NORTHERN IRELAND ELECTRICITY plc

AMENDMENT SHEET - ISSUE 2 - 7 AUGUST 1992
SECURITY OF SUPPLY DOCUMENT (ER P2/5 OCT 1978)

1. General Use

Document P2/5 is a guide to the planning of developments to the NIE System, each scheme for reinforcement or modification being individually assessed by NIE in the light of economic and technical factors obtaining.

2. Particular Modification in Respect of Supply to Specific Levels of Demand

A Revised Table 1 is attached.

This enhancement of the standard is due to the unacceptable widespread and prolonged supply interruptions which would otherwise occur over very large areas of the NIE System.

TABLE 1

Class of Supply	Range of Group Demand	Minimum Demand to be met after: First Circuit Outage	Minimum Demand to be met after: Second Circuit Outage	Notes
A	UP TO 1 MW	In repair time: GROUP DEMAND	NIL	Where demand is supplied by a single 1000KVA transformer the "Range of Group Demand" may be extended to cover the overload capacity of that transformer.
B	OVER 1 TO 12 MW	(a) Within 3 hours: GROUP DEMAND MINUS 1 MW (b) In repair time GROUP DEMAND	NIL	
C	OVER 12 TO 60 MW	(a) Within 15 minutes: SMALLER OF (GROUP DEMAND MINUS 12 MW) AND § GROUP DEMAND (b) Within 3 hours: GROUP DEMAND	NIL	Group Demand will be normally supplied by at least two normally closed circuits or by one circuit with supervisory or automatic switching of alternative circuits.
D	OVER 60 TO 300 MW	(a) Immediately: GROUP DEMAND MINUS UP TO 20 MW (AUTOMATICALLY DISCONNECTED) (b) Within 3 hours: GROUP DEMAND	(c) Within 3 hours: FOR GROUP DEMANDS GREATER THAN 100 MW, SMALLER OF (GROUP DEMANDMINUS 100MW) AND § GROUP DEMAND. (d) Within time to restore arranged outage: GROUP DEMAND.	A loss of supply not exceeding 60 secs is considered as an immediate restoration. The Recommendation is based on the assumption that the time for restoration of Full group demand after a second circuit outage will be minimised by the scheduling and control of planned outages, and that consideration will be given to the use of rota load-shedding to reduce the effect of prolonged outages on consumers.
E	OVER 300 TO 1500 MW	(a) Immediately: GROUP DEMAND	(b) Immediately ALL CONSUMERS AT § GROUP DEMAND (c) Within time to restore arranged outage: GROUP DEMAND	The provisions of Class E apply to infeeds to the distribution system but not to systems regarded as part of the interconnected Supergrid to which the provision of Class F apply. For the system covered by Class E consideration can be given to the feasibility of providing for up to 60 MW to be lost for up to 60 seconds on first circuit outage if this leads to significant economies. This provision is not intended to restrict the period during which maintenance can be scheduled. The provision for a second circuit outage assumes that normal maintenance can be undertaken when demand is below 67%. Where the period of maintenance may be restricted paragraph 2.3 applies.
F	OVER 1500 MW	IN ACCORDANCE WITH CEGB PLANNING MEMORANDUM PLM-SP2 OR SCOTTISH BOARD SECURITY STANDARD NSP 366		

Class of Supply	Range of Group Demand	Minimum Demand to be met after: First Circuit Outage	Minimum Demand to be met after: Second Circuit Outage	Notes
A	UP TO 1 MW	In repair time: GROUP DEMAND	NIL	Where demand is supplied by a single 1000KVA transformer the "Range of Group Demand" may be extended to cover the overload capacity of that transformer.
B	OVER 1 TO 8 MW	(a) Within 3 hours GROUP DEMAND MINUS 1 MW (b) In repair time GROUP DEMAND	NIL	
C1	OVER 8 TO 24 MW	(a) Within 15 minutes GROUP DEMAND MINUS 8 MW (b) Within 3 hours GROUP DEMAND	NIL	Group Demand will be normally supplied by at least two normally closed circuits or by one circuit with supervisory or automatic switching of alternative circuits.
C2	OVER 24 TO 60 MW	(a) Within 15 minutes 2/3 GROUP DEMAND (b) Within 3 hours GROUP DEMAND	(c) Within time to restore arranged outage GROUP DEMAND	Group Demand will be normally supplied by at least two normally closed circuits or by one circuit with supervisory or automatic switching of alternative circuits. It is normal to aim for restoration of supply to 1/3 Group Demand within 3 hours after a second circuit outage to prevent widespread and prolonged supply interruption.
D	OVER 60 TO 300 MW	(a) Immediately GROUP DEMAND MINUS UP TO 20 MW (AUTOMATICALLY DISCONNECTED) (b) Within 3 hours GROUP DEMAND	(c) Within 3 hours For GROUP DEMAND greater than 100 MW, smaller of GROUP DEMAND minus 100 MW and 1/3 GROUP DEMAND. (d) Within time to restore arranged outage GROUP DEMAND	A loss of supply not exceeding 60 secs is considered as an immediate restoration. The Recommendation is based on the assumption that the time for restoration of Full group demand after a second circuit outage will be minimised by the scheduling and control of planned outages, and that consideration will be given to the use of rota loadshedding to reduce the effect of prolonged outages on consumers. It is normal to aim for restoration of supply to 1/3 Group Demand within 3 hours after a second circuit outage to prevent widespread and prolonged supply interruption.
E	OVER 300 TO 1500 MW	(a) Immediately GROUP DEMAND	(b) Immediately ALL CONSUMERS AT 2/3 GROUP DEMAND (c) Within time to restore arranged outage GROUP DEMAND	The provision of Class E apply to infeeds to the distribution system but not to systems regarded as part of the interconnected Supergrid to which the provision of Class F apply. For the system covered by Class E consideration can be given to the feasibility of providing for up to 60 MW to be lost for up to 60 seconds on first circuit outage if this leads to significant economies. This provision is not intended to restrict the period during which maintenance can be scheduled. The provision for a second circuit outage assumes that normal maintenance can be undertaken when demand is below 67%. Where the period of maintenance may be restricted paragraph 2.3 applies.

THE ELECTRICITY COUNCIL

CHIEF ENGINEERS' CONFERENCE

SECURITY OF SUPPLY

1 INTRODUCTION

1.1 This Engineering Recommendation is a revision of Engineering Recommendation P2/4 issued in 1968. It is intended as a guide to system planning.

1.2 It has taken into account the results of extensive reliability studies using fault statistics and risk analysis and the relationship of these to the costs of system reinforcements, including the effects on losses.

2 RECOMMENDED LEVELS OF SECURITY

2.1 Table 1 sets out the normal levels of security required for transmission and distribution networks classified in ranges of group demand.

2.2 If it is known that higher voltage reinforcement is expected in the near future, the improvement in security resulting from this reinforcement may enable lower voltage reinforcement to be deferred.

2.3 Any departure from the recommended normal level of security defined in this document may require detailed risk and economic studies to be undertaken including any costs of out-of-merit generation. An instance where a departure would be justified is for Class E, where the characteristics of the demand curve are such that normal maintenance procedure would entail risk of consumer disconnection. In these cases earlier reinforcement would be required unless alterations to maintenance procedure could be made economically.

3 CAPABILITY OF A NETWORK TO MEET DEMAND

3.1 Studies have shown that the existence and possible provision of transfer capability should always be considered when assessing the need for reinforcement.

3.2 The capacity of a network to meet a group demand after first and second circuit outages should be assessed as:

a The appropriate cyclic rating of the remaining transmission or distribution circuits which normally supply the group demand, following outage of the most critical circuit (or circuits)

PLUS b transfer capacity which can be made available from alternative sources

PLUS c for demand groups containing generation, the effective contribution of the generation to network capacity as specified in Table 2.

3.3 Note that the assessed capacity may need to be reduced to ensure that, under normal running conditions, equipment is not loaded to a point where it would suffer loss of life.

3.4 Table 2 sets out the contribution to security expected from generation connected within a demand group (see Appendix for background notes). This contribution depends on the generating plant operating regimes. In this Recommendation, forecast average annual load factors, agreed between those responsible for generation and for transmission and distribution will be used as indicators of the probable operating regime of each steam generation unit. Such generation is divided into three classes - high, medium and low load factor - the associated load factor ranges are shown in Table 2. Special provisions for gas turbines are also included in Table 2.

3.5 For demand groups containing high load factor generation, it must be possible to operate all units at rated output with an outage of the largest transmission or distribution circuit.

3.6 The contribution of generation specified in Table 2 is based on the assumptions that -

a the cyclic rating of the largest transmission or distribution circuit is greater than two thirds of the total sent-out capacity of the two largest generation units

AND b the cyclic rating of the two largest transmission or distribution circuits is greater than two thirds of the total sent-out capacity of the three largest generating units

AND c the load pattern in the group is similar to the national load pattern.

Where these assumptions do not apply, detailed risk and economic studies may need to be undertaken, particularly if there are only one or two large generators in a group.

4 DEFINITIONS

4.1 GROUP DEMAND

For a single site	The appropriate estimated maximum demand given in the adopted load estimates or the Area Board's own estimates for those points for which no load estimates have been adopted.
For multiple sites	The sum of the appropriate estimated maximum demands in the adopted load estimates with allowance for diversity appropriate to the Group, or the Area Board's own estimates for those parts of the system for which no load estimates have been adopted.

4.2 CIRCUIT

A circuit is the part of an electricity supply system between two or more circuit breakers, switches and/or fuses inclusive. It may include transformers, reactors, cables and overhead lines.

Busbars are not considered as circuits and are to be considered on their merits.

4.3 CIRCUIT CAPACITY

The appropriate cyclic ratings or, where they can be satisfactorily determined, the appropriate emergency ratings should be used for all circuit equipment.

For the first circuit outages, circuit capacity will normally be based on the cold weather ratings, but if the Group Demand is likely to occur outside the cold weather period the ratings for the appropriate ambient conditions are to be used. Where the Group Demand does not decrease at the same rate as the circuit capacity (eg with rising temperature) special consideration is needed.

For second circuit outages, in view of the proportions of Group Demand to be met in Table 1, the most appropriate ratings to use will usually be those for spring/autumn conditions.

"Classes of Supply" are defined in MW, but circuit requirements should be assessed in MVA with due regard for generating plant MW Sent Out and MVAr capability where appropriate.

4.4 FIRST CIRCUIT OUTAGE

Signifies a fault or an arranged circuit outage, but in classes C to F supplies to consumers should not be interrupted by arranged outages.

4.5 SECOND CIRCUIT OUTAGE

Signifies a fault following an arranged circuit outage.

The recommended levels of security are not intended at all times to cater for a first fault outage followed by a second fault outage or for a simultaneous double fault outage. Nevertheless, in many instances, depending upon switching and/or loading/generating arrangements, they will do so.

4.6 TRANSFER CAPABILITY

The extent to which transferable load and transferable capacity can be utilised or provided in the event of a system being affected by outages.

4.7 TRANSFER CAPACITY

That circuit capacity from adjacent load groups which can be made available within the times stated for the first and second outages in Table 1.

4.8 GENERATION UNIT LOAD FACTOR

$$\frac{\text{Total electrical energy sent-out by the unit per year (MWh)}}{8760 \times \text{Declared Net Capability of the unit (MW)}}$$

4.9 DECLARED NET CAPABILITY

The declared gross capability less that proportion of the normal total works power consumption attributable to that set or unit (measured as MWSO).

TABLE 2 EFFECTIVE CONTRIBUTION OF GENERATION TO NETWORK CAPACITY

TYPE OF GENERATION	CONTRIBUTION AFTER FIRST CIRCUIT OUTAGE Classes of supply A-E	CONTRIBUTION AFTER SECOND CIRCUIT OUTAGE Classes of supply D and E only	NOTES
BASE LOAD STEAM UNITS	67% Declared net Capability	67% Declared net Capability	Load Factor 30% or above
GAS TURBINE UNITS	67% Declared net Capability	67% Declared net Capability	The contributions should be restricted to supplying that part of the demand which is not required to be supplied immediately following first or second circuit outages, and/or to relieving short term overloads of transmission or distribution circuits following such outages.
OTHER STEAM PLANT: DAY-PLATEAU OR DAY-PLATEAU & PEAK LOAD UNITS	SMALLER OF 67% Declared net Capability OR 20% group demand	For Class E only: SMALLER OF 67% Declared net Capability OR 13% group demand	Medium load factor: 10% to 30%
PEAK LOAD UNITS ONLY	SMALLER OF 67% Declared net Capability OR 10% group demand	SMALLER OF 67% Declared net Capability OR 7% group demand	Low load factor: Below 10%

A1 THE CONTRIBUTION OF GENERATION TO SECURITY

The following notes indicate the background to the provisions made in the Recommendation concerning generation connected within a demand group.

A2 EQUIVALENCE OF GENERATION AND TRANSMISSION

In P2/4, generation was treated for security purposes as an additional circuit, comparable with transmission or distribution circuits. Because generator unavailability due to faults is much higher than transmission circuit unavailability due to faults, this approach is misleading. Probability studies using a generator availability (excluding planned outage) of 86% have shown that for demand groups with more than two generation units, the loss of two units plus one third of the remaining generation capacity is approximately equivalent, in probability terms, to the loss of a single transmission circuit. Similarly, loss of three units plus one third of the remaining generation capacity is approximately equivalent, in probability terms, to the loss of two transmission circuits. The use of the factor 2/3 in Table 2, and the note in paragraph 3.6, are based on this observation. It should be noted that the factor 2/3 is not an estimate of availability.

A3 CLASSIFICATION OF GENERATION

Generating plant may be operated out-of-merit to avoid loss of supply, and therefore the economic role of generation is not a sufficient indication of its contribution to security. This contribution is, however, constrained for steam plant by staffing arrangements. Generation is classified in this Recommendation according to whether it is manned for base-load, day-plateau or peak-load operation. Because staffing arrangements may not be foreseeable at the planning stage, average annual load factor is used as an approximate indication of the probable staffing arrangements. It should be remembered however, that staffing is the factor of primary importance, rather than merit order.

Application of this Recommendation will not eliminate the need for out-of-merit generation, though it will limit the costs incurred. Such costs should be taken into account in any detailed risk and economic studies which are carried out.

A4 ROLE OF GAS TURBINES

Gas turbines are usually remotely controlled and their use for security purposes is therefore not constrained by staffing arrangements. Their effective contribution can therefore be assessed as for base load plant. Full-load operation from standstill will, however, involve several minutes' delay, and therefore the contribution should be restricted to that part of the demand which is not required to be supplied immediately following a first or second circuit outage, and/or to relieve short term overloads of transmission or distribution circuits following such outages.

A5 CONTRIBUTION OF DAY-PLATEAU AND PEAK-LOAD PLANT

In Table 2 the contribution of day-plateau and peak load steam plant to network capacity is restricted to certain percentages of group demand.