74	137.70	138.70	***5***
Belfast Central	180.0									
Carnmoney	120.0	60.0	44.65	46.42	48.21	49.52	50.87	52.27	53.73	***1***
Glengormley	60.0	30.8	15.93	15.71	15.52	15.83	16.15	16.47	16.79	
Cregagh	150.0	78.9	70.88	73.16	75.55	77.98	80.50	83.11	85.83	***3***
Knock	120.0	59.7	57.99	64.74	65.66	66.56	67.48	68.43	69.40	***1&3***
Donegall North	150.0	78.0	55.44	55.63	55.85	56.05	56.25	56.46	56.69	***1***
Donegall South	120.0	78.0	51.98	52.30	52.65	52.97	53.30	53.63	53.98	***1***

NOTES

1 Transformer exceeds 40years, condition assessment may be required to evaluate rating.
2 Load to be transferred.
3 It is planned to manage capacity issues.
4 New Bulk Supply Point to be commissioned.
5 Both sources are interconnected via 33kV cables
6 Firm capacity based on transformer short term overload capacity may be limited by other network components
7 Load shedding scheme in place.

Substation exceeded Firm Capacity -

NORTHERN IRELAND TRANSMISSION SYSTEM

TABLE 2.2

SEVEN YEAR STATEMENT 2003

Substation Available Capacity

Location	Total Transformer Capacity (MVA)	Substation Firm Capacity(MVA)	Forecasted available Substation Capacity Loading (MVA)							
			03/04	**04/05**	**05/06**	**06/07**	**07/08**	**08/09**	**09/10**	***NOTES***
Antrim	90.0	45.0	2.80	1.95	1.10	0.26	-0.59	-1.44	-2.31	***1&3***
Ballymena Rural	90.0	45.0	-19.05	-20.69	4.06	2.78	1.50	0.22	-1.07	***1&2&7***
Ballymena Town	120.0	72.0	27.25	26.87	26.47	26.09	25.71	25.31	24.91	
Ballynahinch	180.0	71.4	14.26	9.12	7.70	6.30	4.89	3.47	2.03	
Banbridge	120.0	55.3	13.34	12.12	10.90	9.69	8.47	7.25	6.01	***1***
Creagh	120.0	78.0	68.93	68.66	41.97	41.32	40.66	39.98	39.29	***4&6***
Coleraine	120.0	78.0	33.62	32.72	31.80	30.91	30.00	29.09	28.17	***6***
Coolkeeragh	180.0	116.6	43.51	42.42	41.31	40.22	39.13	38.02	36.89	
Drumnakelly	180.0	111.2	17.10	14.26	11.40	8.58	5.77	2.94	0.10	
Dungannon	180.0	117.0	25.51	23.32	21.10	18.91	16.71	14.49	12.24	
Eden	90.0	37.4	4.32	3.53	2.73	1.94	1.15	0.35	-0.46	***3&1***
Enniskillen	150.0	117.0	53.33	24.83	23.32	21.82	20.33	18.81	17.28	***6&1***
Finaghy	90.0	58.5	18.16	17.14	15.98	14.83	13.68	12.52	11.35	
Larne	90.0	58.5	18.88	18.52	18.15	17.79	17.43	3.57	3.19	***1***
Limavady	47.0	22.5	-5.57	-6.32	-7.07	-7.81	-8.55	-9.31	-10.07	***1&3***
Lisaghmore	90.0	58.5	6.32	5.54	4.74	3.97	3.19	2.39	1.59	***6***
Lisburn(N+S)	180.0	117.0	55.58	55.07	54.34	26.64	25.93	25.21	24.48	***1***
Loguestown	90.0	55.3	15.15	14.78	14.40	14.03	13.66	13.28	12.89	
Newry	180.0	74.0	-5.91	-7.85	-9.83	-11.80	-13.78	-15.80	-17.86	***3***
Newtownards	120.0	78.0		34.18	33.81	33.43	33.05	32.65	32.25	***4&6***
Norfil	90.0	58.5	58.50	58.50	58.50	58.50	58.50	58.50	58.50	
Omagh	120.0	78.0	21.89	20.43	18.96	17.50	16.04	14.56	13.07	***6***
Rathgael	180.0	85.0	-5.70	19.17	19.21	18.58	17.97	17.36	16.75	***1&2&7***
Rosebank	180.0	111.2	45.16	74.38	74.79	74.97	74.75	74.51	74.25	***2***
Strabane	90.0	38.0	-2.23	-3.45	-4.68	-5.89	-7.12	-8.35	-9.59	***3***
Waringstown	90.0	58.5	5.93	5.66	5.38	5.12	4.85	4.58	4.29	
West	150.0	267.0	133.99	133.08	132.12	131.20	130.26	129.30	128.30	***5***
Belfast Central	180.0									
Carnmoney	120.0	60.0	15.35	13.58	11.79	10.48	9.13	7.73	6.27	***1***
Glengormley	60.0	30.8	14.87	15.09	15.28	14.97	14.65	14.33	14.01	
Cregagh	150.0	78.9	7.97	5.69	3.30	0.87	-1.65	-4.26	-6.98	***3***
Knock	120.0	59.7	1.68	-5.07	-5.99	-6.89	-7.81	-8.76	-9.73	***1&3***
Donegall North	150.0	78.0	22.56	22.37	22.15	3.95	3.75	3.54	3.31	***1***
Donegall South	120.0	78.0	26.02	25.70	25.35	7.03	6.70	6.37	6.02	***1***

NOTES

1 Transformer exceeds 40years, condition assessment may be required to evaluate rating.
2 Load to be transferred.
3 It is planned to manage capacity issues.
4 New Bulk Supply Point to be commissioned.
5 Both sources are interconnected via 33kV cables.
6 Firm capacity based on transformer short term overload capacity may be limited by other network components
7 Load shedding scheme in place.

Zero capacity available -

NORTHERN IRELAND ELECTRICITY TRANSMISSION SYSTEM DATA LISTING

BUS DATA - WINTER 2003/04 TABLE 3

BUS NUMBER	NODE NAME	NAME	VOLTAGE (KV)	PLOAD (MW)	QLOAD (Mvar)
70011	ANTR1A	ANTRIM	110		
70012	ANTR1B		110		
70030	ANTR3-		33		
70501	BAFDG1	BALLYLUMFORD	13.8		
70502	BAFDG2		13.8		
70503	BAFDG3		13.8		
70504	BAFDG4		15	0	0
70505	BAFDG5		15	0	0
70506	BAFDG6		15	0	0
70507	BAFDG7		11		
70508	BAFDG8		11		
70510	BAFD1-		110	7.4	2.5
70513	BAFD_GA		15	3.7	1.2
70514	BAFD_GB		15	3.7	1.2
70515	BAFD_GC		18	3.7	1.2
70516	BAFD_GD		15	3.7	1.2
70520	BAFD2-		275		
70561	BAFD6P		22		
70562	BAFD6Q		22		
70571	BAFD7P		22		
70572	BAFD7Q		22		
70580	BAFD8-		3.3		
71011	BAME1A	BALLYMENA	110		
71012	BAME1B		110		
71031	BAME3R		33	60.8	20
71032	BAME3T		33	42.5	14
71511	BANB1A	BANBRIDGE	110		
71512	BANB1B		110		
71530	BANB3-		33	39.9	13.1
72010	BAVA1-	BALLYVALLAGH	110		
72511	BNCH1A	BALLYNAHINCH	110		
72512	BNCH1B		110		
72530	BNCH3-		33	54.3	17.8
73521	CACO2A	CABLES AT COOLKERRAGH	275		
73522	CACO2B		275		
74011	CARN1A	CARNMONEY	110		
74012	CARN1B		110		
74030	CARN3-		33	42.4	13.9
74511	CAST1A	CASTLEREAGH	110		
74512	CAST1B		110		
74520	CAST2-		275		
74561	CAST6P		22		
74562	CAST6Q		22		
74563	CAST6R		22		
74571	CAST7P		22		
74572	CAST7Q		22		
74573	CAST7R		22		
74711	CENT1A	BELFAST CENTRAL	110		
74712	CENT1B		110		
74731	CENT3A		33	33.9	11.1
74732	CENT3B		33	33.9	11.1
75010	COLE1-	COLERAINE	110		
75030	COLE3-		33	42.2	13.9
75501	COOLG1-	COOLKERRRAGH	11.8		
75502	COOLG2-		11.8		
75503	COOLG3-		11.8	0	0
75504	COOLG4-		11.8	0	0
75505	COOLG5-		16		
75506	COOLG6-		16	3.7	1.2
75507	COOLG7-		16	3.7	1.2
75508	COOLG8-		11		
75510	COOL1-		110		

NORTHERN IRELAND ELECTRICITY TRANSMISSION SYSTEM DATA LISTING

BUS DATA - WINTER 2003/04 TABLE 3

BUS NUMBER	NODE NAME	NAME	VOLTAGE (KV)	PLOAD (MW)	QLOAD (Mvar)
75514	COOL1C		110		
75520	COOL2-		275		
75530	COOL3-		33	69.4	22.8
75561	COOL6P		22		
75562	COOL6Q		22		
75571	COOL7P		22		
75572	COOL7Q		22		
75810	CREA1-	CREAGH	110		
75830	CREA3-		33	8.6	2.8
75911	CREC1A		110		
75912	CREC1B		110		
76011	CREG1A		110		
76012	CREG1B		110		
76031	CREG3A		33	23.2	7.6
76032	CREG3B		33	13.9	4.6
76511	DONE1C	DONEGAL	110		
76512	DONE1B		110		
76513	DONE1D		110		
76514	DONE1A		110		
76531	DONE3AS		33	49.4	16.2
76532	DONE3N		33	45.7	15
76533	DONE3BS		33	7	2.3
77010	DRUM1-	DRUMNAKELLY	110		
77030	DRUM3-		33	89.4	29.4
77510	DUNG1-	DUNGANNON	110		
77530	DUNG3-		33	86.9	28.6
78030	DUNM3-		33	22.7	7.5
78511	EDEN1A	EDEN	110		
78512	EDEN1B		110		
78530	EDEN3-		33	31.5	10.3
79010	ENNK1_	ENNISKILLEN	110		
79015	ENNKPFA		110		
79016	ENNKPFB		110		
79030	ENNK3-		33	60.5	19.9
80011	FINY1A	FINAGHY	110		
80012	FINY1B		110		
80030	FINY3-		33	38.3	12.6
80511	GLEN1A	GLENGORMLEY	110		
80512	GLEN1B		110		
80530	GLEN3-		33	15.1	5
81010	HANA1A	HANNAHSTOWN	110		
81020	HANA2A		275		
81061	HANA6P		22		
81062	HANA6Q		22		
81071	HANA7P		22		
81072	HANA7Q		22		
81510	KELS1-	KELLS	110		
81520	KELS2-		275		
81561	KELS6P		22		
81562	KELS6Q		22		
81571	KELS7P		22		
81572	KELS7Q		22		
82001	KILRG1-	KILROOT	17	14.8	4.9
82002	KILRG2-		17	14.8	4.9
82020	KILR2-		275		

NORTHERN IRELAND ELECTRICITY TRANSMISSION SYSTEM DATA LISTING

BUS DATA - WINTER 2003/04 TABLE 3

BUS NUMBER	NODE NAME	NAME	VOLTAGE (KV)	PLOAD (MW)	QLOAD (Mvar)
82511	KNCK1A	KNOCK	110		
82512	KNCK1B		110		
82531	KNCK3A		33	20.6	6.8
82532	KNCK3B		33	20.6	6.8
83011	LARN1A	LARNE	110		
83012	LARN1B		110		
83030	LARN3-		33	37.6	12.4
83510	LIMA1-	LIMAVADY	110		
83530	LIMA3-		33	26.7	8.8
84011	LISB1A	LISBURN	110		
84012	LISB1B		110		
84030	LISB3-		33	58.4	19.2
84411	LSMR1A	LISAGHMORE	110		
84412	LSMR1B		110		
84430	LSMR3-		33	49.6	16.3
84511	LOGE1A	LOGUESTOWN	110		
84512	LOGE1B		110		
84530	LOGE3-		33	38.2	12.5
85020	MAGF2-	MAGHERAFELT	275		
86031	MOUN3A	MOUNTPOTTINGER	33	22.1	7.3
86032	MOUN3B		33	22.1	7.3
86220	MOYL2-	MOYLE	275		
86221	SCOT2-		275		
86511	NEWY1A	NEWRY	110		
86512	NEWY1B		110		
86530	NEWY3-		33	75.9	25
87011	NORF1A	NORFIL	110		
87012	NORF1B		110		
87030	NORF3-		33	0	0
87510	OMAH1-	OMAGH	110		
87530	OMAH3-		33	53.3	17.5
88011	RATH1A	RATHGAEL	110		
88012	RATH1B		110		
88030	RATH3-		33	86.2	28.3
88511	ROSE1A	ROSEBANK	110		
88512	ROSE1B		110		
88530	ROSE3-		33	62.8	20.6
89030	SKEG3-	SKEGONEILL	33	35.9	11.8
89510	STRA1-	STRABANE	110		
89515	STRPFCA		110		
89516	STRPFCB		110		
89530	STRA3-		33	38.2	12.6
90011	TAND1A	TANDRAGEE	110		
90012	TAND1B		110		
90020	TAND2-		275		
90061	TAND6P		22		
90062	TAND6Q		22		
90063	TAND6R		22		
90071	TAND7P		22		
90072	TAND7Q		22		
90073	TAND7R		22		
90511	WARN1A	WARINGSTOWN	110		
90512	WARN1B		110		
90530	WARN3-		33	49.9	16.4
91001	WESTG1	PSW	11.8		
91002	WESTG2		11.8		
91003	WESTG3		11.8		
91004	WESTG4		11.8	0	0
91005	WESTG5		11.8	0	0
91011	WEST1A		110		
91012	WEST1B		110		
91031	WEST3A		33	0	0
91032	WEST3B		33	0	0

NORTHERN IRELAND ELECTRICITY TRANSMISSION SYSTEM DATA LISTING

BRANCH DATA - WINTER 2003/04 **TABLE 4**

NODE		*CCT*	*NAME*	*PARAMETERS PU ON 100MVA BASE*				*RATING IN MVA*		
FROM	*TO*	*NO*	*FROM*	*TO*	*RESISTANCE*	*REACTANCE*	*SUSCEPTANCE*	*WINTER*	*AUTUMN*	*SUMMER*
1981	79016	1	CORRACL 110.0	ENNKPFB 110.0	0.04720	0.10680	0.01020	124	115	106
3581	89516	1	LETRKENY 110.0	STRPFCB 110.0	0.03498	0.07926	0.00759	126	115	106
35231	35232	1	LOUTH5 A 275.0	LOUTH5 B 275.0	0.00000	0.00010	0.00000	1000	1000	1000
35231	90020	1	LOUTH5 A 275.0	TAND2- 275.0	0.00240	0.02110	0.12690	881	820	710
35232	90020	2	LOUTH5 B 275.0	TAND2- 275.0	0.00240	0.02110	0.12690	881	820	710
70011	81510	1	ANTR1A 110.0	KELS1- 110.0	0.01280	0.02940	0.00310	103	95	82
70011	87011	1	ANTR1A 110.0	NORF1A 110.0	0.00080	0.00080	0.00770	84	76	76
70012	81510	1	ANTR1B 110.0	KELS1- 110.0	0.01280	0.02940	0.00310	103	95	82
70012	87012	1	ANTR1B 110.0	NORF1B 110.0	0.00080	0.00080	0.00770	84	76	76
70510	72010	1	BAFD1- 110.0	BAVA1- 110.0	0.02520	0.05760	0.00610	103	95	82
70510	72010	2	BAFD1- 110.0	BAVA1- 110.0	0.02520	0.05760	0.00610	103	95	82
70510	78511	1	BAFD1- 110.0	EDEN1A 110.0	0.02280	0.05350	0.00480	86	80	69
70510	78512	1	BAFD1- 110.0	EDEN1B 110.0	0.02280	0.05270	0.00480	87	81	70
70520	81020	2	BAFD2- 275.0	HANA2A 275.0	0.00230	0.01960	0.12700	881	820	710
70520	81520	1	BAFD2- 275.0	KELS2- 275.0	0.00170	0.01500	0.09040	881	820	710
70520	85020	1	BAFD2- 275.0	MAGF2- 275.0	0.00320	0.02860	0.17200	881	820	710
70520	86220	1	BAFD2- 275.0	MOYL2- 275.0	0.00010	0.00130	0.00810	881	820	710
70561	70571	1	BAFD6P 22.00	BAFD7P 22.00	0.00000	0.00010	0.00000	0	0	0
70562	70572	1	BAFD6Q 22.00	BAFD7Q 22.00	0.00000	0.00010	0.00000	0	0	0
71011	81510	1	BAME1A 110.0	KELS1- 110.0	0.01540	0.03680	0.00355	124	119	109
71012	81510	1	BAME1B 110.0	KELS1- 110.0	0.01540	0.03680	0.00355	124	119	109
71511	90011	1	BANB1A 110.0	TAND1A 110.0	0.02360	0.05460	0.00555	103	95	82
71512	90011	1	BANB1B 110.0	TAND1A 110.0	0.02360	0.05460	0.00555	103	95	82
72010	81510	1	BAVA1- 110.0	KELS1- 110.0	0.03040	0.07220	0.00700	124	119	109
72010	81510	2	BAVA1- 110.0	KELS1- 110.0	0.03040	0.07220	0.00700	103	95	82
72010	83011	1	BAVA1- 110.0	LARN1A 110.0	0.00720	0.02340	0.00250	113	96	80
72010	83012	1	BAVA1- 110.0	LARN1B 110.0	0.00720	0.02340	0.00250	113	96	80
72511	74512	1	BNCH1A 110.0	CAST1B 110.0	0.03080	0.07060	0.00740	103	95	82
72512	74512	1	BNCH1B 110.0	CAST1B 110.0	0.03080	0.07060	0.00740	103	95	82
73521	75520	1	CACO2A 275.0	COOL2- 275.0	0.00010	0.00010	0.02280	837	761	761
73521	85020	1	CACO2A 275.0	MAGF2- 275.0	0.00670	0.02400	0.14950	513	477	412
73522	75520	1	CACO2B 275.0	COOL2- 275.0	0.00010	0.00010	0.01930	837	761	761
73522	85020	1	CACO2B 275.0	MAGF2- 275.0	0.00670	0.02400	0.14950	513	477	412
74011	74511	1	CARN1A 110.0	CAST1A 110.0	0.03710	0.08690	0.00780	87	80	69
74011	78511	1	CARN1A 110.0	EDEN1A 110.0	0.01870	0.04390	0.00400	86	80	69
74012	74511	1	CARN1B 110.0	CAST1A 110.0	0.03710	0.08570	0.00780	87	80	69
74012	78512	1	CARN1B 110.0	EDEN1B 110.0	0.01870	0.04330	0.00400	87	81	70
74030	80530	1	CARN3- 33.00	GLEN3- 33.00	0.03510	0.02070	0.00330	18.8	17.1	17.1
74030	80530	2	CARN3- 33.00	GLEN3- 33.00	0.03510	0.02070	0.00330	18.8	17.1	17.1
74511	74512	1	CAST1A 110.0	CAST1B 110.0	0.00000	0.00010	0.00000	1000	1000	1000
74511	74512	2	CAST1A 110.0	CAST1B 110.0	0.00000	0.00010	0.00000	1000	1000	1000
74511	88511	1	CAST1A 110.0	ROSE1A 110.0	0.00100	0.00180	0.02545	128	117	117
74511	88512	1	CAST1A 110.0	ROSE1B 110.0	0.00100	0.00180	0.02545	128	117	117
74512	76011	1	CAST1B 110.0	CREG1A 110.0	0.00120	0.00360	0.06080	145	132	132
74512	76012	1	CAST1B 110.0	CREG1B 110.0	0.00120	0.00360	0.06080	145	132	132
74512	82511	1	CAST1B 110.0	KNCK1A 110.0	0.00520	0.00440	0.04370	73	66	66
74512	82512	1	CAST1B 110.0	KNCK1B 110.0	0.00520	0.00440	0.04370	73	66	66
74512	88011	1	CAST1B 110.0	RATH1A 110.0	0.02740	0.06300	0.00660	103	95	82
74512	88012	1	CAST1B 110.0	RATH1B 110.0	0.02740	0.06300	0.00660	103	95	82
74520	81020	1	CAST2- 275.0	HANA2A 275.0	0.00090	0.00780	0.05060	881	820	710
74520	81020	2	CAST2- 275.0	HANA2A 275.0	0.00090	0.00790	0.05060	881	820	710
74520	82020	1	CAST2- 275.0	KILR2- 275.0	0.00340	0.02940	0.17810	881	820	710
74520	90020	1	CAST2- 275.0	TAND2- 275.0	0.00230	0.01910	0.12350	881	820	710
74561	74571	1	CAST6P 22.00	CAST7P 22.00	0.00000	0.00010	0.00000	0	0	0
74562	74572	1	CAST6Q 22.00	CAST7Q 22.00	0.00000	0.00010	0.00000	0	0	0
74563	74573	1	CAST6R 22.00	CAST7R 22.00	0.00000	0.00010	0.00000	0	0	0
74711	76011	1	CENT1A 110.0	CREG1A 110.0	0.00111	0.00462	0.02222	145	144	144
74712	76012	1	CENT1B 110.0	CREG1B 110.0	0.00111	0.00462	0.02222	145	144	144
74731	74732	1	CENT3A 33.00	CENT3B 33.00	0.00010	0.00010	0.00000	1000	1000	1000
74731	86031	1	CENT3A 33.00	MOUN3A 33.00	0.01290	0.26890	0.00300	33	30	30
74731	91031	1	CENT3A 33.00	WEST3A 33.00	0.01300	0.26699	0.00400	33	30	30
74731	91031	2	CENT3A 33.00	WEST3A 33.00	0.01245	0.26627	0.00400	33	30	30
74732	86032	1	CENT3B 33.00	MOUN3B 33.00	0.01290	0.26890	0.00300	33	30	30
74732	91032	1	CENT3B 33.00	WEST3B 33.00	0.01925	0.26296	0.00400	33	30	30
74732	91032	2	CENT3B 33.00	WEST3B 33.00	0.01171	0.26530	0.00400	33	30	30
75010	75510	1	COLE1- 110.0	COOL1- 110.0	0.06700	0.15390	0.01610	103	95	82
75010	81510	1	COLE1- 110.0	KELS1- 110.0	0.08560	0.20200	0.01970	103	95	82

NORTHERN IRELAND ELECTRICITY TRANSMISSION SYSTEM DATA LISTING

BRANCH DATA - WINTER 2003/04 **TABLE 4**

NODE		CCT	NAME		PARAMETERS PU ON 100MVA BASE			RATING IN MVA		
FROM	TO	NO	FROM	TO	RESISTANCE	REACTANCE	SUSCEPTANCE	WINTER	AUTUMN	SUMMER
75010	83510	1	COLE1- 110.0	LIMA1- 110.0	0.02700	0.06410	0.00610	103	95	82
75010	84511	1	COLE1- 110.0	LOGE1A 110.0	0.01160	0.02700	0.00280	103	95	82
75010	84512	1	COLE1- 110.0	LOGE1B 110.0	0.01160	0.02700	0.00280	103	95	82
75510	75514	1	COOL1- 110.0	COOL1C 110.0	0.00000	0.00010	0.00000	0	0	0
75510	83510	1	COOL1- 110.0	LIMA1- 110.0	0.04280	0.10110	0.00980	103	95	82
75510	84411	1	COOL1- 110.0	LSMR1A 110.0	0.01304	0.02994	0.00315	103	95	82
75510	84412	1	COOL1- 110.0	LSMR1B 110.0	0.01304	0.02994	0.00315	103	95	82
75510	89510	1	COOL1- 110.0	STRA1- 110.0	0.01820	0.05160	0.00168	166	158	144
75510	89510	2	COOL1- 110.0	STRA1- 110.0	0.01800	0.07550	0.00820	166	158	144
75561	75571	1	COOL6P 22.00	COOL7P 22.00	0.00000	0.00010	0.00000	0	0	0
75562	75572	1	COOL6Q 22.00	COOL7Q 22.00	0.00000	0.00010	0.00000	0	0	0
75810	75911	1	CREA1- 110.0	CREC1A 110.0	0.00023	0.00088	0.00614	144	144	144
75810	75912	1	CREA1- 110.0	CREC1B 110.0	0.00023	0.00088	0.00614	144	144	144
75911	81510	1	CREC1A 110.0	KELS1- 110.0	0.02869	0.07478	0.00740	103	95	82
75912	77510	1	CREC1B 110.0	DUNG1- 110.0	0.06423	0.16951	0.01634	103	95	82
76031	76032	1	CREG3A 33.00	CREG3B 33.00	0.00000	0.00010	0.00000	1000	1000	1000
76031	86031	1	CREG3A 33.00	MOUN3A 33.00	0.00670	0.01190	0.00620	50	46	46
76031	86032	1	CREG3A 33.00	MOUN3B 33.00	0.00670	0.01190	0.00620	50	46	46
76032	82531	1	CREG3B 33.00	KNCK3A 33.00	0.02000	0.03000	0.00400	33	30	30
76032	82532	1	CREG3B 33.00	KNCK3B 33.00	0.02000	0.03000	0.00400	33	30	30
76511	81010	1	DONE1C 110.0	HANA1A 110.0	0.00170	0.00470	0.14550	158	144	144
76511	91011	1	DONE1C 110.0	WEST1A 110.0	0.00570	0.00550	0.06320	82	75	75
76512	81010	1	DONE1B 110.0	HANA1A 110.0	0.00170	0.00470	0.14550	158	144	144
76512	91012	1	DONE1B 110.0	WEST1B 110.0	0.00560	0.00530	0.06090	82	75	75
76513	80012	1	DONE1D 110.0	FINY1B 110.0	0.00540	0.01240	0.00120	87	81	70
76514	80011	1	DONE1A 110.0	FINY1A 110.0	0.00540	0.01240	0.00120	86	80	69
76531	76533	1	DONE3AS 33.00	DONE3BS 33.00	0.00000	0.00010	0.00000	0	0	0
76532	76533	1	DONE3N 33.00	DONE3BS 33.00	0.00000	0.00100	0.00000	34.2	34.2	34.2
76532	76533	2	DONE3N 33.00	DONE3BS 33.00	0.00000	0.00100	0.00000	34.2	34.2	34.2
77010	77510	1	DRUM1- 110.0	DUNG1- 110.0	0.03700	0.08600	0.00880	103	95	82
77010	77510	2	DRUM1- 110.0	DUNG1- 110.0	0.04080	0.09450	0.00970	103	95	82
77010	90011	1	DRUM1- 110.0	TAND1A 110.0	0.00460	0.01480	0.00160	113	96	80
77010	90011	2	DRUM1- 110.0	TAND1A 110.0	0.00460	0.01480	0.00160	113	96	80
77010	90011	3	DRUM1- 110.0	TAND1A 110.0	0.00550	0.01520	0.00140	119	106	96
77510	87510	1	DUNG1- 110.0	OMAH1- 110.0	0.05218	0.12421	0.01186	124	119	109
77510	87510	2	DUNG1- 110.0	OMAH1- 110.0	0.05832	0.13881	0.01325	124	119	109
78030	89030	1	DUNM3- 33.00	SKEG3- 33.00	0.01780	0.01200	0.00400	30.8	28	28
78030	89030	2	DUNM3- 33.00	SKEG3- 33.00	0.01350	0.01270	0.00550	34.4	31.3	31.3
78030	91031	1	DUNM3- 33.00	WEST3A 33.00	0.02120	0.27190	0.00300	33	33	30
78030	91032	1	DUNM3- 33.00	WEST3B 33.00	0.02030	0.27090	0.00300	33	33	30
79010	87510	1	ENNK1_ 110.0	OMAH1- 110.0	0.04880	0.11200	0.01180	103	95	82
79010	87510	2	ENNK1_ 110.0	OMAH1- 110.0	0.04880	0.11200	0.01180	103	95	82
80011	81010	1	FINY1A 110.0	HANA1A 110.0	0.00100	0.00300	0.05067	144	144	144
80012	81010	1	FINY1B 110.0	HANA1A 110.0	0.00100	0.00300	0.05067	144	144	144
80511	81510	1	GLEN1A 110.0	KELS1- 110.0	0.03040	0.06780	0.03040	90	82	82
80512	81510	1	GLEN1B 110.0	KELS1- 110.0	0.03040	0.06780	0.03040	90	82	82
81010	84011	1	HANA1A 110.0	LISB1A 110.0	0.00894	0.02792	0.01908	100	93	80
81010	84012	1	HANA1A 110.0	LISB1B 110.0	0.01000	0.02723	0.01907	103	95	82
81020	86220	1	HANA2A 275.0	MOYL2- 275.0	0.00220	0.01880	0.12210	881	820	710
81061	81071	1	HANA6P 22.00	HANA7P 22.00	0.00000	0.00010	0.00000	0	0	0
81062	81072	1	HANA6Q 22.00	HANA7Q 22.00	0.00000	0.00010	0.00000	0	0	0
81520	82020	1	KELS2- 275.0	KILR2- 275.0	0.00150	0.01280	0.07690	881	820	710
81520	82020	2	KELS2- 275.0	KILR2- 275.0	0.00150	0.01280	0.07690	881	820	710
81520	85020	1	KELS2- 275.0	MAGF2- 275.0	0.00150	0.01350	0.08140	881	820	710
81561	81571	1	KELS6P 22.00	KELS7P 22.00	0.00000	0.00010	0.00000	0	0	0
81562	81572	1	KELS6Q 22.00	KELS7Q 22.00	0.00000	0.00010	0.00000	0	0	0
82020	90020	1	KILR2- 275.0	TAND2- 275.0	0.00410	0.03540	0.21490	881	820	710
82531	82532	1	KNCK3A 33.00	KNCK3B 33.00	0.00000	0.00010	0.00000	1000	1000	1000
84011	90011	1	LISB1A 110.0	TAND1A 110.0	0.03910	0.10850	0.01040	103	95	82
84012	90011	1	LISB1B 110.0	TAND1A 110.0	0.03370	0.10600	0.00940	100	93	80

NORTHERN IRELAND ELECTRICITY TRANSMISSION SYSTEM DATA LISTING

BRANCH DATA - WINTER 2003/04 **TABLE 4**

NODE		CCT	NAME		PARAMETERS PU ON 100MVA BASE			RATING IN MVA		
FROM	TO	NO	FROM	TO	RESISTANCE	REACTANCE	SUSCEPTANCE	WINTER	AUTUMN	SUMMER
85020	90020	1	MAGF2- 275.0	TAND2- 275.0	0.00260	0.02150	0.13950	881	820	710
85020	90020	2	MAGF2- 275.0	TAND2- 275.0	0.00260	0.02150	0.13950	881	820	710
86031	86032	1	MOUN3A 33.00	MOUN3B 33.00	0.00000	0.00010	0.00000	1000	1000	1000
86511	90011	1	NEWY1A 110.0	TAND1A 110.0	0.03480	0.07960	0.00840	103	95	82
86512	90011	1	NEWY1B 110.0	TAND1A 110.0	0.03480	0.07960	0.00840	103	95	82
87510	89510	1	OMAH1- 110.0	STRA1- 110.0	0.05150	0.12250	0.01170	103	95	82
87510	89510	2	OMAH1- 110.0	STRA1- 110.0	0.05320	0.12660	0.01210	103	95	82
89030	91031	1	SKEG3- 33.00	WEST3A 33.00	0.02600	0.26760	0.00300	33	33	30
89030	91032	1	SKEG3- 33.00	WEST3B 33.00	0.01820	0.26880	0.00300	33	33	30
90011	90012	1	TAND1A 110.0	TAND1B 110.0	0.00000	0.00010	0.00000	1000	1000	1000
90012	90511	1	TAND1B 110.0	WARN1A 110.0	0.01280	0.04180	0.00440	113	96	80
90012	90512	1	TAND1B 110.0	WARN1B 110.0	0.01280	0.04180	0.00440	113	96	80
90061	90071	1	TAND6P 22.00	TAND7P 22.00	0.00000	0.00010	0.00000	0	0	0
90062	90072	1	TAND6Q 22.00	TAND7Q 22.00	0.00000	0.00010	0.00000	0	0	0
90063	90073	1	TAND6R 22.00	TAND7R 22.00	0.00000	0.00010	0.00000	0	0	0
91031	91032	1	WEST3A 33.00	WEST3B 33.00	0.00400	0.21260	0.00000	38	38	38

NORTHERN IRELAND ELECTRICITY TRANSMISSION SYSTEM DATA LISTING

BRANCH DATA CHANGES 2003/04 - 2009/10 WINTER **TABLE 5**

2003/04 CIRCUITS DELETED

NODE		*CCT*	*NAME*		*PARAMETERS PU ON 100MVA BASE*			*RATING IN MVA*		
FROM	*TO*	*NO*	*FROM*	*TO*	*RESISTANCE*	*REACTANCE*	*SUSCEPTANCE*	*WINTER*	*AUTUMN*	*SUMMER*
75510	89510	3	COOL1- 110.0	STRA1- 110.0	0.04000	0.09190	0.00970	103	95	82
77510	81510	1	DUNG1- 110.0	KELS1- 110.0	0.08470	0.19950	0.01960	103	95	82

2003/04 CIRCUITS ADDED

NODE		*CCT*	*NAME*		*PARAMETERS PU ON 100MVA BASE*			*RATING IN MVA*		
FROM	*TO*	*NO*	*FROM*	*TO*	*RESISTANCE*	*REACTANCE*	*SUSCEPTANCE*	*WINTER*	*AUTUMN*	*SUMMER*
75810	75911	1	CREA1- 110.0	CREC1A 110.0	0.00023	0.00088	0.00614	144	144	144
75810	75912	1	CREA1- 110.0	CREC1B 110.0	0.00023	0.00088	0.00614	144	144	144
75911	81510	1	CREC1A 110.0	KELS1- 110.0	0.02869	0.07478	0.00740	103	95	82
75912	77510	1	CREC1B 110.0	DUNG1- 110.0	0.06423	0.16951	0.01634	103	95	82

2004/05 CIRCUITS ADDED

NODE		*CCT*	*NAME*		*PARAMETERS PU ON 100MVA BASE*			*RATING IN MVA*		
FROM	*TO*	*NO*	*FROM*	*TO*	*RESISTANCE*	*REACTANCE*	*SUSCEPTANCE*	*WINTER*	*AUTUMN*	*SUMMER*
74512	86311	1	CAST1B 110.0	NARD1A 110.0	0.02530	0.05880	0.04640	103	95	82
74512	86312	1	CAST1B 110.0	NARD1B 110.0	0.02530	0.05880	0.04640	103	95	82

2005/06 CIRCUITS DELETED

NODE		*CCT*	*NAME*		*PARAMETERS PU ON 100MVA BASE*			*RATING IN MVA*		
FROM	*TO*	*NO*	*FROM*	*TO*	*RESISTANCE*	*REACTANCE*	*SUSCEPTANCE*	*WINTER*	*AUTUMN*	*SUMMER*
85020	90020	2	MAGF2- 275.0	TAND2- 275.0	0.00260	0.02150	0.13950	881	820	710

2005/06 CIRCUITS ADDED

NODE		*CCT*	*NAME*		*PARAMETERS PU ON 100MVA BASE*			*RATING IN MVA*		
FROM	*TO*	*NO*	*FROM*	*TO*	*RESISTANCE*	*REACTANCE*	*SUSCEPTANCE*	*WINTER*	*AUTUMN*	*SUMMER*
77510	90310	1	DUNG1- 110.0	TYRN1- 110.0	0.00552	0.02186	0.00214	166	158	166
90020	90320	1	TAND2- 275.0	TYRN2- 275.0	0.00130	0.01075	0.06975	881	820	710
90361	90371	1	TYRN6P 22.00	TYRN7P 22.00	0.00000	0.00010	0.00000	0	0	0

2008/09 CIRCUITS DELETED

NODE		*CCT*	*NAME*		*PARAMETERS PU ON 100MVA BASE*			*RATING IN MVA*		
FROM	*TO*	*NO*	*FROM*	*TO*	*RESISTANCE*	*REACTANCE*	*SUSCEPTANCE*	*WINTER*	*AUTUMN*	*SUMMER*
75912	77510	1	CREC1B 110.0	DUNG1- 110.0	0.06423	0.16951	0.01634	103	95	82
77010	77510	1	DRUM1- 110.0	DUNG1- 110.0	0.03700	0.08600	0.00880	103	95	82
77010	77510	2	DRUM1- 110.0	DUNG1- 110.0	0.04080	0.09450	0.00970	103	95	82
77510	87510	1	DUNG1- 110.0	OMAH1- 110.0	0.05218	0.12421	0.01186	124	119	109
77510	90310	1	DUNG1- 110.0	TYRN1- 110.0	0.00552	0.02186	0.00214	166	158	166

2008/09 CIRCUITS ADDED

NODE		*CCT*	*NAME*		*PARAMETERS PU ON 100MVA BASE*			*RATING IN MVA*		
FROM	*TO*	*NO*	*FROM*	*TO*	*RESISTANCE*	*REACTANCE*	*SUSCEPTANCE*	*WINTER*	*AUTUMN*	*SUMMER*
75912	90310		CREC1B 110.0	TYRN1- 110.0	0.05639	0.14883	0.01435	103	95	82
77010	90310	2	DRUM1- 110.0	TYRN1- 110.0	0.03393	0.07859	0.00807	103	95	82
77010	90311	1	DRUM1- 110.0	Tyrtum1 110.0	0.02327	0.05409	0.00554	103	95	82
77510	90312	1	DUNG1- 110.0	Tyrtum2 110.0	0.01373	0.03191	0.00326	103	95	82
77511	87510	1	Dung1 110.0	OMAH1- 110.0	0.05218	0.12421	0.01186	124	119	109
77511	90310	1	Dung1 110.0	TYRN1- 110.0	0.00387	0.01454	0.00623	166	158	144
77512	90310	2	Dung2 110.0	TYRN1- 110.0	0.00784	0.02068	0.00199	103	95	82
77513	90310	3	Dung3 110.0	TYRN1- 110.0	0.00669	0.01591	0.00152	103	95	82
90310	90311	1	TYRN1- 110.0	Tyrtum1 110.0	0.00205	0.00572	0.02585	108	108	108
90310	90312	1	TYRN1- 110.0	Tyrtum2 110.0	0.00205	0.00572	0.02585	108	108	108
90362	90372	1	TYRN6Q 22.00	TYRN7Q 22.00	0.00000	0.00010	0.00000	0	0	0

NORTHERN IRELAND ELECTRICITY TRANSMISSION SYSTEM DATA LISTING

TRANSFORMER DATA - WINTER 2003/04 TABLE 6

NODE		CCT	NAME		PARAMETERS PU ON 100MVA BASE		RATING IN MVA			UPPER PU	LOWER PU	NUMBER OF
FROM	TO	NO	FROM	TO	RESISTANCE	REACTANCE	WINTER	AUTUMN	SUMMER	OFF NOMINAL RATIO	OFF NOMINAL RATIO	TAP POSITIONS
3522	35231	1	LOUTH 220.0	LOUTH5 A 275.0	0.0000	0.0303	300	300	300	1.157	0.850	23
3522	35231	2	LOUTH 220.0	LOUTH5 A 275.0	0.0000	0.0303	300	300	300	1.157	0.850	23
3522	35232	3	LOUTH 220.0	LOUTH5 B 275.0	0.0000	0.0152	600	600	600	1.157	0.850	23
70011	70030	1	ANTR1A 110.0	ANTR3- 33.00	0.0268	0.4440	22.5	22.5	22.5	1.100	0.900	15
70011	70030	2	ANTR1A 110.0	ANTR3- 33.00	0.0268	0.4440	22.5	22.5	22.5	1.100	0.900	15
70012	70030	1	ANTR1B 110.0	ANTR3- 33.00	0.0268	0.4440	22.5	22.5	22.5	1.100	0.900	15
70012	70030	2	ANTR1B 110.0	ANTR3- 33.00	0.0268	0.4440	22.5	22.5	22.5	1.100	0.900	15
70501	70520	1	BAFDG1 13.80	BAFD2- 275.0	0.0024	0.1035	145	145	145	1.224	1.002	15
70502	70520	1	BAFDG2 13.80	BAFD2- 275.0	0.0024	0.1035	145	145	145	1.224	1.002	15
70503	70520	1	BAFDG3 13.80	BAFD2- 275.0	0.0024	0.1035	145	145	145	1.224	1.002	15
70504	70520	1	BAFDG4 15.00	BAFD2- 275.0	0.0012	0.0729	240	240	240	1.248	1.021	15
70505	70520	1	BAFDG5 15.00	BAFD2- 275.0	0.0012	0.0729	240	240	240	1.248	1.021	15
70506	70520	1	BAFDG6 15.00	BAFD2- 275.0	0.0012	0.0729	240	240	240	1.248	1.021	15
70507	70510	1	BAFDG7 11.00	BAFD1- 110.0	0.0068	0.2000	75	75	75	1.200	0.982	15
70508	70510	1	BAFDG8 11.00	BAFD1- 110.0	0.0068	0.2000	75	75	75	1.200	0.982	15
70510	70516	1	BAFD1- 110.0	BAFD_GD 15.00	0.0037	0.1326	135	135	135	1.175	0.875	25
70510	70580	1	BAFD1- 110.0	BAFD8- 3.300	0.0081	0.2867	75	75	75	1.500	0.510	159
70513	70520	1	BAFD_GA 15.00	BAFD2- 275.0	0.0023	0.0816	217	217	217	1.171	0.866	25
70514	70520	1	BAFD_GB 15.00	BAFD2- 275.0	0.0023	0.0816	217	217	217	1.171	0.866	25
70515	70520	1	BAFD_GC 18.00	BAFD2- 275.0	0.0020	0.0712	250	250	250	1.171	0.866	25
71011	71031	1	BAME1A 110.0	BAME3R 33.00	0.0132	0.2384	45	45	45	1.100	0.850	16
71011	71032	1	BAME1A 110.0	BAME3T 33.00	0.0116	0.2780	45	45	45	1.100	0.800	19
71012	71031	1	BAME1B 110.0	BAME3R 33.00	0.0132	0.2384	45	45	45	1.100	0.850	16
71012	71032	1	BAME1B 110.0	BAME3T 33.00	0.0116	0.2780	45	45	45	1.100	0.800	19
71511	71530	1	BANB1A 110.0	BANB3- 33.00	0.0168	0.4102	30	30	30	1.100	0.900	15
71511	71530	2	BANB1A 110.0	BANB3- 33.00	0.0168	0.4102	30	30	30	1.100	0.900	15
71512	71530	1	BANB1B 110.0	BANB3- 33.00	0.0168	0.4102	30	30	30	1.100	0.900	15
71512	71530	2	BANB1B 110.0	BANB3- 33.00	0.0168	0.4102	30	30	30	1.100	0.900	15

NORTHERN IRELAND ELECTRICITY TRANSMISSION SYSTEM DATA LISTING

TRANSFORMER DATA - WINTER 2003/04 TABLE 6

NODE		CCT	NAME		PARAMETERS PU ON 100MVA BASE		RATING IN MVA			UPPER PU	LOWER PU	NUMBER OF
FROM	TO	NO	FROM	TO	RESISTANCE	REACTANCE	WINTER	AUTUMN	SUMMER	OFF NOMINAL RATIO	OFF NOMINAL RATIO	TAP POSITIONS
72511	72530	1	BNCH1A 110.0	BNCH3- 33.00	0.0038	0.2419	90	90	90	1.100	0.800	19
72512	72530	1	BNCH1B 110.0	BNCH3- 33.00	0.0038	0.2419	90	90	90	1.100	0.800	19
74011	74030	1	CARN1A 110.0	CARN3- 33.00	0.0111	0.2854	60	60	60	1.150	0.850	19
74012	74030	1	CARN1B 110.0	CARN3- 33.00	0.0306	0.5956	30	30	30	1.150	0.850	19
74012	74030	2	CARN1B 110.0	CARN3- 33.00	0.0306	0.5956	30	30	30	1.150	0.850	19
74711	74731	1	CENT1A 110.0	CENT3A 33.00	0.0060	0.2424	90	90	90	1.150	0.850	19
74712	74732	1	CENT1B 110.0	CENT3B 33.00	0.0060	0.2424	90	90	90	1.150	0.850	19
75010	75030	1	COLE1- 110.0	COLE3- 33.00	0.0074	0.2500	60	60	60	1.100	0.800	19
75010	75030	2	COLE1- 110.0	COLE3- 33.00	0.0074	0.2500	60	60	60	1.100	0.800	19
75501	75530	1	COOLG1- 11.80	COOL3- 33.00	0.0149	0.2400	38	38	38	1.100	0.992	5
75502	75530	1	COOLG2- 11.80	COOL3- 33.00	0.0149	0.2400	38	38	38	1.100	0.992	5
75503	75510	1	COOLG3- 11.80	COOL1- 110.0	0.0055	0.1690	75	75	75	1.200	0.982	15
75504	75510	1	COOLG4- 11.80	COOL1- 110.0	0.0055	0.1690	75	75	75	1.200	0.982	15
75505	75520	1	COOLG5- 16.00	COOL2- 275.0	0.0053	0.1766	70	70	70	1.187	0.971	15
75506	75520	1	COOLG6- 16.00	COOL2- 275.0	0.0053	0.1766	70	70	70	1.187	0.971	15
75507	75520	1	COOLG7- 16.00	COOL2- 275.0	0.0053	0.1766	70	70	70	1.187	0.971	15
75508	75510	1	COOLG8- 11.00	COOL1- 110.0	0.0068	0.2000	75	75	75	1.200	0.982	15
75510	75530	1	COOL1- 110.0	COOL3- 33.00	0.0086	0.2556	90	90	90	1.100	0.800	19
75510	75530	2	COOL1- 110.0	COOL3- 33.00	0.0086	0.2556	90	90	90	1.100	0.800	19
75810	75830	1	CREA1- 110.0	CREA3- 33.00	0.0110	0.2740	60	60	60	1.100	0.800	19
75810	75830	2	CREA1- 110.0	CREA3- 33.00	0.0110	0.2740	60	60	60	1.100	0.800	19

NORTHERN IRELAND ELECTRICITY TRANSMISSION SYSTEM DATA LISTING

TRANSFORMER DATA - WINTER 2003/04 TABLE 6

NODE		CCT	NAME		PARAMETERS PU ON 100MVA BASE		RATING IN MVA			UPPER PU	LOWER PU	NUMBER OF
FROM	TO	NO	FROM	TO	RESISTANCE	REACTANCE	WINTER	AUTUMN	SUMMER	OFF NOMINAL RATIO	OFF NOMINAL RATIO	TAP POSITIONS
76011	76031	1	CREG1A 110.0	CREG3A 33.00	0.0118	0.3200	75	75	75	1.150	0.850	19
76012	76031	1	CREG1B 110.0	CREG3A 33.00	0.0118	0.3200	75	75	75	1.150	0.850	19
76511	76532	1	DONE1C 110.0	DONE3N 33.00	0.0060	0.2424	90	90	90	1.150	0.850	19
76512	76532	1	DONE1B 110.0	DONE3N 33.00	0.0210	0.3670	60	60	60	1.150	0.850	19
76513	76531	1	DONE1D 110.0	DONE3AS 33.00	0.0210	0.3670	60	60	60	1.150	0.850	19
76514	76531	1	DONE1A 110.0	DONE3AS 33.00	0.0210	0.3670	60	60	60	1.150	0.850	19
77010	77030	1	DRUM1- 110.0	DRUM3- 33.00	0.0060	0.2424	90	90	90	1.100	0.800	19
77010	77030	2	DRUM1- 110.0	DRUM3- 33.00	0.0060	0.2424	90	90	90	1.100	0.800	19
77510	77530	1	DUNG1- 110.0	DUNG3- 33.00	0.0086	0.2582	90	90	90	1.100	0.800	19
77510	77530	2	DUNG1- 110.0	DUNG3- 33.00	0.0086	0.2582	90	90	90	1.100	0.800	19
78511	78530	1	EDEN1A 110.0	EDEN3- 33.00	0.0110	0.2740	45	45	45	1.100	0.800	19
78512	78530	1	EDEN1B 110.0	EDEN3- 33.00	0.0110	0.2740	45	45	45	1.100	0.800	19
79010	79015	1	ENNK1_ 110.0	ENNKPFA 110.0	0.0020	0.0213	125	125	125	45.000	-45.000	9999
79010	79030	1	ENNK1_ 110.0	ENNK3- 33.00	0.0120	0.2660	45	45	45	1.150	0.850	19
79010	79030	2	ENNK1_ 110.0	ENNK3- 33.00	0.0120	0.2660	45	45	45	1.150	0.850	19
79010	79030	3	ENNK1_ 110.0	ENNK3- 33.00	0.0074	0.2500	60	60	60	1.100	0.800	19
79015	79016	1	ENNKPFA 110.0	ENNKPFB 110.0	0.0000	0.0213	125	125	125	1.227	0.774	35
80011	80030	1	FINY1A 110.0	FINY3- 33.00	0.0076	0.2533	45	45	45	1.100	0.800	19
80012	80030	1	FINY1B 110.0	FINY3- 33.00	0.0076	0.2533	45	45	45	1.100	0.800	19
80511	80530	1	GLEN1A 110.0	GLEN3- 33.00	0.0111	0.3380	60	60	60	1.150	0.850	19
82001	82020	1	KILRG1- 17.00	KILR2- 275.0	0.0007	0.0488	340	340	340	1.224	0.890	19
82002	82020	1	KILRG2- 17.00	KILR2- 275.0	0.0007	0.0488	340	340	340	1.224	0.890	19

NORTHERN IRELAND ELECTRICITY TRANSMISSION SYSTEM DATA LISTING

TRANSFORMER DATA - WINTER 2003/04 TABLE 6

NODE FROM	NODE TO	CCT NO	NAME FROM	NAME TO	PARAMETERS PU ON 100MVA BASE RESISTANCE	PARAMETERS PU ON 100MVA BASE REACTANCE	RATING IN MVA WINTER	RATING IN MVA AUTUMN	RATING IN MVA SUMMER	UPPER PU OFF NOMINAL RATIO	LOWER PU OFF NOMINAL RATIO	NUMBER OF TAP POSITIONS
82511	82531	1	KNCK1A 110.0	KNCK3A 33.00	0.0120	0.3370	60	60	60	1.150	0.850	19
82512	82532	1	KNCK1B 110.0	KNCK3B 33.00	0.0120	0.3370	60	60	60	1.150	0.850	19
83011	83030	1	LARN1A 110.0	LARN3- 33.00	0.0116	0.2780	45	45	45	1.100	0.900	15
83012	83030	1	LARN1B 110.0	LARN3- 33.00	0.0116	0.2780	45	45	45	1.100	0.900	15
83510	83530	1	LIMA1- 110.0	LIMA3- 33.00	0.0286	0.5551	24.5	24.5	24.5	1.100	0.900	15
83510	83530	2	LIMA1- 110.0	LIMA3- 33.00	0.0286	0.5510	22.5	22.5	22.5	1.100	0.900	15
84011	84030	1	LISB1A 110.0	LISB3- 33.00	0.0086	0.2550	90	90	90	1.100	0.800	19
84012	84030	1	LISB1B 110.0	LISB3- 33.00	0.0086	0.2550	90	90	90	1.100	0.800	19
84411	84430	1	LSMR1A 110.0	LSMR3- 33.00	0.0076	0.2533	45	45	45	1.100	0.800	19
84412	84430	1	LSMR1B 110.0	LSMR3- 33.00	0.0076	0.2533	45	45	45	1.100	0.800	19
84511	84530	1	LOGE1A 110.0	LOGE3- 33.00	0.0126	0.2800	45	45	45	1.100	0.800	19
84512	84530	1	LOGE1B 110.0	LOGE3- 33.00	0.0126	0.2800	45	45	45	1.100	0.800	19
86511	86530	1	NEWY1A 110.0	NEWY3- 33.00	0.0038	0.2419	90	90	90	1.100	0.800	19
86512	86530	1	NEWY1B 110.0	NEWY3- 33.00	0.0038	0.2419	90	90	90	1.100	0.800	19
87011	87030	1	NORF1A 110.0	NORF3- 33.00	0.0124	0.2778	45	45	45	1.500	0.510	159
87012	87030	1	NORF1B 110.0	NORF3- 33.00	0.0124	0.2778	45	45	45	1.500	0.510	159
87510	87530	1	OMAH1- 110.0	OMAH3- 33.00	0.0074	0.2500	60	60	60	1.100	0.800	19
87510	87530	2	OMAH1- 110.0	OMAH3- 33.00	0.0074	0.2500	60	60	60	1.100	0.800	19
88011	88030	1	RATH1A 110.0	RATH3- 33.00	0.0086	0.2554	90	90	90	1.100	0.800	19
88012	88030	1	RATH1B 110.0	RATH3- 33.00	0.0086	0.2554	90	90	90	1.100	0.800	19
88511	88530	1	ROSE1A 110.0	ROSE3- 33.00	0.0086	0.2554	90	90	90	1.100	0.800	19

NORTHERN IRELAND ELECTRICITY TRANSMISSION SYSTEM DATA LISTING

TRANSFORMER DATA - WINTER 2003/04 TABLE 6

NODE		*CCT*	*NAME*		*PARAMETERS PU ON 100MVA BASE*		*RATING IN MVA*			*UPPER PU*	*LOWER PU*	*NUMBER OF*
FROM	*TO*	*NO*	*FROM*	*TO*	*RESISTANCE*	*REACTANCE*	*WINTER*	*AUTUMN*	*SUMMER*	*OFF NOMINAL RATIO*	*OFF NOMINAL RATIO*	*TAP POSITIONS*
88512	88530	1	ROSE1B 110.0	ROSE3- 33.00	0.0086	0.2554	90	90	90	1.100	0.800	19
89510	89515	1	STRA1- 110.0	STRPFCA 110.0	0.0020	0.0213	125	125	125	45.000	-45.000	9999
89510	89530	1	STRA1- 110.0	STRA3- 33.00	0.0078	0.2500	45	45	45	1.100	0.800	19
89510	89530	2	STRA1- 110.0	STRA3- 33.00	0.0078	0.2500	45	45	45	1.100	0.800	19
89515	89516	1	STRPFCA 110.0	STRPFCB 110.0	0.0000	0.0213	125	125	125	1.227	0.774	35
90511	90530	1	WARN1A 110.0	WARN3- 33.00	0.0120	0.3000	45	45	45	1.100	0.800	19
90512	90530	1	WARN1B 110.0	WARN3- 33.00	0.0120	0.3000	45	45	45	1.100	0.800	19
91001	91031	1	WESTG1 11.80	WEST3A 33.00	0.0144	0.2760	36	36	36	1.100	0.992	5
91002	91031	1	WESTG2 11.80	WEST3A 33.00	0.0144	0.2760	36	36	36	1.100	0.992	5
91003	91031	1	WESTG3 11.80	WEST3A 33.00	0.0080	0.1527	72	72	72	1.100	0.992	5
91004	91031	1	WESTG4 11.80	WEST3A 33.00	0.0080	0.1527	72	72	72	1.100	0.992	5
91005	91032	1	WESTG5 11.80	WEST3B 33.00	0.0080	0.1527	72	72	72	1.100	0.992	5
91011	91031	1	WEST1A 110.0	WEST3A 33.00	0.0074	0.1670	75	75	75	1.150	0.850	19
91012	91032	1	WEST1B 110.0	WEST3B 33.00	0.0074	0.1670	75	75	75	1.150	0.850	19

Note - The above ratings are nominal. For transformers less than 25 years old we allow overload ratings depending on the season of the year (ambient temperature).
These are taken into account in our analysis in Table 2.

NORTHERN IRELAND ELECTRICITY TRANSMISSION SYSTEM DATA LISTING

TRANSFORMER DATA CHANGES- WINTER 2003/04 - 2009/10 TABLE 7

2003/04 B.S.P TRANSFORMERS ADDED

NODE		CCT	NAME		PARAMETERS PU ON 100MVA BASE		RATING IN MVA			UPPER PU	LOWER PU	NUMBER OF
FROM	TO	NO	FROM	TO	RESISTANCE	REACTANCE	WINTER	AUTUMN	SUMMER	OFF NOMINAL RATIO	OFF NOMINAL RATIO	TAP POSITIONS
75810	75830	1	CREA1- 110.0	CREA3- 33.00	0.011	0.274	60	60	60	1.100	0.800	19
75810	75830	2	CREA1- 110.0	CREA3- 33.00	0.011	0.274	60	60	60	1.100	0.800	19

2004/05 B.S.P TRANSFORMERS ADDED

NODE		CCT	NAME		PARAMETERS PU ON 100MVA BASE		RATING IN MVA			UPPER PU	LOWER PU	NUMBER OF
FROM	TO	NO	FROM	TO	RESISTANCE	REACTANCE	WINTER	AUTUMN	SUMMER	OFF NOMINAL RATIO	OFF NOMINAL RATIO	TAP POSITIONS
86311	86330	1	NARD1A 110.0	NARD3- 33.00	0.01	0.25	60	60	60	1.100	0.800	19
86312	86330	1	NARD1B 110.0	NARD3- 33.00	0.01	0.25	60	60	60	1.100	0.800	19

2005/06 GENERATOR TRANSFORMERS ADDED

NODE		CCT	NAME		PARAMETERS PU ON 100MVA BASE		RATING IN MVA			UPPER PU	LOWER PU	NUMBER OF
FROM	TO	NO	FROM	TO	RESISTANCE	REACTANCE	WINTER	AUTUMN	SUMMER	OFF NOMINAL RATIO	OFF NOMINAL RATIO	TAP POSITIONS
75510	75515	1	COOL1- 110.0	COOLST- 11.80	0.0026	0.0634	200	200	200	1.200	0.982	15
75516	75520	1	COOLGT- 16.00	COOL2- 275.0	0.0015	0.0432	300	300	300	1.187	0.971	15

NORTHERN IRELAND ELECTRICITY TRANSMISSION SYSTEM DATA LISTING

275/110kV INTERBUS TRANSFORMER & CAPACITANCE DATA - WINTER 2003/04 **TABLE 8**

NODE			*CCT*	*NAME*			*PARAMETERS PU ON 100MVA BASE*						*RATING IN MVA*			*UPPER PU - OFF*	*LOWER PU - OFF*	*NO. of*
FROM (W1)	*TO (W2)*	*LAST (W3)*	*NO*	*FROM (W1)*	*TO (W2)*	*LAST (W3)*	*(W 1-2) R*	*(W 1-2) X*	*(W 2-3) R*	*(W 2-3) X*	*(W 3-1) R*	*(W 3-1) X*	*W1*	*W2*	*W3*	*NOMINAL RATIO*	*NOMINAL RATIO*	*TAP POS.*
70510	70520	70561	1	BAFD1- 110.0	BAFD2- 275.0	BAFD6P 22.00	0.0018	0.0641	0.0018	0.2092	0.0000	0.1325	240	240	30	1.15	0.85	19
70510	70520	70562	1	BAFD1- 110.0	BAFD2- 275.0	BAFD6Q 22.00	0.0018	0.0641	0.0018	0.2059	0.0000	0.1280	240	240	30	1.15	0.85	19
74511	74520	74561	1	CAST1A 110.0	CAST2- 275.0	CAST6P 22.00	0.0018	0.0641	0.0018	0.2092	0.0000	0.1325	240	240	30	1.15	0.85	19
74511	74520	74562	1	CAST1A 110.0	CAST2- 275.0	CAST6Q 22.00	0.0018	0.0641	0.0018	0.2092	0.0000	0.1325	240	240	30	1.15	0.85	19
74512	74520	74563	1	CAST1B 110.0	CAST2- 275.0	CAST6R 22.00	0.0018	0.0656	0.0018	0.2375	0.0000	0.1593	240	240	30	1.15	0.85	19
75510	75520	75561	1	COOL1- 110.0	COOL2- 275.0	COOL6P 22.00	0.0018	0.0609	0.0018	0.1273	0.0000	0.0570	240	240	30	1.15	0.85	19
75510	75520	75562	1	COOL1- 110.0	COOL2- 275.0	COOL6Q 22.00	0.0018	0.0609	0.0018	0.1273	0.0000	0.0570	240	240	30	1.15	0.85	19
81010	81020	81061	1	HANA1A 110.0	HANA2A 275.0	HANA6P 22.00	0.0018	0.0591	0.0018	0.1261	0.0000	0.0560	240	240	30	1.15	0.85	19
81010	81020	81062	1	HANA1A 110.0	HANA2A 275.0	HANA6Q 22.00	0.0018	0.0591	0.0018	0.1261	0.0000	0.0560	240	240	30	1.15	0.85	19
81510	81520	81561	1	KELS1- 110.0	KELS2- 275.0	KELS6P 22.00	0.0018	0.0609	0.0018	0.1273	0.0000	0.0570	240	240	30	1.15	0.85	19
81510	81520	81562	1	KELS1- 110.0	KELS2- 275.0	KELS6Q 22.00	0.0018	0.0607	0.0018	0.1317	0.0000	0.0570	240	240	30	1.15	0.85	19
90011	90020	90061	1	TAND1A 110.0	TAND2- 275.0	TAND6P 22.00	0.0018	0.0641	0.0018	0.2092	0.0000	0.1325	240	240	30	1.15	0.85	19
90011	90020	90062	1	TAND1A 110.0	TAND2- 275.0	TAND6Q 22.00	0.0018	0.0641	0.0018	0.2092	0.0000	0.1325	240	240	30	1.15	0.85	19
90012	90020	90063	1	TAND1B 110.0	TAND2- 275.0	TAND6R 22.00	0.0018	0.0656	0.0018	0.2375	0.0000	0.1575	240	240	30	1.15	0.85	19

2005/06 INTERBUS TRANSFORMER ADDED

NODE			*CCT*	*NAME*			*PARAMETERS PU ON 100MVA BASE*						*RATING IN MVA*			*UPPER PU - OFF*	*LOWER PU - OFF*	*NO. of*
FROM	*TO*	*LAST*	*NO*	*FROM*	*TO*	*LAST*	*(W 1-2) R*	*(W 1-2) X*	*(W 2-3) R*	*(W 2-3) X*	*(W 3-1) R*	*(W 3-1) X*	*W1*	*W2*	*W3*	*NOMINAL RATIO*	*NOMINAL RATIO*	*TAP POS.*
90310	90320	90361	1	TYRN1- 110.0	TYRN2- 275.0	TYRN6P 22.00	0.0046	0.1252	0.0046	0.4670	0.0000	0.3002	120	120	30	1.15	0.85	19

2008/09 INTERBUS TRANSFORMER ADDED

NODE			*CCT*	*NAME*			*PARAMETERS PU ON 100MVA BASE*						*RATING IN MVA*			*UPPER PU - OFF*	*LOWER PU - OFF*	*NO. of*
FROM	*TO*	*LAST*	*NO*	*FROM*	*TO*	*LAST*	*(W 1-2) R*	*(W 1-2) X*	*(W 2-3) R*	*(W 2-3) X*	*(W 3-1) R*	*(W 3-1) X*	*W1*	*W2*	*W3*	*NOMINAL RATIO*	*NOMINAL RATIO*	*TAP POS.*
90310	90320	90362	1	TYRN1- 110.0	TYRN2- 275.0	TYRN6Q 22.00	0.0023	0.0626	0.0023	0.2335	0.0000	0.1501	240	240	30	1.15	0.85	19

CAPACITANCE WINTER 2003/04

BUS NUMBER	*NODE NAME*	*NAME*	*VOLTAGE (kV)*	*LOAD (MVAr)*	*NOTES*
74571	CAST7P	CASTLEREAGH	22	25	NOTE 1
74572	CAST7Q		22	25	NOTE 1
74573	CAST7R		22	25	NOTE 1
75514	COOL1C	COOLKEERAGH	110	40	NOTE 1
79030	ENNK3-		33	30	NOTE 1
86220	MOYL2-	MOYLE	275	236	NOTE 2
90071	TAND7P	TANDRAGEE	22	25	NOTE 1
90073	TAND7R		22	25	NOTE 1

NOTE 1 - Capacitance in switched in as necessary to ensure load flow convergence

NOTE 2 - Capacitance varies with transfer (from/to Scotland), 0 - 236MVAr in blocks of 59MVAr

NOTE 3 - The Interbus Transformers have been remodelled since our last statement

NORTHERN IRELAND ELECTRICITY TRANSMISSION SYSTEM
SEVEN YEAR STATEMENT 2003
Switchgear Ratings and Fault Levels 2006/07 Table 9
(With ESB connection)

Location	*Voltage* (*kV*)	*Switchgear Fault rating* (*MVA*)	*Calculated Fault Level* (*MVA*) *three phase*	*single phase to earth*
Ballylumford	275	9500 *note 2*	8186	9751
Castlereagh	275	9500	6550	7356
Coolkeeragh	275	9500	5389	6021
Hannahstown	275	15000	6549	7350
Kells	275	9500	7418	8102
Kilroot	275	15000	7233	7896
Magherafelt	275	9500	7363	7546
Moyle	275	15000	7580	9078
Tandragee	275	9500	7462	8080
Tyrone	275	15000	5979	5663
Antrim	110	3500	1754	1866
Ballylumford	110	4200/5000 *note 1&2*	4222	5131
Ballymena	110	3500	1586	1686
Banbridge	110	3500	1295	1247
Ballyvallagh	110	3500	2817	2831
Ballynahinch	110	3500	1061	1028
Belfast Central	110	6000	2715	3223
Carnmoney	110	3500	1779	1639
Castlereagh	110	6000	3394	4378
Coleraine	110	7600	1275	1470
Coolkeeragh	110	3500 *note 4*	3637	4709
Creagh	110	6000	1177	921
Cregagh	110	3500 *note 3*	3053	3777
Donegall North	110	6000	2659	3321
Donegall South	110	-	2055	2194
Drumnakelly	110	7600	3348	3844
Dungannon	110	3500	2406	2600
Eden	110	3500	2010	1930
Enniskillen	110	3500	1156	1441
Finaghy	110	6000	2754	3514
Glengormley	110	3500	1000	964
Hannahstown	110	6000	2997	3935
Kells	110	5000	3374	4298
Knock	110	3500	2869	2944
Larne	110	3500	1728	1625
Limavady	110	3500	1176	1214
Lisaghmore	110	3500	1757	1696
Lisburn	110	3500	1899	1988
Loguestown	110	3500	942	1027
Newry	110	3500	1021	1026
Newtownards	110	6000	1189	1169
Norfil	110	3500	1727	1835
Omagh	110	7600	1847	2035
Rathgael	110	3500	1141	1120
Rosebank	110	3500 *note 3*	3191	4033
Strabane	110	3500	2391	2662
Tandragee	110	6000	3736	4602
Tyrone	110	6000	1886	1937
Waringstown	110	3500	1521	1428
West	110	3500	2302	2396

The above ratings are based on the lowest rated switchgear although NIE is carrying out a review of all substat equipment capacities.
note1 - 3phase fault rating - 4200MVA & 1 phase fault rating 5000MVA.
note 2 - Fault current decrement studies indicate the switchgear will not be over stressed at switchgear operatin
note 3 - It is planned to change isolators.
note 4 - NIE is carrying out work to increase the fault rating at this substation.

NIE Transmission Capability Matrix for 2009/10 **Table 10**

From	Description	To Existing Load	To Republic of Ireland	To Scotland
Ballylumford	a) Incremental Transfer	0MW	0MW	400MW
	b) Problem Outage	Bfd-Han + Bfd-Moyle Bfd-Kells + Bfd-Mag	Bfd-Han + Bfd-Moyle Bfd-Kells + Bfd-Mag	
	c) Network Problem	O/L Bfd-Kells O/L Bfd-Han Also Voltage	O/L Bfd-Kells O/L Bfd-Han Also Voltage	
	d) Work Required	Reconductor + SVC	Reconductor + SVC	
	e) Resulting Transfer	400MW	400MW	
Castlereagh	a) Incremental Transfer	400MW	400MW	400MW
	b) Problem Outage			
	c) Network Problem			
	d) Work Required		SVC (see note p.22)	
	e) Resulting Transfer			
Coolkeeragh	a) Incremental Transfer	0MW	0MW	0MW
	b) Problem Outage	Cool-Mag D/C	Cool-Mag D/C	Cool-Mag D/C
	c) Network Problem	110kV O/L in NW	110kV O/L in NW	110kV O/L in NW
	d) Work Required	New 275kV Cool-Mag + SVC (See Note p.22)	New 275kV Cool-Mag + SVC (See Note p.22)	New 275kV Cool-Mag + SVC (See Note p.22)
	e) Resulting Transfer	400MW	400MW	400MW
Kells	a) Incremental Transfer	400MW	400MW	400MW
	b) Problem Outage			
	c) Network Problem			
	d) Work Required		SVC (See Note p.22)	
	e) Resulting Transfer			
Kilroot	a) Incremental Transfer	400MW	400MW	400MW
	b) Problem Outage			
	c) Network Problem			
	d) Work Required		SVC (See Note p.22)	
	e) Resulting Transfer			
Magherafelt	a) Incremental Transfer	400MW	400MW	0MW
	b) Problem Outage			2 IBTx at Han
	c) Network Problem			O/L Lisburn-Tandragee
	d) Work Required		SVC (See Note p.22)	Reconductor to UPAS
	e) Resulting Transfer			400MW
Moyle	a) Incremental Transfer	0MW	0MW	400MW
	b) Problem Outage	Bfd-Han + Bfd-Moyle Bfd-Kells + Bfd-Mag	Bfd-Han + Bfd-Moyle Bfd-Kells + Bfd-Mag	
	c) Network Problem	O/L Bfd-Kells O/L Bfd-Han Also Voltage	O/L Bfd-Kells O/L Bfd-Han Also Voltage	
	d) Work Required	Reconductor + SVC	Reconductor + SVC (See Note p.22)	
	e) Resulting Transfer	400MW	400MW	
Tyrone/ Drumkee	a) Incremental Transfer	400MW	0MW	0MW
	b) Problem Outage		Tyr-Mag + Tyr-Tan	2 IBTx at Han
	c) Network Problem		O/L Tyr-Drum	O/L Lisburn-Tandragee
	d) Work Required		Reconductor + SVC (See Note p.22)	Reconductor to UPAS
	e) Resulting Transfer		400MW	400MW
Tandragee	a) Incremental Transfer	400MW	400MW	0MW
	b) Problem Outage			2 IBTx at Han
	c) Network Problem			O/L Lisburn-Tandragee
	d) Work Required		SVC (See Note p.22)	Reconductor to UPAS
	e) Resulting Transfer			400MW

Note: **Bfd = Ballylumford; Han = Hannahstown; Mag = Magherafelt; Cool = Coolkeeragh; Tyr = Tyrone; Dung = Dungannon; Tan = Tandragee**