USERS' GUIDE TO THE POOL RULES

Issue 1.00

Published by:

Chief Executive's Office, Electricity Pool of England and Wales,
15 Bloomsbury Square, LONDON, WC1A 2LP

Telephone: 071 831 4790
International: on +44 71 ~~831 4790~~ 380 4100
CTN: 254 201

British Library Cataloguing-in-Publication Data: a catalogue record for this book is available from the British Library.

NOTICE

The information contained in this book has been prepared by the Chief Executive's Office for the Executive Committee for the Pooling and Settlement System in England and Wales (the "Executive Committee"). No independent verification of any such information has been made. No representation or warranty, express or implied, is or will be made in relation to, and no responsibility or liability is or will be accepted by the Executive Committee or any member thereof or the Chief Executive's Office as to or in relation to the accuracy or completeness of, this book and any liability therefore is expressly disclaimed.

Readers are referred to the Schedule 9 of the Pooling and Settlement Agreement, which is available from the Chief Executive's Office, as described on page 75.

CONTENTS

REFERENCE

PREFACE

The start of electricity trading through the Pool brought a revolution, representing, as it did, the first national open market in electricity in the world.

One of the key documents involved in the operation of the Pool is the "Pool Rules" section of the Pooling and Settlement Agreement (Schedule 9), running to over 450 pages. Even experienced users admit this is difficult to understand in parts. This document provides a comprehensive guide to aid understanding.

After a brief introduction, Sections of the Pool Rules are covered in order, so that the guide can be used on its own or in conjunction with the original document. A glossary of technical and financial terms, flow charts of the variables, and comprehensive indexes are provided to ensure that the wider picture is always available while studying the details.

It is expected that the guide will be of use to those who are: starting the process of understanding the detail of the Pool Rules; involved in one area of the Pool Rules in detail, but require an understanding of the context; or need to make reference to the Pool Rules only occasionally. A companion publication "An Introduction to the Pool Rules" is available, from the Chief Executive's Office (CEO) (see page 75), which is a shorter overview description of the operation of the Pool Rules.

As the Pool evolves over time, the Pool Rules will change. It is expected that this guide will be updated as and when appropriated. If any reader has any comments or suggested amendments please contact the CEO (see page 75).

INTRODUCTION TO THE POOL

The Old Order

Before privatisation of the industry in 1990, the Central Electricity Generating Board (CEGB), a government owned nationalised industry, had charge of almost all generation and transmission of electricity in England and Wales. It had a statutory obligation to plan and produce electricity to meet demand. Prices for bulk supply, to the Area Boards and very large customers, were set by the Electricity Council at levels designed to meet financial targets set by the government.

The distribution and supply activities, including setting customer tariffs, were run by local Area Boards, which were also government owned monopolies.

The New Order

The new electricity supply industry is quite different. The supply and distribution businesses throughout England and Wales have now been privatised as the twelve Regional Electricity Companies (RECs). As well as taking over the main activities of the Area Boards, the RECs are also joint shareholders of the National Grid Company plc (NGC), which owns and operates the national high voltage transmission system for England and Wales.

The large fossil fuel generation capacity within the CEGB was privatised as two competing companies, National Power plc and the smaller PowerGen plc. Nuclear Electric plc was vested with the twelve nuclear power stations previously owned by the CEGB, and was retained in government ownership. Other independent generating companies have been established since Vesting, including several using renewable energy sources.

Most customers are connected to the networks of the RECs, although a few large consumers - for example steelworks and large chemical plants - are connected direct to the national grid. Customers consuming 1 MW and over are entitled to purchase energy from any licensed supplier. In April 1994 this arrangement will be expanded to include all customers taking 100 kW and over, and in 1998 to all customers.

It should be noted that separate privatisation arrangements apply in Scotland and Northern Ireland, although Scotland, like France, can trade with the English and Welsh companies through arrangements which cover the interconnections between the respective countries.

The New Market

On 31 March 1990 the Pool was established for the trading of electricity between generators and suppliers. Compared with other traded commodities, from gold and coffee to North Sea Brent crude oil, electricity poses two challenges to the market. Firstly, with a national integrated system it is not possible to trace electricity from a particular generator to a particular consumer. Secondly, it is not possible to store electrical energy in large quantities, so there must be constant matching of generation and demand.

Electricity is sold by generators and purchased by suppliers, including the RECs, according to rules outlined in the next section. To participate in the market, parties must join the Pool by acceding to the Pooling and Settlement Agreement, binding them to its terms. All licensed generators and suppliers must join the Pool.

The "Pool Rules" specify the way in which the Pool trades, in conjunction with the other provisions of the Pooling and Settlement Agreement. Many activities are supplemented by "Agreed Procedures" which define how they are to be carried out, and "Codes of Practice" which define the requirements for Metering Systems necessary to record consumer and generation data.

How Prices are Worked Out

The day is divided up into 48 half hour periods called **Settlement Periods**. Each day, every generator bids into the Pool prices at which it is willing to generate electricity from each of its generating units (gensets) at its power stations, and their available outputs. The Grid Operator forecasts the demand and then schedules the gensets to meet demand and limited reserve. A scheduling system called GOAL, run on behalf of the Pool, attempts to produce a minimum cost schedule, based on offered prices and outputs, but excluding any physical constraints due to the national transmission network. The first (day-ahead) schedule is called the **Unconstrained Schedule**.

In each Settlement Period, the price of the marginal "flexible" bid in the stack of plant required to meet estimated demand for that period sets the **System Marginal Price** (SMP). This is a price per megawatt-hour (£/MWh) which forms the basis of the payments for gensets which are scheduled for generation in the Unconstrained Schedule.

Pool Purchase Price (PPP) includes a second element, the **"Capacity Payment"**. This is essentially an incentive payment to ensure that enough generating capacity is kept available for times of peak demand. The payment is high at times when there is little spare plant available, but falls away to zero when there is a large excess.

The key equation relating PPP to SMP is, for any half hour Settlement Period:-

$$PPP = SMP + LOLP * (VLL - SMP)$$

LOLP is the **Loss of Load Probability**, the probability that demand will exceed the available generation. It is calculated after consideration of forecast demand and availability of generation offered.

VLL is the **Value of Lost Load**, a value fixed annually. It represents the price consumers are assumed to be willing to pay to avoid loss of supply, currently £2345 per MWh, and allows the equation above to convert LOLP into a cost per MWh.

The following table illustrates, in simplified terms, the payments that (centrally despatched) gensets receive:

	Situation	Generator payment
1	Genset in the Unconstrained Schedule and required on the day	PPP = SMP + Capacity Payment
2	Genset in the Unconstrained Schedule but not required on the day	PPP - Offer Price (ie loss of profit)
3	Genset offered but not in the Unconstrained Schedule but required on the day	Offer Price + Capacity Payment
4	Genset offered but not in the Unconstrained Schedule and not required on the day	Capacity Payment

Suppliers buying electricity through the Pool are required to pay **Pool Selling Price** (PSP), which is the total of all generation and system costs allocated to that particular Settlement Period, divided by MWh sold.

On the day the actual performance of Generating Units and the actual demand taken are metered giving rise to **Metered Data**. In addition the Grid Operator requires certain other services (such as the provision of reactive power) to enable him to run the Grid System to within licence standards these are known as **Ancillary Services**.

The difference between PSP and PPP is often known as **"Uplift"**. It represents the difference in unit cost between the Unconstrained Schedule and actual operation on the day, caused by a number of factors, including the cost of out-of-merit running because of transmission constraints, generation shortfall, demand forecast errors, reserve, unscheduled availability, and also the cost of Ancillary Services.

Prices set in the Pool vary from half hour to half hour, day to day, and season to season. In simple terms, the fluctuations usually relate to the variation in demand. For example, prices tend to be higher early on winter evenings, when domestic consumption rises whilst that of industry and commerce is still substantial. However, this relationship is far from exact and, for a number of reasons, it is not always the case that higher demands mean higher prices.

Price Statistics

The average levels of the various price components for the first three years of operation of the Pool are set out below.

	1990/1	1991/2	1992/3
Average SMP	17.37	19.52	22.64
Average PPP	17.41	20.82	22.80
Average PSP	18.73	22.43	24.19

The publications list on page 75 contains three Pool documents of statistical interest: the Quarterly Report, the Statistical Digest, and, for those requiring extensive detail, the Catalogue of Data on General Release.

Settlement Overview

Settlement is essentially the complete handling of financial matters, from the initial offers through to the passing of data to the Pool Funds Administrator for payment or invoicing - see figure 1 which is an overview of the main process.

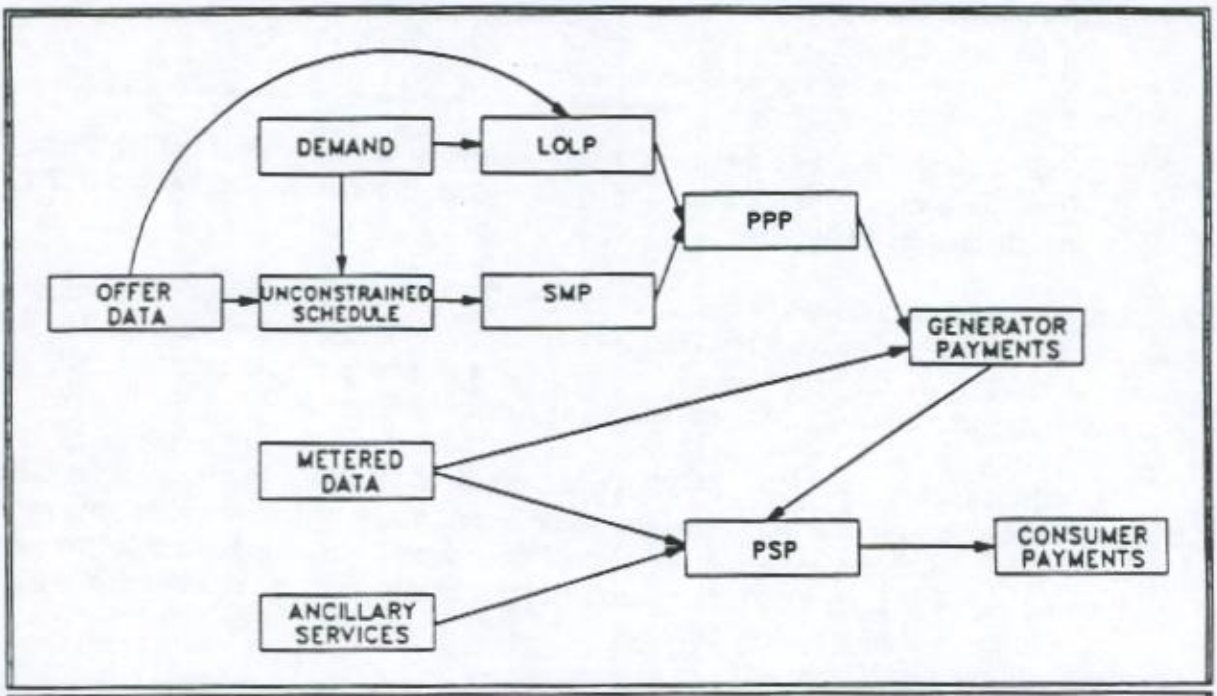


Figure 1 - Settlement flow chart

Times used by the Pool

The **Schedule Day** is a key feature and runs from 05.00 hrs on the day in question until 05.00 hrs on the next day. The timing was chosen to ensure a smooth changeover daily at a period of low demand. New prices may be submitted for each Schedule Day.

The **Availability Declaration Period** (ADP) starts at 21.00 hrs on the day before the Schedule Day and runs 39 hours to 12.00 hrs on the day following the Schedule Day. This is to ensure that appropriate scheduling of gensets is possible at the beginning and end of the Schedule Day, as generators have to submit their Day Ahead Offer Files for the full ADP.

Day Ahead Offer Files are submitted by 10.00 hrs on the day before the Schedule Day, in other words eleven hours before the start of the ADP.

Settlement Runs are necessary to evaluate sums due to and from Pool Members. During the twelve days after the Schedule Day metered data is collected and Preliminary and

Provisional Runs of results are sent both to generators and suppliers. This allows time for them to raise disputes on the accuracy of data. A Final Run is generally made on the 24th day following the Schedule Day.

Payments to and from the Pool must be exactly equal in total. The Pool Funds Administrator receives data from the Final Run of Settlements and undertakes the matching transfer of funds through the Pool Bank Account, with all amounts usually cleared 28 days after the day of trading.

NOTES ON THE TEXT AND POOL DOCUMENTS

Abbreviations used

ADP Availability Declaration Period
CDCS Central Data Collection System
NGC The National Grid Company plc
PSA Pooling and Settlement Agreement
RPI Retail Price Index
SSA Settlements System Administrator

Note on Terms

"National" refers to England and Wales. Use of the term "period" has been restricted, where possible, to Settlement Periods. Many variables are prefixed "Genset" and in a few cases this is omitted where it would be duplicated in the sentence and the context is clear.

Pool Documents

On 30 March 1990, the founder Pool Members and other parties signed the Pooling and Settlement Agreement, which remains in force as amended. The Pool Rules are Schedule 9 to the Pooling and Settlement Agreement.

From time to time various modifications and clarifications to the Pool Rules are agreed by the Executive Committee. Any such changes to the Pool Rules comes into effect at the time agreed by the Executive Committee provided that they have been accepted by the Director General of Electricity Supply. Details are then sent to Pool Members and Parties in "Pool Circulars", and summarised in the Quarterly Report of the Pool. At intervals, Pool Members and Parties sign a "Supplemental Deed", which includes all the changes to the Pool Rules since the previous Deed and any other changes to the Pooling and Settlement Agreement that have been agreed between the Pool Members and Parties. A "restated" edition of the PSA is normally published after each Supplemental Deed; the version used in this guide is dated 1 April 1993.

It should be noted that in the event of any internal inconsistency or conflict, the Pool Rules prevails over the rest of the PSA (with the exception of the objectives) and both prevail over the software used in the settlements process.

Pool documents can be obtained from the CEO (see page 75). Further revisions to the rules will be implemented in the future. One of the most significant changes is a set of rules called "Phase 4" (a version of which is included as an Annex to the PSA and is noted in he Annex to this guide). These changes are based on the wish to implement the full intentions of the PSA as stated at Vesting, in particular the ability to monitor and test gensets against the following of despatch instructions and against thier offered availability.

Units and Decimal Points

Power is the rate of flow of energy, and is sometimes called wattage in the rules, or active power. For example, offer files specify genset power levels and times.

1 kilowatt (kW) = 1 kilojoule per second (kJ/s)
= 1000 watts (W)

1 megawatt (MW) = 1 megajoule per second (MJ/s)
= 1000 kW

Energy in the electrical sense represents the capacity to do work, and is sometimes called active energy in the rules. Energy is sold and has to be metered for settlement. It can be calculated over a given timescale if the power is known, by a process called integration.

1 kilowatt-hour (kWh) = 3600 kJ
(equivalent to 1 kW plant running for one hour)

1 megawatt-hour (MWh) = 3600 MJ
= 1000 kWh

The English decimal point convention is used. Commas are not used in numbers; instead numbers 10 000 and larger are broken into groups of three with a space, as suggested in international standards.

Equations

Max and min in the Pool Rules and guide refer to the maximum or minimum of the alternatives following. For clarity, in this guide some expressions with a maximum or minimum value of zero are indicated as such in the line below.

Section and Subsection Numbering

Numbering in the Pool Rules and this guide is identical.

GUIDE TO THE POOL RULES

Sections 1 and 2 of the Pool Rules are useful reference while considering the rest of the rules as they relate to standard definitions, interpretation and the values of certain standing data. They should be read in this light.

1 DEFINITIONS AND ACRONYMS

This section covers definitions and acronyms, and the reader is referred to the Glossary on page 77 for further terminology not covered here.

Because the Pool Rules are a Schedule of the PSA, this gives rise to the legal phrase "this Schedule". An acronym is a shortened name (eg $LOLP_j$) employed to avoid repeated use of the longer name. Most acronyms in the rules are variables used in mathematical formulae and algebraic expressions.

1.1 Definitions and Acronyms

Appendix 1 of the Pool Rules is summarised, and is an essential part of the rules. Part I of the appendix contains a long table of entries; each comprises a definition, acronym, and units. A much simpler "Index by Subject" is given in this guide on page 96.

Appendix 1 Part II is indexed in order of acronym, and the full expression name can be traced. For this guide there is an equivalent "Index by Variable" on page 85.

Treatment of special case Generating Units

References in the rules to Centrally Despatched Generating Units (gensets), include Generation Trading Blocks, unless special provisions apply.

Generating Units also include Combined Cycle Gas Turbine Modules but not Combined Cycle Gas Turbine Units. In other words the complete module (gas plus steam turbines and plant) is considered to be the genset, not its component parts.

A Power Station consisting of Non-Centrally Despatched Generating Units is treated as a single Non-Centrally Despatched Generating Unit.

1.2 Legal Definitions of Section References

Cross referencing to other parts of the Pool Rules is frequently necessary, and this subsection explains that references without a document shown refer to the Pool Rules (Schedule 9); references to "Clauses" are to clauses in the PSA. Other documents are specified by name.

1.3 Subscript Definitions

Subscripts are smaller letters at the end of an acronym referring to its application, for example ij in A_{ij}. Whilst some readers may find this a complication, it is important to be able to identify the application of a variable. Thus A_{ij} means the "Genset Metered Generation" for a Generating Unit for a Settlement Period.

Subscript	Refers to
c	Consumer
e	Externally Interconnected Party or External Interconnection
f	Shortfall period
g	Generator
i	Generating Unit (except in 1.5)
j	Variable associated with settlement period or Spot variable associated with end of settlement period
m	Calendar month
p	Pool Member or Party
q	Point in time referred to
r	Range
s	Power Station
S	Standard Season
t	Variable associated with particular minute; identified by minute time at which minute ends (*).
T	Settlement Day or Schedule Day
Y	Calendar Year or Scheme Year.

** The Grid Operator works to "minute beginning" due to previous practice.*

Further definitions and explanations:

(a) The symbol "*" indicates multiplication.

(b) The symbol "♦" is equivalent to a blank, but is used only once.

(c) A zero "0" is taken as a positive whole number.

(d) The acronym ABS refers to the absolute value of expression, in other words its positive value regardless of positive or negative sign.

(e) The standard deviation of a set of data items is taken to be the square root of the arithmetic mean of the squares of the deviations. Deviation refers to the difference between a data item and the arithmetic mean of all data items.

(f) The acronyms "max" and "min" refer to the maximum and minimum values of the alternatives following in brackets, which are separated by commas.

(g) The subscript j refers to a particular Settlement Period; j-1 refers to the previous period, and j+1 to the next period in time. Special rules are necessary at the beginning and end of a Schedule Day D.

Where j-1 falls in the previous Schedule Day (D-1) the variable from the Schedule Run for the current day D is used instead. Similarly, if j+1 falls in the next Schedule Day (D+1) the variable for Schedule Day D is used instead.

There is an exception to this convention relating to values of XMD_{ij} and XMP_{ij}, but in this guide the detail is given in context, in 16.5.

(h) Values of V_{ij}, VR_{ij} and XH_{ij} which correspond to the Settlement Period immediately preceding the first Settlement Period of the Schedule Run are provided as part of the data for a Schedule Run.

(i) Where a variable is not to be determined it is set to zero.

(j) UK local time is used.

(k) Genset Offered Availability (GOA_{it}) and Genset Reoffered Availability (GRA_{it}), which are defined in 6.1 and 6.2, are treated as if submitted for all minutes in the applicable time periods.

(l) Decommissioned units are excluded.

1.4 Summation Symbol Σ

The Greek Sigma symbol Σ is used to sum algebraic expressions in conjunction with the suffix letters of 1.3.

For example Σ_s^c is summed over all Power Stations (s) owned by a Consumer (c). Σ_t is summed over all minutes (t) in a Settlement Period.

1.5 Linear Interpolation

Linear interpolation is used when a value has to be evaluated and only spot values either side are available.

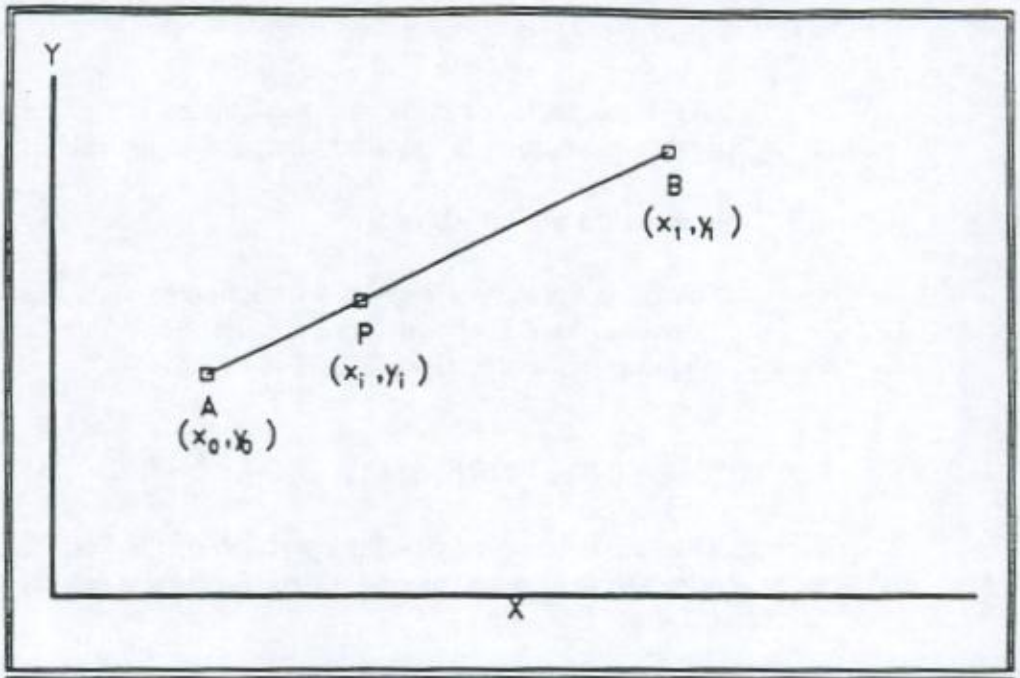


Figure 2 - Linear Interpolation

Values between spot values A and B in Figure 2 are deemed to be on a straight line, and so increase in linear proportion. The mathematical expression of this is:

$$y_i = y_0 + [(y_1 - y_0) * \frac{(x_i - x_0)}{x_1 - x_0}]$$

For example, if $x_0 = 1$, $x_1 = 4$, $y_0 = 5$, $y_1 = 20$, and y_i for intermediate point $x_i = 3$ has to be found:

$$y_i = 5 + (15 * 2/3) = 15$$

1.6 Authority of Decisions

The obligations on the SSA to perform calculations using the Settlement software and report results are set out in this sub-section.

1.7 Time of the Essence

Certain obligations on the SSA are time specific, and the importance of meeting the timescale is stated in a recognised "legal" form. In other matters timely response is laid down.

1.8 Value Added Tax

VAT is not included in the sums calculated and where appropriate is payable in addition to amounts specified in the rules.

1.9 Submission of Variables

Where the Pool Rules require submission of variables to the Grid Operator, it must be made at the correct time and in the correct form, even if not obligatory under the Grid Code.

2 SETTLEMENT STANDING DATA

Various characteristics necessary for operation of the Pool change only infrequently, and are only submitted or recalculated when they do so. They are "Standing Data".

2.1 System Parameters

Set by the Executive Committee after consultation, or by Supply Licence conditions of the Secretary of State in the case of VLL (with annual updating).

Acronym	Name	Current Value
PTT	Peak Trough Tolerance	500 MW
SDD	Settlement Day Duration	24 hours†
SCD	Schedule Day Duration	24 hours†
SPD	Settlement Period Duration	½ hour
TBH1	Table B Hours 1	3.5 hours
TBH2	Table B Hours 2	10 hours
TBH3	Table B Hours 3	2.5 hours
TBT	Table B Trigger	1000 MW
VLL	Value of Lost Load	£2345/MWh

† *Except on clock change to and from British Summer Time*

2.2 Standing Data required from Pool Members

List of details required on registration, including:

- General details, such as address
- Genset details for generators
- Grid Supply Point details for consumers
- Meter specification
- Meter connections to NGC Transmission System
- All relevant dates

- Whether Range CCGT module - CCGTs only.

Please consult the Pool Rules and relevant Agreed Procedures for the full list.

2.3 Standing Data Amendments

There is a duty on Pool Members to notify changes immediately, and on the SSA to amend records.

3 CENTRAL DATA COLLECTION SYSTEM (CDCS)

3.1 Data Input and Validation

Active Energy exported or imported is measured by Metered Data, with rules set out in Clause 60 of the PSA.

The SSA has duties to:

- Collect the Metered Data and check it
- Investigate and correct errors and missing data
- Enter Metered Data into CDCS
- Update Standing Data when new information is received
- Carry out meter readings from time to time
- Reconcile actual meter readings (eg at Power Stations) with electronically received Metered Data used in CDCS.

3.2 Adjustment and Aggregation of Metered Data

The principle used in settlement is that all trading is related back to a Grid Supply Point, regardless of actual meter position.

Metered data, after it has been collected, is adjusted to take into account the losses between the meter and the Grid Supply Point and then aggregated together in certain defined ways.

Power Stations

Metered data from Power Stations, subject to Central Despatch, is summated Gross/Net. Gross/Net refers to the gross output of a genset, less the demand through the associated unit transformer. Power Stations not subject to Central Despatch are treated Net; only the net flow to or from the Site associated with the Power Station is considered.

Embedded Generating Units, Subordinate Generation and Demand are essentially cases where connections and meters are within Distribution Systems, rather than directly to the NGC Transmission System. The

output/input of Subordinate Generation/Demand is adjusted up or down using loss factors agreed between the Parties concerned, and endorsed by the Executive Committee. These are based on engineering studies of the network, taking into account such factors as the position of the Grid Supply Point and Distribution Network loading. Detailed notes are available in Pool Circular 012, available from the CEO (see page 75).

Demand

Finally, subjects particularly affecting Regional Electricity Companies (RECs) are considered. These arrangements apply to those within their Distribution Networks, ie Second Tier Suppliers and Embedded Power Stations not subject to Central Despatch. The SSA employs Second Tier Agents to monitor such generation and supply, using the Second Tier Data Collection Service (STDCS). From 1 April 1994 a new national Second Tier Agent has been appointed.

The detailed aggregation rules for Power Stations and Demand are in Appendix 6. A very simple illustration is of a Grid Supply Point where overall demand of M1 MWh is measured over a half hourly Settlement Period, and, immediately below, M2 MWh of demand is taken by a Second Tier network. The Second Tier Supplier is charged for M2, and the First Tier Supplier (the "host" REC) is charged for (M1 - M2) MWh.

3.3 Variables Metered for CDCS in each Settlement Period

A small but vital subsection showing the origin of fundamental variables from which many others are determined. Precise details of aggregation are listed in Appendix 6.

Acronym	Name	May be
A_{ij}	Genset Metered Generation ¶	Zero or positive
MSL_{sj}	Station Load	Positive or negative†
ND_{cj}	Consumer Metered Demand ¶	Positive or negative
IMF_{ej}	Interconnector Metered Flow	Positive (import) Negative (export)

¶ *These variables are determined for Interconnectors in Section 26*
† *Subsequently set to zero if negative, in 24.2*

4 REQUIREMENTS FOR LARGE CONSUMERS TO NOTIFY DEMAND

4.1 Requirement to Notify under Section 4

The requirement applies to External Pool Members, NGC Pumped Storage, and Large Consumers, that is those with a maximum demand of over 250

MWh in any Settlement Period at a single site. Currently no consumer meets this demand criterion.

Where energy is resold by a licensed supplier, the supplier must be notified by the consumer if demand reaches the limit above, and the supplier is required to inform the SSA.

4.2 Demand Notification

By 10.00 hrs each Settlement Day, each External Pool Member and any Large Consumer must submit to the Grid Operator a "schedule of demand", its expected average demand in MW for each Settlement Period of the following ADP.

4.3 Pumped Storage Demand Notification

NGC Pumped Storage must also submit its forecast demand as in 4.2 and must also show Maximum Pumping Capability (MPC_j) in MW average for each Settlement Period.

The Maximum Pumping Price used in 5.5 is deemed equal to VLL.

4.4 Accuracy of Schedule Demand

There is a duty of care in preparing the Schedule of Demand, but no obligation to purchase according to it.

4.5 Additional Demand Data

This provision is no longer used.

5 DEMAND FORECASTING

The Pool requires a generation forecast, ie the forecast of output required to meet likely demand by Centrally Despatched Generating Units and Small Independent Generating Units (SIGUs). It is produced on a day-ahead basis for each Settlement Period in the ADP, using the following procedure.

By 10.00 hrs daily, the Grid Operator produces under 5.1 a forecast of Nominal Demand in MW for the following ADP, based mainly on historic data and weather forecasts. In 5.2 this is converted into a forecast of Total Demand in MW, with other factors included.

Total Demand does not take into account demand from Large Consumers, External Pool Members and NGC Pumped Storage, which is estimated separately under 4.2 and added to Total Demand. This total is called Forecast Demand, and is the key demand variable used in settlement. Whilst the following sub-sections set out the

procedure for determining Forecast Demand much of the algebra now has no effect for the reason discussed in 5.4.

5.1 Consumer Demand Forecast

By 10.00 hrs daily the Grid Operator has to prepare for the SSA a forecast of demand in MW sufficient for the preparation of a demand curve for the forthcoming ADP starting at 21.00 hrs that day. Only factors which affect demand and are capable of independent verification may be included. The rules mention meteorological forecasts, current and historic weather conditions and, of course, historic demand data.

Factors incapable of independent verification in Nominal Demand are excluded from the forecast. The expected output of SIGUs, customer demand management and the response of demand to price may only be included if verifiable independently.

The Grid Operator uses a computer model to convert its forecast of Nominal Demand to a forecast of Total Demand ($Q0_j$) in MW for each Settlement Period, and passes it to the SSA. There are many further details in Grid Code OC1, but basically $Q0_j$ represents Nominal Demand plus national station load for all power stations.

The Grid Operator must also inform the SSA of the output of SIGUs. This may be zero in the absence of any notification - see Grid Code OC1.5. It is necessary to include the output of SIGUs in both the Demand Forecast and the generation schedule due to the interaction of the Unconstrained and operational schedules.

If requested by the Executive Committee, the Pool Auditor may review any of the information used in 5.1 and require explanations.

5.2 Determination of Forecast Demand

Forecast Demand ($TGSD\#_j$) which is used to compile the Unconstrained Schedule is compiled from preliminary figures of 5.1.

The acronyms used for Pool Purchase Price (PPP) and others in this subsection are:

ID_j and $ID\#_j$	= Interconnector Demand
$PPP0_j$	= Estimated PPP in respect of $Q0_j$ above (5.3)
$PPP1_j$	= Estimated PPP in respect of $TGSD1_j$ (5.3)
$PPP\#_j$	= Average of $PPP0_j$ and $PPP1_j$
PS_j and $PS\#_j$	= Pumped Storage Demand based on PPP0; and PPP1 respectively
$TGSD1_j$	= Total Gross System Demand Forecast
ZQ_{cj}	= Demand Schedule Demand Entry

In practice, because the demand adjustment proved to add little to the accuracy of forecasting, demand is now treated in a much simplified way, and interconnectors submit a demand insensitive to price. The original software still runs, but the only results of importance are:

- $ID\#_j = ID_j = ZQ_{cj}$ = Demand submitted by Interconnectors
- $PS\#_j = PS_j$ determined from $Q0_j$ and ID_j
- $TGSD\#_j = Q0_j + ID\#_j + PS\#_j$

The full steps used by the software are:

(a)	$PPP0_j$ determined from $Q0_j$	(5.3)
(b)	ID_j determined from $PPP0_j$	(5.4)
(c)	PS_j determined from $Q0_j$ and ID_j	(5.5)
(d)	$TGSD1_j = Q0_j + ID_j + PS_j$	
(e)	$PPP1_j$ determined from $TGSD1_j$	(5.3)
(f)	$PPP\#_j = ½ * (PPP0_j + PPP1_j)$	
(g)	$ID\#_j$ determined from $PPP\#_j$	(5.4)
(h)	$PS\#_j$ determined from $Q0_j$ and $ID\#_j$	(5.5)
(i)	$TGSD\#_j = Q0_j + ID\#_j + PS\#_j$	

5.3 Demand Adjustment: Reference Prices

In practice, 5.4 ensures that demand is treated as insensitive to price under all conceivable circumstances.

For readers interested, the intention of this subsection is to reflect the elasticity of price and demand - in other words there is a reduced demand if the price is higher. The actual table entries show Demand (QT) and Price (PT); Pool Purchase Prices for each Settlement Period are determined using linear interpolation, as explained in 1.5.

At Vesting the Executive Committee provided the SSA with historic price and demand figures for use each Schedule Day. At 14 days notice it may also require use of revised tables.

$PPP0_j$ is determined from Total Demand $Q0_j$ (5.1); and
$PPP1_j$ is determined from $TGSD1_j$ (5.2), using the tables relating price to demand (PT vs QT)

5.4 Demand Adjustment: Interconnectors and Large Consumers

In practice there is now no adjustment to the offered demand. This is done by allocating a Price Entry of VLL, ie very high, for all demand levels.

Again, for readers interested, Interconnector Demands ID_j and $ID\#_j$ for each Settlement Period are evaluated for each External Pool Member, using its Demand Schedule Demand Entry ZQ_{cj}. The rules used are:

$ID_{cj} = ZQ_{cj}$ under all normal circumstances, ie $0 \leq PPP0_j \leq VLL$.
$ID_{cj} = 0$ in any other case.
$ID_j = \Sigma_c [ID_{cj} * (1 + LFID_c)]$ summation over all interconnectors, including loss factors.
$ID\#_j$ similarly calculated, but using $PPP\#_j$.

5.5 Demand Adjustment: Pumped Storage

Pumped storage consists of reversible hydro generation plant, capable at short notice of either generation using water from an upper reservoir, or taking demand by pumping back to the reservoir, converting electricity to potential energy. Pumping is normally carried out at off-peak times when Pool prices are low.

The function of pumped storage in the context above is to "fill in" the troughs in national demand, known in the industry as "bath-tubbing" from the appearance of graphs such as Figure 3. 5.5 attempts to model the likely pumping requirements of NGC Pumped Storage.

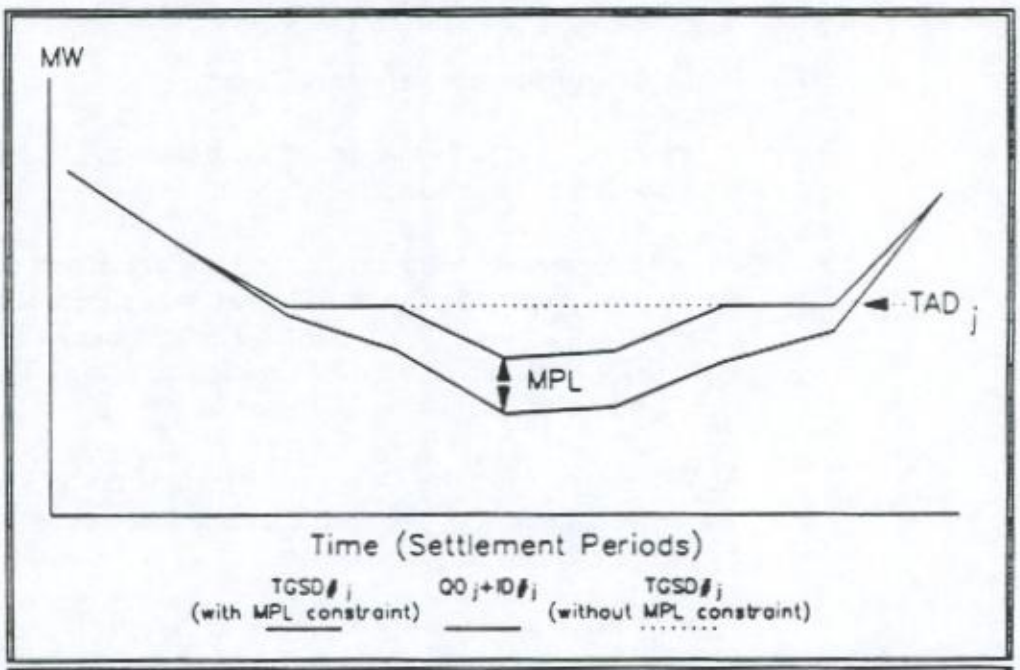


Figure 3 - Settlement treatment of Pumped Storage demand

Two Pumping Periods apply when demand is evaluated from data supplied by NGC Pumped Storage:

- Pumping Period 1 runs from the beginning of the ADP (21.00 hrs) to 12.00 hrs next day (15 hours)

- Pumping Period 2 runs from 12.00 hrs above to the end of the ADP (12.00 hrs) (24 hours).

Firstly, the Maximum Pumping Load 1 in MW is found, being the maximum value for Pumping Period 1 of the Maximum Pumping Capacity (MPC_j) supplied by NGC Pumped Storage under 4.3. Secondly, the Total Pumping Load 1 (TPL1) in MW is found by summation of the demand submitted under 4.3 over Pumping Period 1.

Unadjusted Pumped Storage Demand (UPS_j) and Minimum Total Demand 1 (MINTD1) are evaluated for Pumping Period 1, knowing the number of Settlement Periods in it, currently 30. TAD_j is the Total Assumed Demand in MW calculated below. UPS_j is effectively determined by allocating TPL1 over all of the 30 Settlement Periods, so as to maximise the minimum value of Total Assumed Demand (TAD_j).

(a) where $\frac{\text{TPL1}}{\text{MPL1}} < 30$ (number of Settlement Periods in Pumping Period 1)

then the Total Assumed Demand (TAD_j) in MW is considered to be within the capacity limit and is given by the equation:

$$TAD_j = [UPS_j * (1 + LFPS)] + Q0_j + ID_j$$

subject to the constraints that MINTD1 (minimum value of TAD_j where $UPS_j < MPL1$) is maximised and UPS_j must be $< MPL1$.

(b) where $\frac{\text{TPL1}}{\text{MPL1}} \geq 30$ then:

TAD_j is considered to be equal or greater than capacity, so UPS_j is set at MPL1, and MINTD1 is not determined.

Identical calculations then apply for Pumping Period 2 (using suffix 2), which contains 48 Settlement Periods rather than 30, to complete calculations for the 78 periods of the ADP.

Demand Adjustment to Price

Pumped Storage Demand (PS_j), in MW average for a Settlement Period, is deemed inelastic to price, following provisions in 4.3. Effectively, a simplification now applies:

$$PS_j = UPS_j * (1 + LFPS)$$

The full determination is:

$$PS_j = \min [(MTD - Q0_j - ID_j), UPS_j * (1 + LFPS)]$$
(minimum of zero)

MTD is the total demand associated with the highest price NGC Pumped Storage is prepared to pay. $PS\#_j$ is calculated in an identical way, using the rules of this subsection, but substituting $PS\#_j$ for PS_j and $ID\#_j$ for ID_j.

5.6 Schedule of Demand: Default Values

If an External Pool Member, NGC Pumped Storage, or a Large Consumer fails to supply data required under 4.2 or 4.3, values from the preceding Schedule of Demand are used.

5.7 Not used

5.8 External Pool Members' Notional Demand

An Externally Interconnected Party must submit by 17.00 hrs a statement, with times, of demand for each Settlement Period of the following Schedule Day for energy to be exported from the NGC Transmission System. This is subject to maximum capacity of the interconnector (see 25.4), and may be revised at any time. However, only the day ahead statement is used in calculating the Unconstrained Schedule.

The Grid Operator takes the original day ahead statement and after considering from 17.00 hrs any revisions, modifies it to the extent thought appropriate, to form the Agreed Final Demand Programme. The first revision typically occurs after 17.00 hrs, when the day-ahead prices are published.

5.9 Pumped Storage Demand

NGC Pumped Storage must submit, with times, by 20.00 hrs daily, a Final Nighttime Pumping Programme for its Pumping Units, that is the Generating Units operating in pumping mode. The programme covers the Settlement Periods from 22.00 hrs that day to 07.00 hrs the next morning, or 08.00 hrs if not a Business Day (as defined in the Grid Code).

Similarly, a Final Daytime Pumping Programme is submitted by 17.00 hrs daily, covering the Settlement Periods from the end of the Nighttime Pumping Programme until 22.00 hrs the following day.

Both programmes can only be changed with consent of the Grid Operator, though only the original is used to compile the Unconstrained Schedule. As MPC_j can be up to 2.05 GW - which can represent one eighth of the

summer night time demand - Pumped Storage plays a significant role in demand management at such off-peak times.

6 GENERATOR OFFER DATA

6.1 Generators' Day Ahead Offer Files

By 10.00 hrs daily, generators must submit for each centrally despatched genset for the following ADP, which commences at 21.00 hrs in the same day, an Offer file in the manner required by the Grid Code (principally in SDC1.4). Many of the requirements of the Pool Rules and the Grid Code are identical, but the latter requires additional technical parameters not necessary for settlement. Availability must be offered Gross/Net, in other words net of unit transformer consumption. Data for Embedded Generating Units and Generation Trading Blocks must be adjusted to apply at the Grid Supply Point, by applying scaling factors.

(a) Genset Offered Availability

The generator submits an offer stating whether the genset is available to run, and if so the level of output at which it is available to be scheduled. This offer covers every minute of the following ADP and is submitted in the form of a MW value together with the time from which it applies.

The variable used is Genset Offered Availability (GOA_{it}), ie Gross/Net power available in whole numbers of MW, 999 MW maximum.

(b) Operational Characteristics

Genset technical characteristics, such as run-up rates, run-down rates, and synchronising generation, must be submitted to the Grid Operator under Grid Code SDC1.4 and SDC1 Appendix 1. These variables are used in assessing any "deemed inflexibility" of the genset in 11.5 to 11.7. Any subsequent revision must be notified, but does not affect the Unconstrained Schedule.

Certain operational characteristics are treated as a single set of values for the Schedule Day, called the Genset Capacity Set:

MG_i - Genset MG (Minimum Generation), in whole number of MW (must be $\leq GRC_i$)
SG_i - Genset Synchronising Generation in whole number of MW (must be ≥ 1 and $\leq MG_i$)
SRL_i - Genset Spinning Reserve Level, to provide Five Minute Reserve (must be $\geq MG_i$ and $\leq GRC_i$)

If the generator fails to supply the Genset Capacity Set, default values are used, as specified in 6.4.

(c) Inflexibility Declaration

A genset may be declared by the generator as inflexible, that is either unable to shut down, or required to generate at or above a given level. Full details are in 11.1 and 11.2.

(e) Prices for next Schedule Day

A set of Day Ahead Offer prices is submitted in the form detailed in later subsections 6.3 and 8.3.

6.2 Redeclared Availability Declarations

At any time, the generator may submit to the Grid Operator a revised figure for available generation or inflexibility of a genset which replaces that in the Availability Declaration and any previous redeclared value. This can happen because the genset becomes available at a different availability or degree of inflexibility, or because a genset declared not available became available for generation.

In the rules, at 21.00 hrs daily a new ADP starts, and the Availability Declarations specified in the new Day Ahead Offer File are deemed to be redeclarations for the eight hours to 05.00 hrs.

However, where the Day Ahead Offer File contains different declarations of inflexibility for the overlap minutes 21.01 hrs - 05.00 hrs, these are not considered to constitute a redeclaration.

6.3 Generators' Offer Prices

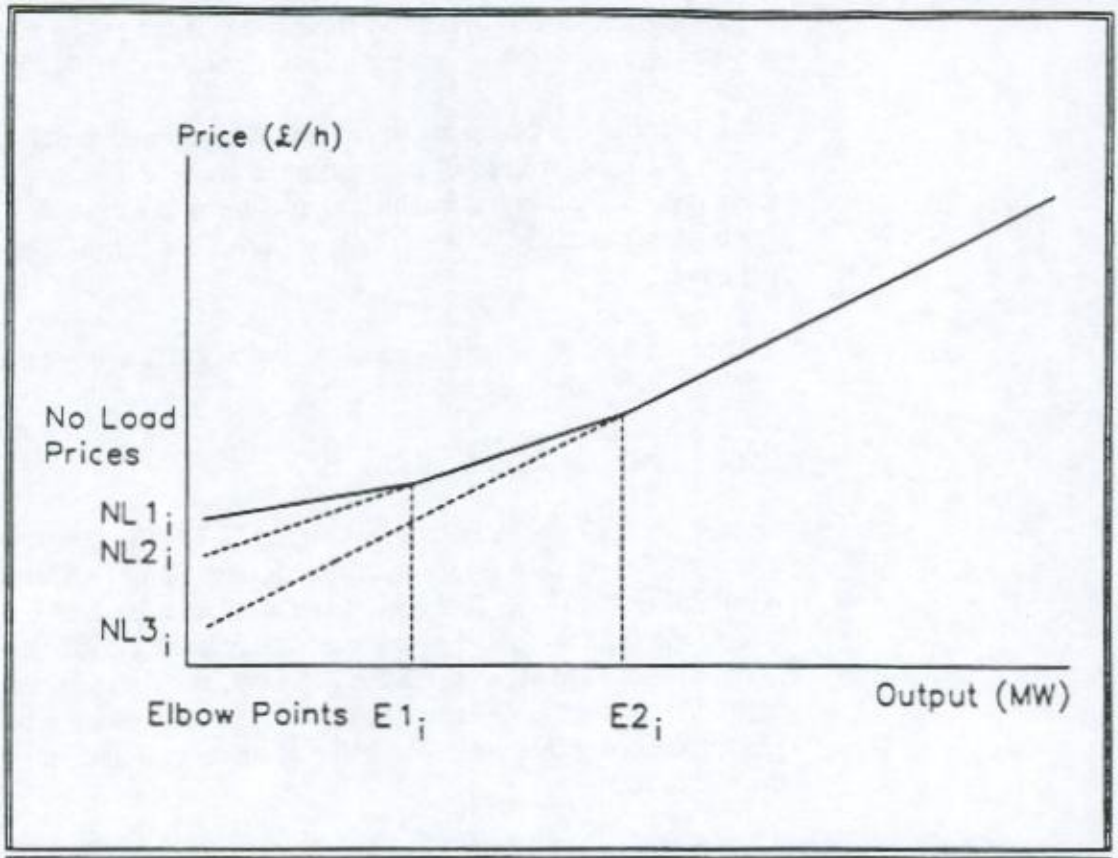


Figure 4 - Generator offer price diagram (Willans Line)

(a) Genset Incremental Prices

A maximum of three Genset Incremental Prices are permitted with related Genset Elbow Points, a Genset Start-Up Price, and a MaxGen Price (applicable only for generation above offered availability).

Term	Acronym	Must be	Units
Genset Start-Up Price	SU_i	< 100 000	£XX XXX
Genset No-Load Price 1	$NL1_i$	< 10 000	£X XXX.XX/h
Genset Incremental Prices 1/2/3	$INC1_i$/$INC2_i$/$INC3_i$	< 1000	£XXX.XX/MWh
Genset Elbow Points 1/2	$E1_i$/$E2_i$	$E2_i > E1_i$ if submitted	MW
Genset MaxGen Price	MP_i	< 10 000	£X XXX.XX/MWh

Fractions of a megawatt and fractions of a penny are not permitted; pennies are allowed except in SU_i. Until otherwise decided by the Executive Committee, all prices must be positive (note that zero is treated as a positive number).

The number of Genset Incremental Prices must necessarily be one more than the number of Elbow Points. The Genset Incremental Price Set is rendered invalid in its entirety if the requirements of this paragraph or the table above is not complied with.

$NL1_i$ permits the generator to recover fixed genset costs per hour, which occur regardless of the instructed load. $NL2_i$ and $NL3_i$ are variables used purely to enable calculation of a single £/MWh price for a genset at all MW levels and are calculated in 8.3; they can be negative.

Section 25 and Appendix 7 contain special rules applying to Generation Trading Blocks.

(b) Genset Merit Order Availability

Genset Merit Order Availability (MOA) in MW is the time weighted average of those two hours with the highest Genset Offered Availability (GOA_{it}). If the genset is available for less than two hours, the time weighted average of the offered period is used. If it is not available at all in the Schedule Day, the previous day's value is used. The variable is used by GOAL in compilation of the Unconstrained Schedule. The value is calculated and submitted by the Generator.

6.4 Generators' Offer Prices: Default Values

The SSA has powers to use replacement offer data if a generator's submission is missing at 10.00 hrs on the Settlement Day, is faulty or does not conform to format. It uses the last valid notification available from the preceding ADP or Schedule Day. However, for ordinary gensets (not Generation Trading Blocks or those of NGC Pumped Storage) the most recent GOA_{it} and GRA_{it} are used to replace the missing offers of availability.

For any minute of the Schedule Day from 05.00 hrs for which there has not been a redeclared availability under 6.2, then the Genset Reoffered Availability (GRA_{it}) is set to the value of the corresponding Genset Offered Availability (GOA_{it}). This is simply to assist in the necessary software operations.

6.5 Special Requirements for External Pool Members and NGC Pumped Storage

When a demand for energy is submitted at the day ahead stage (4.2, 4.3), the Genset Offered Availability (GOA_{it}) for the relevant minutes must be offered as zero.

Externally Interconnected Parties and NGC Pumped Storage also submit demand schedules after the day ahead stage, under 5.8 and 5.9. In these cases, Genset Reoffered Availability (GRA_{it}) of zero has to be submitted for the relevant minutes.

6.6 PORTHOLE Input

PORTHOLE is the electronic interface which allows the transfer of operational data from the Grid Operator to the SSA and the Ancillary Services Provider on a daily basis, including:

- Generator offer data - availability, prices, operational parameters
- Generator reoffers
- SMP_j
- Unconstrained Schedule information.

The SSA is responsible for operating PORTHOLE and facilities for input of Genset MaxGen Price (MP_i) so as to accurately and completely record submissions described in Section 6. Fuller details of PORTHOLE are in Appendix 5.

7 GENERATORS' OBLIGATIONS TO GENERATE

7.1 Availability of Plant

Under the rules the generator's decision on whether or not any genset is available for generation is final.

7.2 Generation of Energy

Nothing in the Pool Rules may be held to impose any obligation on a generator to secure physical despatch of declared availability.

8 GOAL AND THE UNCONSTRAINED SCHEDULE

As seen in 5.2, the Grid Operator forecasts the demand $TGSD\#_j$ for each period of the next Schedule Day. $TGSD\#_j$ and generator offer data are fed into the unconstrained GOAL program suite, which is designed to calculate a minimum cost schedule to meet Forecast Demand with the gensets available.

The Unconstrained Schedule of required generation takes no account of geographical transmission constraints and could thus be considered an idealised schedule, ensuring that offers from all locations receive equal treatment.

8.1 Production of the Unconstrained Schedule

The SSA produces this using the Settlement GOAL Suite procedures listed in Appendix 2, in other words by operation of the GOAL software.

8.2 Integration of MWh Values

GOAL produces "spot" power levels (Genset Unconstrained Spot Generation, V_{ij}, and Genset Unconstrained Spot Reserve, VR_{ij}) in megawatts for half hourly intervals, on the hour and half hour. Settlement requires these to be converted to energy in MWh for each half hour Settlement Period. Thus the following variables are defined:

Genset Unconstrained Generation $U_{ij} = ½ * [(V_{ij-1} + V_{ij}) * SPD]$

Genset Unconstrained Reserve $UR_{ij} = ½ * [(VR_{ij-1} + VR_{ij}) * SPD]$

Genset Average GOAL Availability $XH_{ij} = ½ * [(XG_{ij-1} + XG_{ij}) * SPD]$

MWh MW MW ½h

8.3 Determination of Table A Prices

Genset No-Load Price 1 ($NL1_i$) is submitted by the Generator but $NL2_i$ and $NL3_i$ are calculated. Genset No-Load Price 2 ($NL2_i$) represents the zero MW intercepts of a line drawn from the Willans Line at Elbow Point 1 ($E1_i$) - see the graphical representation, figure 4, in 6.3. Similarly, $NL3_i$ represents the zero MW intercept of a line drawn at Elbow Point 2 ($E2_i$). Algebraically:

$$NL2_i = NL1_i + [(INC1_i - INC2_i) * E1_i]$$

$$NL3_i = NL2_i + [(INC2_i - INC3_i) * E2_i]$$

The settlement software uses three Genset Incremental Prices and two Elbow Points, but under 6.3 it is also possible to submit fewer. Values for the remainder are allocated, as below, to reflect the wishes of the generator and enable the software to run. The 9999 MW entries for Elbow Points are artificially high figures, to enable the generator's offer to be implemented.

(a) $INC1_i$ only submitted:
$INC2_i = INC1_i$, $INC3_i = INC1_i$, $E1_i = 9999$, $E2_i = 9999$

(b) $INC1_i$, $INC2_i$, $E1_i$ only submitted:
$INC3_i = INC2_i$, $E2_i = 9999$

The software also requires an average price per MWh for a genset operating at each Elbow Point and also at its Genset Spot GOAL Availability (XG_{ij}), according to the rules of Table 1:

	$XG_{ij} = 0$	$0 < XG_{ij} \leq E1_i$	$E1_i < XG_{ij} \leq E2_i$	$E2_i < XG_{ij}$
$GAP1_{ij}$	9999	9999	$INC1_i + \frac{NL1_i}{E1_i}$	$INC1_i + \frac{N}{E}$
$GAP2_{ij}$	9999	9999	9999	$INC2_i + \frac{N}{E}$
$GAP3_{ij}$	0	$INC1_i + \frac{NL1_i}{XG_{ij}}$	$INC2_i + \frac{NL2_i}{XG_{ij}}$	$INC3_i + \frac{N}{X}$

For any given MW level, the Genset Table A Price (TAP_{ij}) is set at the minim of $GAP1_{ij}$, $GAP2_{ij}$, $GAP3_{ij}$.

Table 1 - Determination of Genset Table A Price

9 PORTHOLE

As mentioned in 6.6, PORTHOLE is an interface which allows the transfer of operational information from the Grid Operator to the SSA and Ancillary Services Provider.

9.1- Not used 9.3

9.4 Audit and Maintenance of Recording

The SSA must comply with Agreed Procedures regarding PORTHOLE records and manual logs.

9.5 Variables Derived from PORTHOLE Output

This subsection refers forward to a variable list in Appendix 5. Essentially, these variables are those from the Generator's Day Ahead Offer File plus the spot values every half hour for generation, reserve and availability evaluated in Settlement GOAL, or default values, where applicable.

10 TABLE A PERIODS AND TABLE B PERIODS

Taking the Unconstrained Schedule overall, it may be cheaper to instruct a number of gensets to reduce output for a few hours, and then to increase output when demand rises, than to order a smaller number of gensets to shut down and start up

again later. Indeed, it may not be possible for some gensets to stop and start in this manner.

Because of this there are periods, usually of low demand, when there is plenty of spare genset capacity, and others, nearer to demand peaks, when there is less. The latter periods are called Table A Periods.

In Table A Periods the fixed costs from a genset's entire period of continuous running within the Schedule Day contribute towards its Genset Price. These are any start-up cost and its accumulated no-load cost (sum over time of appropriate no-load prices). No-load prices were explained in 6.3, with the related graph of the Willans Line in Figure 4.

Table B Periods occur when there is national Spare Capacity of over 1000 MW, compared to a defined value at the related peaks. 10.4 defines a maximum number of such periods. The Genset Price is set at its marginal cost - its incremental offer price. There are two reasons for this. Firstly, to meet a known peak, gensets often need to be started well before that peak in order to run up, so the Table A/B system permits a fairer system of allocating costs close to the periods which give rise to them. Secondly, by producing lower prices when there is plenty of national spare capacity, it encourages demand at those times.

10.1 Definition

Each Settlement Period is either a Table A or a Table B Period, using the rules given later in this section.

10.2 Peaks, Troughs and Trough Periods

Peaks and troughs are Settlement Periods which lie at minima or maxima of the demand shape. A Trough Period is a number of Settlement Periods between, and generally including, two demand peaks.

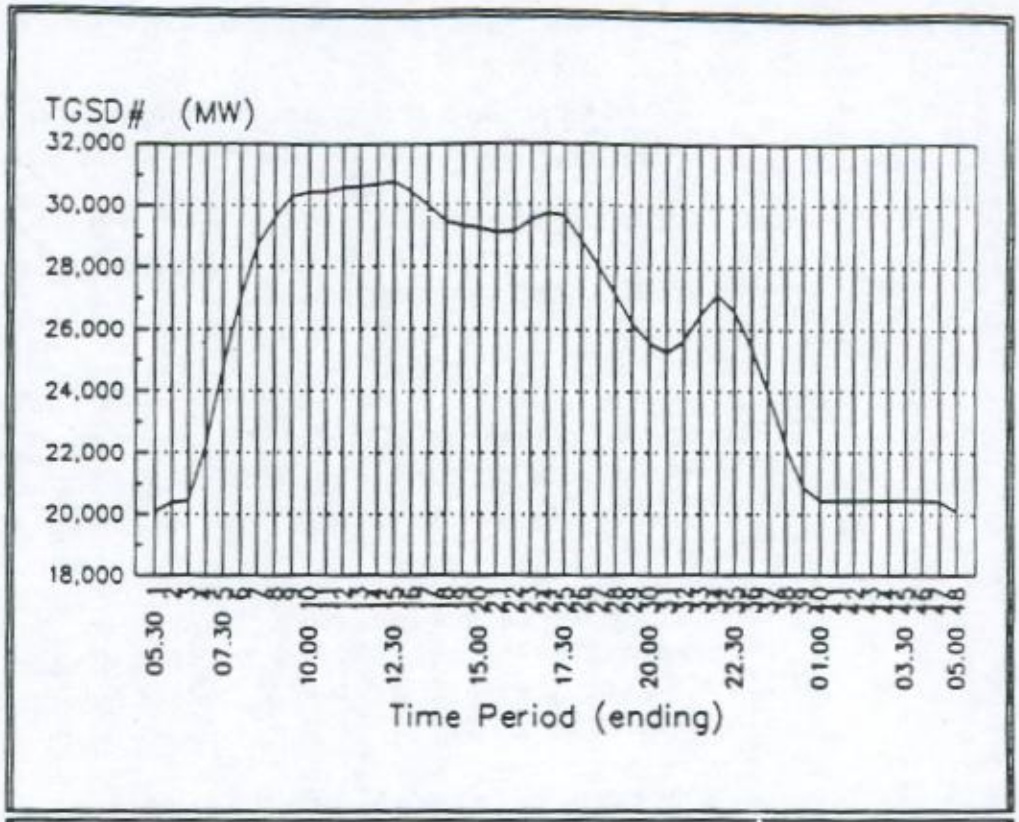


Figure 5 - Forecast Demand: Schedule Day Thursday 28 May 1992

Scheduled Capacity

For each Settlement Period this is the scheduled Unconstrained Generation and Reserve summed over all gensets:

$$\text{Scheduled Capacity } \underset{\text{MWh}}{D_j} = \Sigma_i (U_{ij} + UR_{ij})$$

Identification of Peaks and Troughs

The first and last periods of the Schedule Run are peaks if greater than the adjacent period in the Schedule Day, otherwise they are undefined. Schedule Run has the same meaning as ADP.

Other Settlement Periods are classed as peaks if Scheduled Capacity reaches a maximum, in other words:

$$D_{j-1} < D_j \geq D_{j+1}$$

or troughs if Scheduled Capacity reaches a minimum, ie

$$D_{j-1} \geq D_j < D_{j+1}$$

It should be noted that a peak or trough consisting of two equal and adjacent values will designate the first period as the peak or trough.

In the graphical example of Figure 5 troughs occur at periods 1, 21, 31 and 48. Forecast Demand TGSD#$_j$ in MW is plotted here rather than D_j in MWh, but they are very closely related.

Definition of Trough Periods

The periods from the start of the Schedule Run to first peak and the periods from the last peak to the end of the Schedule Run are defined as Trough Periods, regardless of whether the first and last periods are peaks themselves.

Other Trough Periods run from one peak to the next. Minor peaks, unofficially called "humps", which relate to falls of under 500 MW/ 250 MWh, are ignored. The 500 MW figure is formally called the Peak Trough Tolerance (PTT).

Using the example of Figure 5, there is a hump at period 10 which is ignored, as the fall to trough at period 11 is only 19 MW. In the example Trough Periods are thus from sometime before 05.00 hrs (off the graph) to period 15, 15-24, 24-34, 34-off graph. Note that Trough Periods overlap at the peaks.

If no peaks of sufficient size have been identified throughout the Schedule Run then the entire Schedule Run is treated as one Trough Period.

10.3 Spare Capacity of Table B Active Plant

Gensets scheduled at the trough Settlement Period of the Trough Period are termed "Table B Active". This is irrespective of whether the trough is subsequently labelled Table A or Table B.

A national total of Genset Spare Capacity (SC_{ij}) is determined for Table B Active sets at each Settlement Period in the Trough Period. Its value is their total availability minus scheduled generation and reserve. Appendix 7 Section 6 contains an additional condition to the determination of SC_{ij}, which will be implemented from the start of Phase 3.3.

The Period Residual PR_v represents the minimum value of the national spare capacity at the adjacent peaks associated with a Trough Period. PR_v is set at zero if no qualifying peak has been identified.

10.4 Table B Periods Identified

If the national spare capacity of the Table B Active gensets in a Settlement Period is more than 1000 MW greater than Period Residual PR_v associated

with that Trough Period, then the Settlement Period is designated a Table B Period, subject to limits below. The 1000 MW figure is formally called the Table B Trigger (TBT).

All other periods are Table A. The Table A/B indicator (TBI_j) is set at A or B as a record as settlement payments are calculated in different ways accordingly, as outlined in the introduction to this section.

Maximum Number of Table B Periods

The maximum number of hours of Table B for three period of the Schedule Run are called Table B Hours 1/2/3 respectively in the rules. The period maxima are:

Time span 21.00 (start of the Schedule Run) to 05.00 hrs, only 7 B Periods out of 16 allowed.
Time span 05.01 to 05.00 hrs, only 20 B Periods out of 48 allowed.
Time span 05.01 to 12.00 hrs (end of Schedule Run), 5 B Periods out of 14 allowed.

If the initial calculations produce more than the allowed number of Table B periods in any of the time spans, the Table B Period associated with the minimum margin of spare capacity above the Period Residual at the associated peaks is changed to Table A. The process is repeated until the number of Table B Periods is within the required range.

11 DECLARED INFLEXIBILITY

A genset may be declared or redeclared as inflexible, that is either unable to shut down, or required to generate at or above a given level. There are three types of inflexibility.

11.1 Definition of Inflexibility

Refers forward to 11.2 and 11.5.

11.2 Genset Inflexibility Flags

Two-Shifting Limit

In the production of operational schedules, Two-Shifting Limit TSL_i indicates how often a genset is able to shut down between daily peaks. In settlement, a genset that declares zero Two-Shifting Limit is considered inflexible and unable to shut down in the relevant ADP. The name arose in CEGB days, relating to gensets shut down during the night shift.

The Genset Declared Two-Shifting Indicator ($GIDS_i$) is set to 1.

Equal (EQ)

This means that the genset is inflexible and must operate at the specified level of output between two specified times.

The Genset Declared Inflexibility Indicator ($GIDG_{ij}$) is set to 1, for all Settlement Periods in any continuous run in the Unconstrained Schedule for which the condition applies, even if only for one minute.

Greater Than or Equal To (GE)

This means that the genset must operate at or above the specified level of output between specified times. If this level is above zero MW, the genset is inflexible, however an inflexibility declaration of GE zero MW is a declaration of flexibility.

$GIDG_{ij}$, is set to 1 in the same manner as for an EQ inflexibility.

11.3 Redeclared Inflexibility Indicators

For a redeclaration of zero Two-Shifting Limit, the genset is considered inflexible from the notification time until the Settlement Period immediately preceding the period in which the genset is redeclared flexible or it desynchronizes.

The Genset Redeclared Two-Shifting Indicator ($GIRS_{ij}$) is set to 1 when inflexible in this way.

For a redeclaration of EQ or GE inflexibility, the genset is considered inflexible from the start of the period of continuous running in which the redeclaration lies.

The Genset Redeclared Inflexibility Indicator ($GIRG_{ij}$) is set to 1. However, it is not extended back beyond the notification time of the inflexibility.

Also for all three types of inflexibility, the inflexibility may be extended beyond this period until the genset either desynchronises, or runs-up or runs at a constant level above the Minimum Generation MG_i. This reflects the fact that the effect of an inflexibility extends beyond the period of that inflexibility, due to the treatment of its start up costs within the scheduler.

Currently the Grid Operator uses "minute beginning" times and settlement uses "minute ending", so for settlement purposes one minute is added to the redeclaration start times commencing on the hour and half hour.

If the end time of a redeclaration is not given or an end time beyond the end of the next Schedule Day is specified, the end time is reset to the end of the next Schedule Day.

The Day Ahead Offer File may contain different declarations of inflexibility for the overlap minutes 21.01 hrs - 05.00 hrs, but these are not currently considered to constitute a redeclaration.

11.4 Not used

11.5 Deemed Inflexibility

If a genset has been scheduled to run in the Unconstrained Schedule for more than two hours and is running up or down at its maximum rate in a Settlement Period, it is considered inflexible for that period. Inflexibility is also deemed if it is run at or below its Minimum Generation (MG_i) both at the beginning and end of a Settlement Period.

A Genset Inflexibility Indicator (GII_{ij}) is set to I (for inflexible) or F (for flexible) accordingly.

11.6- Genset Run-Up and Run-Down Times
11.7

These are the calculations required in the determination of deemed inflexibility in 11.5. Note that the Run-Up and Run-Down times are the declared values used in settlement, and may be different from the redeclared values used by the Grid Operator.

12 SYSTEM MARGINAL PRICE

Broadly speaking, SMP_j for each Settlement Period is a price derived from the marginal genset scheduled in the Unconstrained Schedule, in other words the most expensive flexible genset required. The calculation is different depending upon whether the period is Table A or Table B. Gensets which are inflexible cannot set the price above zero.

12.1 Genset Unconstrained Prices

The Genset Unconstrained Incremental Price ($INCU_{ij}$) and Genset Unconstrained No-Load Price (NLU_{ij}) are effectively evaluated from the offer prices submitted under 6.3. Knowing Genset Unconstrained Generation (U_{ij}) from 8.2, an appropriate intersect on the Willans Line can be found, and the incremental and no-load prices of 8.3 used.

If a genset starts ($V_{ij-1} = 0$ and $V_{ij} > 0$) then a Genset Unconstrained Start-Up Price (SUU_{ij}) is paid, equal to SU_i from the Day Ahead Offer File.

If $U_{ij} = 0$, then $NLU_{ij} = 0$ and $INCU_{ij} = INC1_i$, other than for the determination of Genset Price and Adjusted Genset Price, where $INCU_{ij} = 0$ is used.

12.2 Genset Actual Prices

If a genset is not scheduled in a Settlement Period the Genset Price (GP_{ij}) is set at zero.

Otherwise, in a Table B Period, GP_{ij} (units £/MWh) is set at $INCU_{ij}$ only, for reasons discussed in Section 10.

In a Table A Period the price includes the other elements of the genset's offer price, namely its start-up price and the other fixed element of its price - the no-load price. The start-up and the accumulated no-load price for a time of continuous running within a particular ADP are allocated across all the Table A Periods in that time. These prices are allocated to each Table A Period in proportion to output in that period.

Algebraically for Table A:

$$GP_{ij} = INCU_{ij} + \sum_{End}^{Start} [(NLU_{ij} * SPD) + SUU_{ij})] \; / \; \sum_{A\ End}^{A\ Start} (U_{ij} + UR_{ij})$$

£/MWh

Start and End refer to the continuous running time above, and A Start and A End refer to all Table A Periods between Start and End.

Consider an example of a genset with Day Ahead Offer File prices:

- Start-up £1000
- No-load £50/h
- Incremental £15/MWh

This genset has an Offered Availability of 200 MW and is scheduled in the Unconstrained Schedule to generate as shown in Figure 6. The shaded areas in the diagram indicate Table A Periods.

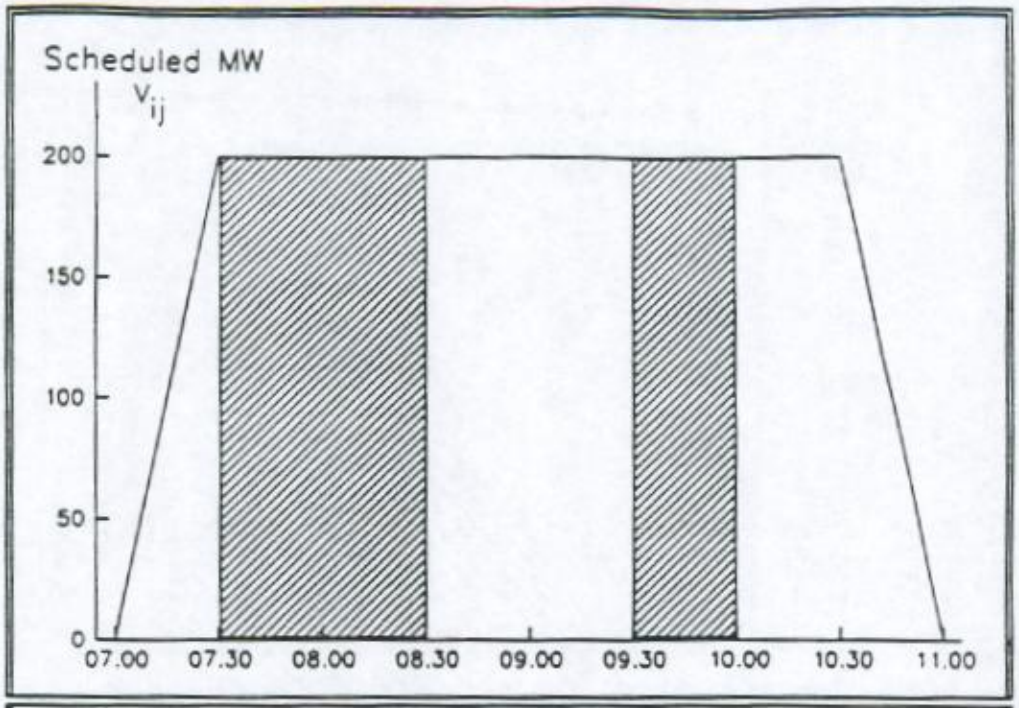


Figure 6 - Genset price example

In the Table B Periods, ie Settlement Periods 07.30, 09.00, 09.30, 10.30 and 11.00 hrs, the Genset Price is the same as the genset's incremental price, ie £15/MWh. In the Table A periods, the start-up price and 4 hours of no-load price need to be recovered. This recovery takes place over

200 * 1.5 = 300 of Table A output
MW h MWh

Thus the Table A price for Settlement Periods 08.00, 08.30 and 10.00 hrs is set to:

[1000 + (4 * 50)] /300 + 15 = 19
£ h £/h MWh £/MWh

12.3 Adjusted Genset Price

The determination of Genset Price above in a Table A Period involves allocation of the start-up and no-load costs across all output in Table A Periods in a continuous run. If a genset is set to pulse - ie to start in one period and shut down in the next - then if one or both of these periods are Table A Periods the entire start-up price will be allocated over, at most, two periods. This was felt to give an incorrect price signal, and the Adjusted Genset Price AGP_{ij} is used.

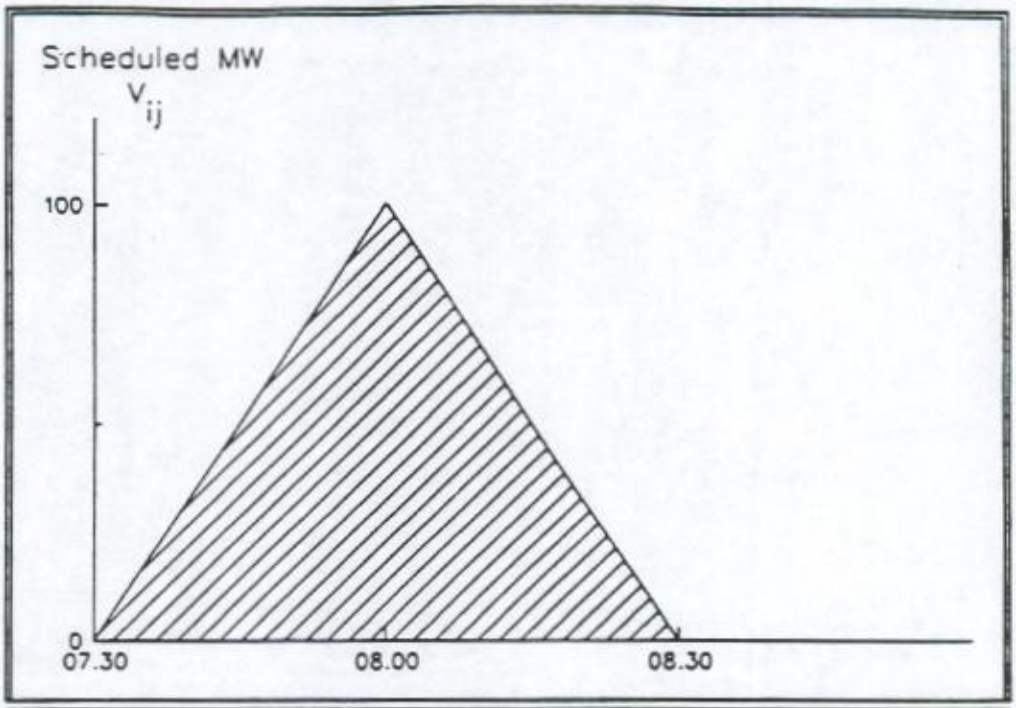


Figure 7 - Genset scheduled to pulse

The shaded area indicates the low average output over which the start-up and no-load prices are allocated.

If we consider the same genset example used in 12.2 and say that GOAL schedules it only at 08.00 hrs for 100 MW of generation, then the total output in Table A periods is:

$$0.5 \text{ h} * 100 \text{ MW} = 50 \text{ MWh}$$

If unadjusted this would set a Genset Price for Settlement Periods 08.00 hrs and 08.30 hrs of:

$$[1000 \text{ £} + (50 \text{ £/h} * 1 \text{ h})] / 50 \text{ MWh} + 15 = £36/\text{MWh}$$

If a flexible genset has been scheduled in this way, and is operating below the most economical point at which it can run - the Table A Capacity (TAC_{ij}) - AGP_{ij} is calculated as if the genset had been scheduled to run at its Table A Capacity for one hour. If the adjusted price is lower than the unadjusted, the lower value is used in the determination of System Marginal Price below. In all other cases, including gensets for which AGP_{ij} has not been determined, AGP_{ij} is set equal to GP_{ij}.

Continuing the example, if we are told that the Table A Capacity is the same as offered availability, 200 MW, the output used in the calculation of SMP_j is:

$$\underset{\text{MW}}{200} * \underset{\text{h}}{1} = \underset{\text{MWh}}{200}$$

This gives a price for SMP_j calculation

$$[\underset{\text{£}}{1000} + (\underset{\text{£/h}}{50} * \underset{\text{h}}{1})] / \underset{\text{MWh}}{200} + 15 = \text{£}20.25/\text{MWh}$$

(rather than £36/MWh first calculated above).

12.4- Genset Stack Price and System Marginal Price
12.5

For each Settlement Period the appropriate prices as evaluated above for all flexible gensets are placed in increasing price order, called Genset Stack Price (SP_{ij}) which is set equal to AGP_{ij}. The price of the most expensive genset is taken as SMP_j. Inflexible gensets are included at the bottom of the stack by setting SP_{ij} at zero.

SMP_j is capped at Value of Lost Load (VLL).

12.6 Marginal Set Adjustment

Generally, a genset which is flexible and scheduled in the Unconstrained Schedule will be expected to cover at least its costs, as measured by its offer price, over the Schedule Day, because SMP_j is set to the Genset Price of the most expensive flexible genset in each Settlement Period. The Marginal Set Adjustment is one of two additional payments covering the possible situations in which this may not occur. The other situation is Table B Start-Up, which is covered in Section 20.2.

The Marginal Set Adjustment is made to gensets whose operating costs have not been recovered through SMP_j, ie $GP_{ij} > SMP_j$, because of the operation of the Adjusted Genset Price for "pulsing" gensets (12.3). It represents payment for the difference, including reserve. Note however that the Genset Revised Unconstrained Generation $W_{ij} > 0$.

$$\underset{\text{£}}{MSA_{ij}} = (\underset{\text{£/MWh}}{GP_{ij}} - AGP_{ij}) * \underset{\text{MWh}}{(U_{ij} + UR_{ij})}$$

13 POOL PRICES AND PAYMENTS

The prices calculated from the Day Ahead Offers as above are combined with actual energy and availability (calculated in 16.8 in what is called the Revised Unconstrained Schedule) to calculate payments to generators.

13.1 Pool Purchase Price

Defined as:

PPP_j	=	SMP_j	+	$LOLP_j$	*	(VLL - SMP_j)
£/MWh		£/MWh		Number		£/MWh

SMP_j comes from 12.5 above, and $LOLP_j$ * (VLL - SMP_j) is known as the capacity element.

Loss of Load Probability $LOLP_j$ comes from 21.6.
Value of Lost Load VLL to 31 March 1994 is £2345/MWh.

The following example (rounded to four figures) is taken from 17 February 1992, Settlement Period 18.30 hrs:

SMP_j	= £24.57/MWh
$LOLP_j$	= 0.001 960
PPP_j	= 24.57 + 0.001 960 * (2187 - 24.57)
	= £28.80/MWh

This occurred with availability for GOAL purposes 52 605 MW, reserve 892 MW and Forecast Demand $TGSD\#_j$ of 43 610 MW. VLL at that date was £2187/MWh.

$LOLP_j$ (and thus capacity element) is generally much lower in summer and at weekends, and often zero at times of lowest demand. The daily variation is shown well in Figure 11, a graph in section 21.

13.2 Pool Reserve Price

Reserve is paid for at PPP_j less the genset's incremental cost, to reflect the cost saving brought about by being constrained to operate at a lower level of output while holding reserve:

PRP_{ij}	=	PPP_j	-	$INCU_{ij}$	(or zero if < 0).
£/MWh		£/MWh		£/MWh	

13.3 Payment for Energy: Non-Centrally Despatched Generating Units

The Genset Non-Despatch Payment GNY_{ij} comprises the only payment to which such plant is entitled. It is based on Metered Generation:

$$GNY_{ij} = PPP_j * A_{ij}$$
£ £/MWh MWh

13.4 Payment for Energy: Centrally Despatched Generating Units

The Genset Unconstrained Energy Payment EP_{ij} is based on W_{ij}, its Genset Revised Unconstrained Generation, calculated in 16.8. The Energy Payment can be an important part of a generator's income.

$$EP_{ij} = PPP_j * W_{ij}$$
£ £/MWh MWh

13.5 Payment for Reserve: Centrally Despatched Generating Units

The Genset Unconstrained Reserve Payment RP_{ij} is based on WR_{ij}, Genset Revised Unconstrained Reserve (16.8):

$$RP_{ij} = PRP_{ij} * WR_{ij}$$
£ £/MWh MWh

14 REVISED UNCONSTRAINED SCHEDULE AND TRANSMISSION CONSTRAINTS

Certain prices, costs and payments have to be adjusted for differences between its Metered Generation and that scheduled in the Revised Unconstrained Schedule, the basis for all other payments. This difference may be caused by:

- Transmission constraints which require a genset to operate at a different output from the level in the Unconstrained Schedule, for reasons such as limits to the capacity of the network, or planned grid maintenance
- Differences between forecast and actual demand, which require the Grid Operator to instruct gensets to operate at different output levels from those planned
- Differences between Actual and Redeclared Availability
- Differences between actual and instructed output
- The operation of Non-Centrally Despatched Generating Units
- Transmission losses
- Station Demand.

14.1 Genset Revised Prices

The Willans Line procedure detailed in 12.1 is repeated, except that acronyms have letter W instead of letter U. W_{ij} from the Revised Unconstrained Schedule is used to derive variables $INCW_{ij}$, NLW_{ij} and SUW_{ij}.

14.2 Genset Revised Unconstrained Cost

This only applies if the Over-Scheduled Indicator (OSI_j) as calculated by GOAL (4.2 of Appendix 2 of the Pool Rules) is set to zero.

$$\underset{£}{CW_{ij}} = (\underset{£/MWh}{INCW_{ij}} * \underset{MWh}{W_{ij}}) + (\underset{£/h}{NLW_{ij}} * \underset{½h}{SPD}) + \underset{£}{SUW_{ij}}$$

If scheduled gensets and Small Independent Generating Units in the Unconstrained Schedule exceed Forecast Demand and scheduled reserve by more than 100 MW, OSI_j is set to 1 and:

CW_{ij} is set to zero if $W_{ij} > 0$ and $A_{ij} = 0$

The total is summed over the Schedule Day.

14.3 Genset Metered Prices

Once again the Willans Line calculation detailed in 12.1 is employed, except that acronyms have letter A instead of letter U. From Genset Metered Generation (A_{ij}) variables $INCA_{ij}$ and NLA_{ij} are derived.

If Metered Generation starts in a period, $SUA_{ij} = SU_i$, otherwise it is zero.

14.4 Not used

14.5 Genset Metered Cost

The Genset Metered Cost (CA_{ij}) is defined as:

(a) $$\underset{£/MWh}{[INCA_{ij}} * \underset{MWh}{\min (XD_{ij}, A_{ij})}] + (\underset{£/h}{NLA_{ij}} * \underset{½h}{SPD}) + \underset{£}{SUA_{ij}}$$

or, in the event of a genset which is redeclared inflexible, the minimum of (a) above and

(b) CW_{ij} from 14.2.

The total is summed over the Schedule Day. Condition (b) is included to prevent a generator increasing its payments by redeclaring a genset as inflexible, to run when it would not otherwise have done so.

14.6 Genset Metered Payment

The Genset Metered Payment OP_{ij} is made to adjust a genset's payments (up or down) for differences between its Metered Generation and that scheduled in the Revised Unconstrained Schedule, for reasons given at the

beginning of this section. The payment is totalled across the Schedule Day and apportioned equally to all the Settlement Periods of that Schedule Day:

$$OP_{ij} = (\Sigma_j CA_{ij} - \Sigma_j CW_{ij}) * SPD/SCD$$

Metered Payments are only significant when a set is constrained off (negative) or when it remains flexible and generates in excess of the amount scheduled (positive).

15 MAXGEN

15.1- Not used 15.5

15.6 MaxGen Payment

The Grid Operator may, by agreement with the generator, instruct a genset at short notice to generate beyond its normal operating range. This is often possible at an additional cost, by means such as bypassing feed heaters, which reduces efficiency. This instruction is called a MaxGen Instruction, and a log is kept by the Grid Operator and passed to the SSA. When used, MaxGen Instructions are often issued simultaneously to several power stations in order to meet specific unexpected system requirements.

For Settlement Periods in which such instructions are started, are in place, or end, output above current Redeclared Availability is paid at the Genset MaxGen Price (MP_i).

16 AVAILABILITY

We have already seen in 6.1 and 6.2 how availability of a genset in MW is offered and reoffered for each minute. This section shows how actual genset characteristics are handled, and how redeclared and actual availability are assessed for the Revised Unconstrained Generation and Reserve used in settlement.

16.1- Not used 16.2

16.3 Availability Profiling

Availability is offered and reoffered in the form of step changes, but genset operating characteristics prevent these step changes being achievable. In order to make this availability consistent with potential generation it is profiled to take some account of these constraints and then converted from MW to MWh. The rules show the evaluation in mathematical form.

The profiling, as shown in figure 8, is done by calculating the maximum potential generation of the genset, assuming that:

- It synchronised at its standard synchronising load
- It ran for the entire time it was available
- It increased and decreased its output at the standard run-up and run-down rates
- It decreased its output as late as possible (in order to avoid exceeding new lower availability).

These standard rates are held as Standing Data for each genset under 2.2 and are changed infrequently. They are changed by written request to the SSA, no later than the time of the Day Ahead Offer. They may differ from the operating characteristics specified as part of the Day Ahead Offer File under 6.1. The value of Genset Registered Capacity (GRC_i) is held as Standing Data under 2.2; it represents the maximum capability of that genset. Any offer or reoffer of availability is capped at this level before being profiled.

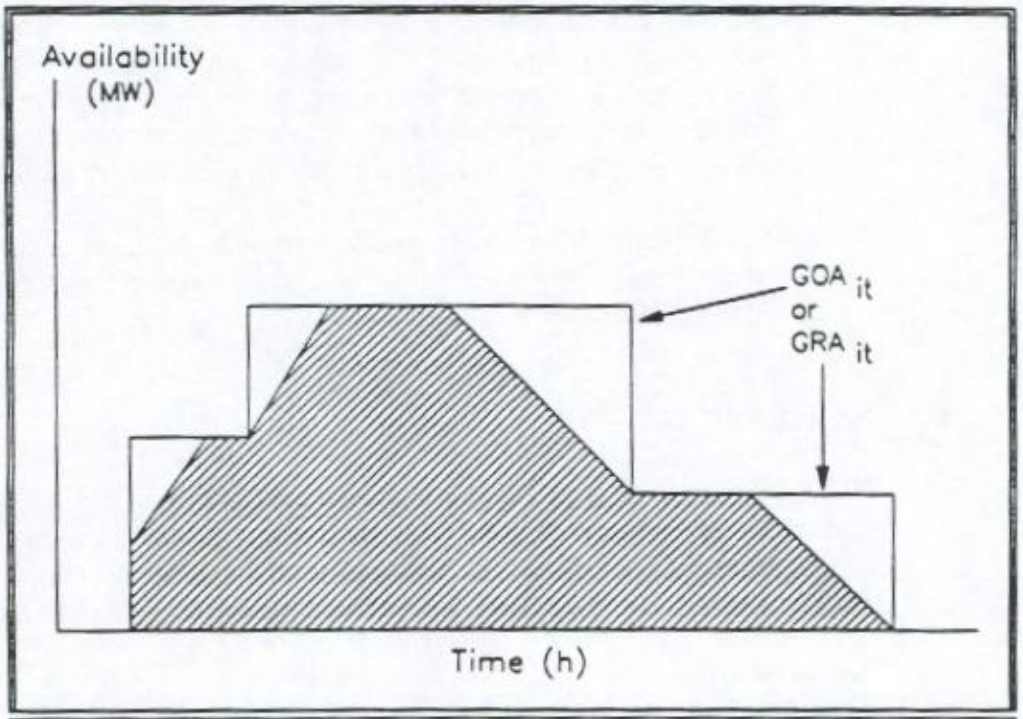


Figure 8 - Profiled Availability

16.4 Genset Declared and Redeclared Availability

The spot values of availability in MW from the Day Ahead Offer (GOA_{it}) are profiled by minute as above, and then integrated by Settlement Period

to give MWh values, called Genset Declared Availability (XA_{ij}). These are used to calculate availability payments.

Note that step changes in XA_{ij} may occur at Schedule Day boundaries where extracts from separate offers occur in adjacent half hour periods.

Reoffers of availability are also profiled using a similar method, except that this is only carried out for the Schedule Day, not the 39 hour ADP. The result is the Genset Redeclared Availability (XD_{ij}) in MWh. It is used in compilation of Genset Revised Unconstrained Generation (W_{ij}), as described in 16.8.

Note that the run-downs are profiled back in time, but a reoffer applying shortly after 05.00 hrs is not processed backwards over a Schedule Day boundary. For example, a set offered at 500 MW which reoffers to zero at 05.05 hrs will still be credited with XD_{ij} of 250 MWh for 04.31 - 05.00 hrs, even though the rundown may in reality have needed more than five minutes.

16.5 Genset Failure, Actual and Redeclared Availabilities

Failure for settlement purposes occurs if a genset fails to synchronise within five minutes of the time instructed by the Grid Operator, or desynchronizes (trips) without notice or certain defined reasons. An entry is made in the genset failure log supplied to the SSA and a Genset Failure Indicator (GFI_{ij}) is set. Detailed notes are available in Pool Circular 011, obtainable from the CEO (see page 75).

Reasons for not logging a GFI include instruction from the Grid Operator, or a trip resulting from a fault affecting the NGC Transmission System or a distribution system, where desynchronisation is necessary under the Grid Code or a Distribution Code. Trips due to certain faults on the NGC grid or a REC distribution system will not result in a GFI.

For the purposes of calculating generator payments a perceived availability for each genset is determined. This is called Genset Actual Availability (XP_{ij}), which is colloquially referred to as the "proven availability". It is obtained by considering the availability as offered and reoffered, and the genset's Metered Generation (A_{ij}).

Under normal running conditions XP_{ij} is set equal to Genset Redeclared Availability (XD_{ij}). However, when a genset fails, XP_{ij} is reset to zero for the Settlement Period in which the failure occurs. As a number of major payments are capped by XP_{ij} it is essential that the best possible levels are restored as quickly as possible, according to the variable values of Table 2 below.

Reproving a genset involves resetting its Genset Maximum Actual Availability (XMP_{ij}), which is generally the maximum value of Metered Generation (A_{ij}) following the failure. XMP_{ij} may be thought of as a "ratchet", as it can only fall lower if there is another failure but will rise as the genset reproves its availability. This reproving continues until A_{ij} reaches a level at which the genset is deemed capable of normal running. This is the Genset Maximum Redeclared Availability (XMD_{ij}), which is set to the Genset Redeclared Availability (XD_{ij}) prior to the period of the failure, which can be thought of as a "target" availability level.

	Normal running	Time of failure ($GFI_{ij} = 0$)	Reproving
XMP_{ij}	GRC_i	0	max [XMP_{ij-1}, min (XD_{ij}, A_{ij})]
XMD_{ij}	XD_{ij}	max (XMD_{ij-1}, XD_{ij})	max (XMD_{ij-1}, XD_{ij})
XP_{ij}	XD_{ij}	0	min (XMP_{ij}, XD_{ij})

Table 2 - Values of variables whilst reproving a genset

XMD_{ij} and XMP_{ij} relative to the first Settlement Period of a Schedule Day are taken from the last period of the previous Schedule Day. If no such values exist defaults are specified in 1.3:

$XMD_{ij} = 0$ and $XMP_{ij} = GRC_i * SPD$

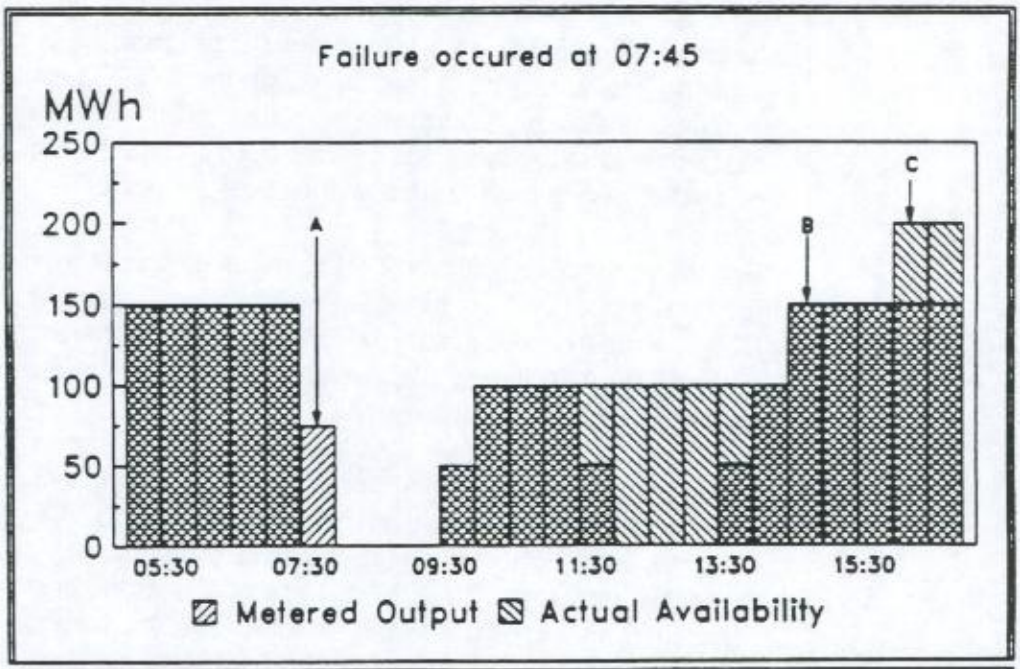


Figure 9 - Genset Actual Availability

As an example: in Figure 9 a genset with Registered Capacity (GRC_i) of 500 MW is running with Redeclared Availability (GRA_{it}) of 300 MW, giving XD_{ij} and XMD_{ij} of 150 MWh prior to a failure in Settlement Period A. In this period XP_{ij} is set to zero even though Metered Generation (A_{ij}) is positive.

Settlement Period B is when A_{ij} reaches 150 MWh per Settlement Period and the genset is deemed capable of normal running. In Settlement Period C availability is redeclared higher and the Actual Availability tracks this.

16.6- Not used
16.7

16.8 Revised Unconstrained Schedule

The Unconstrained Schedule is adjusted to take account of Redeclared and Actual Availability above, so that the Energy Payment derived from them reflects any revisions which occurred on the day.

In most cases a simplification applies:

$$W_{ij} = \min (U_{ij}, XP_{ij})$$

More complex rules apply when Genset Unconstrained Reserve (UR_{ij}) is involved, and Genset Revised Unconstrained Reserve (WR_{ij}) has to be determined. If $XD_{ij} < U_{ij} + UR_{ij}$ then firstly reserve, then generation values, as above, are reduced until $W_{ij} + WR_{ij} = XD_{ij}$.

If $XP_{ij} < XD_{ij}$ then firstly generation, then reserve values are reduced by the shortfall until $W_{ij} + WR_{ij} = XP_{ij}$.

Finally if the genset generated in the period then W_{ij} will not be set below the level of generation A_{ij}.

17 PAYMENTS FOR AVAILABILITY

Payments for non-zero Genset Declared Availability (XA_{ij}) not scheduled for generation or reserve in the Revised Unconstrained Schedule are based on Actual Availability, as shown in Figure 10.

The payment is to encourage generators to make plant available beyond that necessary to meet demand, to cover for breakdowns, demand beyond expected, etc. It is weighted towards lower cost gensets which could well be of use, and is based on costs incurred if the availability were used in full.

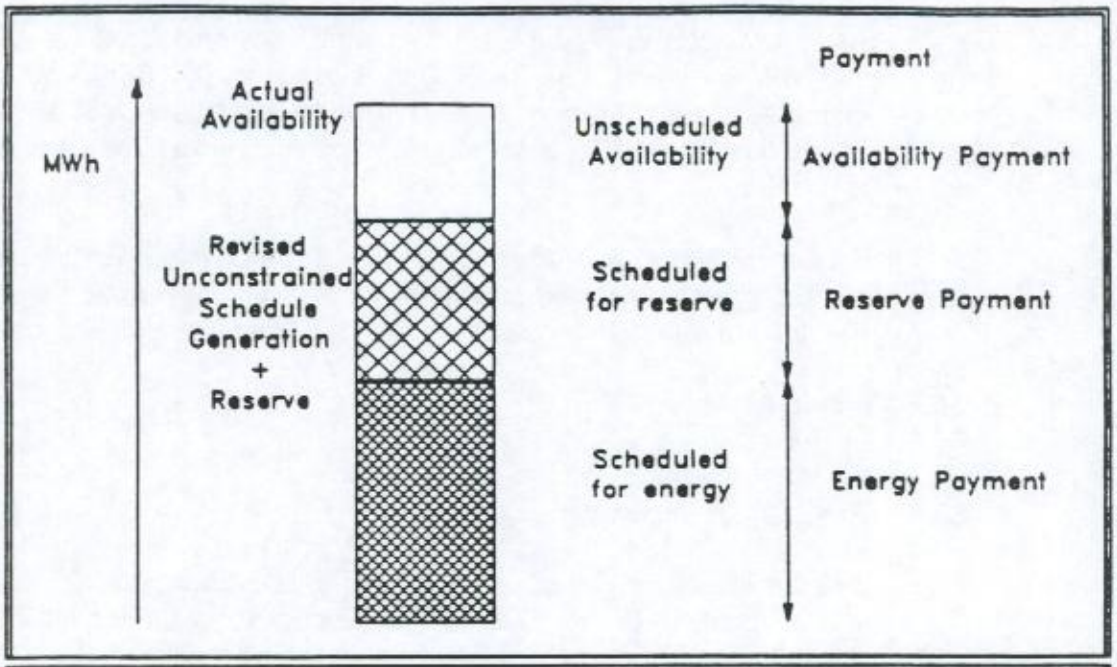


Figure 10 - Payments from the Revised Unconstrained Schedule

17.1 Genset Declared Prices

Using the Willans Line calculation of 12.1, prices are evaluated at the level of XA_{ij}, substituting acronyms XA for U, INCXA for INCU, and NLXA for NLU. A start-up payment of SU_i is allocated to the first Settlement Period of the Schedule Day in which XA_{ij} is non-zero. Acronym $SUXA_{ij}$ is used. It is also allocated to any subsequent availability start-ups, where $XA_{ij-1} = 0$ and $XA_{ij} > 0$.

17.2 Genset Availability Cost

Availability Periods for gensets are defined in the rules to cover time spans of whole Settlement Periods when positive availability is continuously offered. Note that the availability period in this context is different from the 39 hour Availability Declaration Period (ADP).

The Genset Availability Cost (CC_{ij}) is assessed by Settlement Period using the component costs of 17.1, on the basis of cost at full availability.

$$\underset{£}{CC_{ij}} = \underset{£/MWh}{(INCXA_{ij}} * \underset{MWh}{XA_{ij})} + \underset{£/h}{(NLXA_{ij}} * \underset{½h}{SPD)} + \underset{£}{SUXA_{ij}}$$

CC_{ij} is summed over the availability period as defined here to form the Genset Total Availability Cost (TCC_{in}). It is used in calculation of Genset Bid Price below.

17.3 Genset Bid Price

Genset Bid Price BP_{ij}, units £/MWh, is set at the total cost of each availability period, TCC_{in} above, divided by the summation of XA_{ij} in MWh over the same availability period.

For $XA_{ij} = 0$ no availability period exists and BP_{ij} is set at zero.

17.4 Genset Availability Payment

Genset Availability Payment AP_{ij} is defined by:

$$\underset{\pounds}{AP_{ij}} = \underset{\substack{MWh \\ \text{(minimum of zero)}}}{(XP_{ij} - W_{ij} - WR_{ij})} * \underset{\substack{Number \\ \{ \text{ minimum of zero } \}}}{\{LOLP_j} * \underset{£/MWh}{[VLL - \max (BP_{ij}, SMP_j]\}}$$

It can be seen that payments are highest to gensets potentially of use, with prices below or close to SMP_j. Revised Unconstrained Generation and Reserve are paid elsewhere and thus deducted from XA_{ij} in the calculation, as shown in Figure 10.

18 OVERGENERATION AND UNDERGENERATION

Not used at present (see Annex).

19 AVAILABILITY TESTING

Not used at present (see Annex).

20 MAXGEN PAYMENT AND TABLE B START-UP ADDITION

Section 20 covers two cases of additional payments to Generators.

20.1 Genset MaxGen Payment

Called GMP_{ij}, and received for all generation above XD_{ij} when a MaxGen instruction applies (15.6). Generators offer a MaxGen Price and the power, in MW, that they are able to make available (6.3). There is no penalty if generation does not exceed XD_{ij} during a MaxGen instruction.

$$\underset{\pounds}{GMP_{ij}} = \underset{£/MWh}{MP_i} * \underset{MWh}{(A_{ij} - XD_{ij})}$$

MP_i is the Genset MaxGen Price submitted in the Day Ahead Offer File. The payment cannot be less than zero.

20.2 Genset Table B Start-Up Payment

Generally, a genset which is flexible and scheduled in the Unconstrained Schedule will be expected to cover at least its costs, as measured by its offer price, over the Schedule Day. We have already seen in 12.6 (Marginal Set Adjustment) one special payment where this is not so. This sub-section covers the other case.

This payment is called TBP_{ij}, and is made when a flexible genset is scheduled in the Unconstrained Schedule to run only in Table B Periods. This is, of course, relatively unusual, because, as noted in Section 10, Table B Periods are periods of reduced demand relative to adjacent peaks.

In Table B Periods the cost of start-up and no-load prices are not included in SMP_j, and a genset scheduled in this way could make a loss. To avoid this, the genset's payments are calculated for each Settlement Period:

$$\underset{\text{MWh}}{(W_{ij}} * \underset{\text{£/MWh}}{SMP_j)} + [\underset{\text{MWh}}{WR_{ij}} * \underset{\text{£/MWh}}{(SMP_j - INCU_{ij})}] + \underset{\text{£}}{MSA_{ij}}$$

[minimum of zero]

These are summed for the Schedule Day and compared with the Genset Total Revised Unconstrained Cost (TCW_i) for the same Schedule Day evaluated in 14.2. If the latter is higher the difference is divided by 48, the number of Settlement Periods, to give (TBP_{ij}) for each Settlement Period.

21 LOSS OF LOAD PROBABILITY

It will be recalled from 13.1 that:

$$PPP_j = SMP_j + LOLP_j * (VLL - SMP_j)$$

The Loss of Load Probability ($LOLP_j$) in this equation is evaluated from the difference between the national availability and demand in each Settlement Period, in other words the spare unused capacity. In simple terms, the smaller the national spare capacity, the greater the value of $LOLP_j$. The historic differences between forecast and actual demand are taken into account, as well as factors ("disappearance ratios") based on historic genset performance.

The first and principal stage in the calculation of $LOLP_j$ is via PROMOD, a computer program, covered in 21.4. PROMOD requires several variables in addition to Forecast Demand, and these are defined in 21.1 to 21.3. $LOLP_j$ is derived from two intermediate variables $JOLP_j$ and $KOLP_j$. These acronyms were chosen simply as an alphabetic sequence J, K, L as the LOLP calculation progresses.

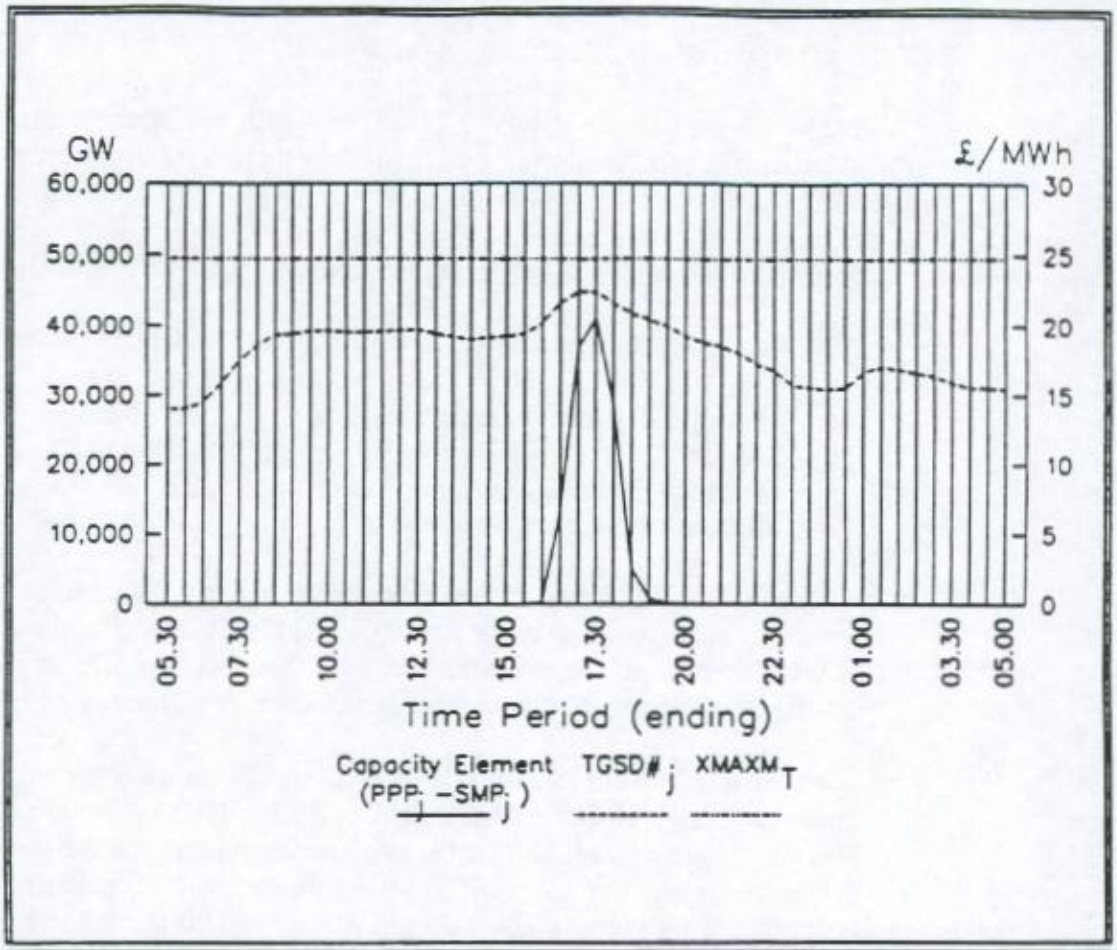


Figure 11 - Capacity Element: Wednesday 18 November 1992

21.1 Seasonal Error Allowance

Each year is divided into four Standard Seasons, starting at 05.00 hrs on the following dates:

1 March, 1 June, 1 September, 1 November.

The Executive Committee has determined a Seasonal Error Allowance (SE_S) for each Standard Season, based on the historic standard deviation of Forecast Demand ($TGSD\#_j$) (5.2) relative to actual demand for each Settlement Period. This actual demand is evaluated from national summation of Metered Generation over centrally despatched gensets.

21.2 Daily Offered and Reoffered Availabilities

These are used in the PROMOD computer program which evaluates $JOLP_j$, to provide a combination of current and historic weighting to the forecast of availability.

Maximum Offered and Reoffered Availability (DMAXO and DMAXR)

Separate acronyms are used for Daily Offered Availability in respect of:

Small Independent Generating Unit	$DMAXO_{iT}$
Range	$DMAXO_{rT}$
Interconnector	$DMAXO_{eT}$
Genset not in categories above	$DMAXO_{iT}$

A Range consists of two or more gensets supplied by a common steam source in such a way that the steam can be distributed between the gensets at the discretion of the operator (see 21.8). An option offered in 21.3.5 for a Range comprising Small Independent Generating Units is no longer used.

The Daily Offered Availability DMAXO in MW is determined. It is the maximum value of Genset Offered Availability (GOA_{it}) for the Schedule Day being considered, and values are also calculated for the seven previous Schedule Days. For ranges, GOA_{it} is summed over all gensets. Small Independent Generating Units do not offer availability, so the highest value of its expected generation as notified to the Grid Operator is used instead.

Similarly, Daily Reoffered Availability DMAXR (or more precisely $DMAXR_{iT}$, $DMAXR_{eT}$ and $DMAXR_{rT}$) is calculated, for the categories for DMAXO. DMAXR is the maximum value of Redeclared Availability (GRA_{it}) over a given Schedule Day. It is calculated for the first six days of the eight day time span above; data for the final two days is not available at the time that the value of $LOLP_j$ needs to be calculated. Inclusion of reoffers prevents artificial inflation of $LOLP_j$ by offers of zero availability followed by subsequent redeclarations to normal levels.

Maximum Availability (XMAX)

The values of DMAXO for the eight Schedule Days are compared with the six values of DMAXR mentioned, and the maximum value of the fourteen (or eight for SIGUs) is selected. This is called XMAX, Maximum Availability. Once again, separate subscripts and names are used for gensets, interconnectors and ranges, namely $XMAX_{iT}$, $XMAX_{eT}$ and $XMAX_{rT}$.

21.3 Disappearance Ratios

In general terms, Disappearance Ratios reflect genset reliability, based on historic performance relative to the levels of availability offered and reoffered by the generator. The sum of Genset Actual Availability (XP_{ij}) over a Schedule Day is divided by XMAX * SCD, and the resulting value subtracted from 1. Thus, the ideal genset has a Disappearance Ratio of zero, in that all availability offered and reoffered proves available in practice.

The main Disappearance Ratios are calculated for each Standard Season. However, newly commissioned plant is initially allocated a Disappearance Ratio of 1, and this figure is adjusted monthly to build up a more accurate figure, until sufficient data is on record to treat such plant in the standard manner.

If a Minor Independent Generating Unit - a unit within Minor Independent Generating Plant, ie non-centrally despatched, with capacity of 50 MW or less - changes its status and becomes centrally despatched it is treated as if it was newly commissioned.

There are several complications which extend this subsection to 47 pages:

- Separate variables and text apply in respect of the five categories listed in 21.2

- CDCS is based not on the Schedule Day, but the Settlement Day (to midnight). When the most recent Schedule Day is being analysed, equations specify summations for periods 1-38, that is up to the end of the Settlement Day

- Plant commissioned before 28 April 1992 enjoys transitional simplified arrangements until 1 June 1993 (21.3.1.(a)); even after that date values for such plant remain normalised against figures up to 1993/94 (sub-paragraph (ii) (E))

- Before 7 April 1992, $XMAX_{iT}$ was calculated without reference to DMAXR, so further variables are introduced in order to calculate equivalent figures for Schedule Days to 6 April 1992.

21.4 PROMOD AND JOLP

Using the variables described above, the PROMOD software is used to produce a preliminary probability for loss of load, called $JOLP_j$, for each Settlement Period based on:

- Forecast Demand $TGSD\#_j$
- Seasonal Error Allowance SE_S

- Disappearance Ratios
- Maximum Availabilities XMAX.

The settings of the software are specified and the SSA may not make any changes unless authorised by the Executive Committee.

$JOLP_j$ is the probability that Forecast Demand will not be met by the available generating capacity, taking account of the error in the demand forecast and the Disappearance Ratios of gensets.

21.5 KOLP

$JOLP_j$ above is adjusted for elasticity of demand and supply to determine an intermediate probability $KOLP_j$. This adjustment is a mechanism to reflect the expected price elasticity of demand and supply, that is the expectation that a higher electricity price (caused by increased probability of loss of supply) will cause consumers to buy less and generators to offer more supply. Both factors lead to a reduction of the probability of lost load.

The elasticities referred to are always used in pairs, and have been provided by the Executive Committee to the SSA.

Other variables used in the calculation of $KOLP_j$ are:

- Notional Marginal Price NMP in £/MWh, a value which is adjusted on 1 April of each year in accordance with the Retail Prices Index (RPI). It is notified by the SSA to all Pool Members.

- $BASE_j$, the arithmetic mean of $LOLP_j$ in the corresponding Settlement Period in each of the preceding seven Schedule Days. This will always include two weekend days, when $JOLP_j$ values are normally lower than those for weekdays.

21.6 LOLP

The final stage produces the Loss of Load Probability $LOLP_j$ actually used in settlement. This step is simply a smoothing process using intermediate values for the Settlement Periods before and after:

$$LOLP_j = \tfrac{1}{3} * (KOLP_{j-1} + KOLP_j + KOLP_{j+1})$$

If j+1 or j-1 fall in another Schedule Day then $KOLP_j$ is substituted, in other words it appears twice. This is not normally significant, as all three values are usually close to zero at the Schedule Day boundary.

21.7 Redetermination of LOLP in Case of Error

When $LOLP_j$ is miscalculated due to transcription error in the input, the SSA is required to examine and correct all values likely to be affected, in principle an error in $LOLP_j$ could affect all subsequent days but in practice those considered are restricted.

If the error is in $TGSD\#_j$ all values in that Schedule Day are affected.

If the error is in DMAX all values in that Schedule Day and the seven following are affected.

21.8 Definition of Range Station

Formally defined as those power stations listed on 31 March 1990, and any others considered to have similar steam connections:

- Bradwell
- Dungeness "A"
- Hinkley Point "A"
- Trawsfynydd
- Wylfa.

A Range consists of two or more gensets supplied by a common steam source, in such a way that steam can be distributed between the gensets by the operator. A Range CCGT is a CCGT Module where there is a physical connection by way of a steam or hot gas main between that Module and other Module(s), which contributes to efficient modular operation (Appendix 1). Detailed guidance notes are available in Pool Circular 017, obtainable from the CEO (see page 75).

21.9 XMAX Mean

XMAX Mean ($XMAXM_T$) in MW is calculated as the first step in the PROMOD program. It represents the Maximum Availability for each Schedule Day summed nationally, but reduced to allow for disappearance ratios. XMAX values for each genset are on general release, but $XMAXM_T$ is published to provide an indication of the national availability used in $LOLP_j$ calculations.

22 VALUE OF LOST LOAD

The price consumers are assumed to be willing to pay to avoid loss of supply, currently £2345/MWh, as in the supply licences issued by the Secretary of State or the Director General Electricity Supply.

22.1 Initial Value of VLL

Defined as the maximum Value of Lost Load applicable in supply licences in force at the relevant time. The government granted licences specified £2000/MWh at Vesting date which was index linked in each subsequent year to the Retail Prices Index (RPI), thus:

£2000/MWh from 31 March 1990
£2187/MWh from 1 April 1991
£2285/MWh from 1 April 1992
£2345/MWh from 1 April 1993

22.2 Substitute Value of VLL

This sub-section only applies in the unlikely situation when there is a modification, amendment, or revocation of a licence, but no provision is made for adjustment of VLL. The value and adjustment procedure of 22.1 is still held to apply.

22.3 Timing of Changes to VLL

When a change to VLL occurs, it is implemented from the beginning of the Schedule Day on the date specified, normally 1 April. The SSA notifies Pool Members around the end of February.

23 ANCILLARY SERVICES AND DAILY POOL PAYMENT

This section covers two additional payments recovered or paid through the Pool.

23.1 Statements of Ancillary Services

The Ancillary Services Provider, currently a division of NGC, contracts for various requirements of the Grid Code, including:

- Reactive power
- Hot standby
- Frequency control
- Black start capability.

On a daily basis, the Ancillary Services Provider informs the SSA of the total charge to be recovered from consumers for provision of these services. If it fails to do so, the default value is the previous day's figure. Actual payments by the Ancillary Services Provider to generators for Ancillary Services are made outside the Settlement System.

23.2 Not used

23.3 Daily Pool Payment

Called DPP, and is the sum in £ to be recovered from, or paid to, Pool Members to cover charges or payments authorised by the Executive Committee for a particular Settlement Day, within its powers under the PSA.

In practice DPP is not used; alternative arrangements contained in the PSA have proved more satisfactory.

24 PAYMENTS TO GENERATORS PAYMENTS BY CONSUMERS POOL SELLING PRICE (PSP_j)

This is a large section whose subjects are fairly self-explanatory, and where much of the work earlier is drawn together, with the final aim of determining correct payments. It also covers Transmission Losses, which are allocated to consumers in 24.3. Trading Sites, where demand and generation are associated, are defined in 24.6.

24.1 Payments to Generators

The components evaluated earlier are summed for each Settlement Period, the gensets receiving payments for:

	Unconstrained Energy	EP_{ij}
+	Unconstrained Reserve	RP_{ij}
+	Marginal Set Adjustment	MSA_{ij}
+	Availability	AP_{ij}
+	Metered	OP_{ij}
+	MaxGen	GMP_{ij}
+	Table B Start-Up	TBP_{ij}
+	Non-Despatch Payment.	GNY_{ij}

The Genset Payments (GY_{ij}) for each Settlement Period are totalled over the Settlement Day and paid as Genset Total Payment (TGY_i). The figures for all the gensets belonging to each Pool Member are summed and passed to the Pool Funds Administrator for payment.

24.2 Treatment of Station Load

Power Stations and Trading Sites have their generation and demand metered separately, and the rules evaluate charges for demand in two alternative ways. If a Power Station or Trading Site is a net exporter of electricity, its station demand is paid for at PPP_j. If a Station or Trading Site is a net importer, it is treated as a normal consumer and demand is paid for at PSP_j; however, see also 24.6.

There are a few exceptions, namely stations (Agecroft, Bold, Didcot, Rugeley "B") which have electrical connections between their gensets and station transformer of a specified type. On these all demand is charged at PSP_j, as if they were net importers. Not all are still in operation.

24.3 Consumer Metered Demand and Transmission Losses

Due to the nature of electricity flow, there is a loss of energy between generation and supply. In each Settlement Period, the difference between national metered generation and national metered demand is known as the Period Transmission Losses (TL_j), in MWh.

At present, these losses cannot readily be assigned to a given cause, and so they are allocated pro rata to consumers, including power stations which are net importers, but not those which are net exporters.

Accordingly, the Consumer Gross Demand (GD_{cj} in MWh) includes the transmission losses, and is used in 24.5 to assess charges due for each Settlement Period, so that each consumer is allocated a share of losses. In the evaluation of GD_{cj}, variables calculated in 24.2 are used, as well as Consumer Metered Demand (ND_{cj}) and Station Load (MSL_{sj}) metered via CDCS under 3.3.

24.4 Pool Selling Price (PSP_j)

This is the price in £/MWh for Consumer Metered Demand and Metered Station Load for net importers, after uprating as above for transmission losses. It is calculated so that payments to generators and the Ancillary Services Provider balance those from consumers each Settlement Day.

In Table B Periods PSP_j is set equal to PPP_j. In Table A Periods, PPP_j has to be augmented with an uplift element to produce PSP_j. This uplift recovers on a daily basis the additional payments needed to make the Pool balance. The components of uplift include costs of:

- Ancillary services
- Reserve
- Availability
- Variance between Metered Generation and the Revised Unconstrained Schedule
- Changes in availability after the original offers, including breakdown of gensets
- Plant constrained on or off, or higher/lower because of transmission constraints.

External Pool Members are able to trade as systems, with different prices at different times of the day, and "firm" Availability Declarations.

The total Offered/Reoffered Availability of all blocks must not exceed allocated link capability on a minute by minute basis. Availability can be exchanged between blocks. Under the "old" Section 25 rules, it is total Genset Registered Capacity for blocks which must not exceed link capacity, and availability cannot be exchanged between blocks.

The Generation Trading Blocks must be numbered, with the lowest Genset Incremental Price ($INC1_i$) allocated to Block 1, and thereafter in ascending order of price/block number. Genset No-Load Price 1 ($NL1_i$) and Start-Up Price (SU_i) have to be offered as zero. An availability profile for each block (Notional Availability) is given to the EIP at the day ahead stage. Offered/Reoffered Availability must be allocated to the cheapest blocks within this availability profile at all times.

An additional subsection on Merit Order Availability (MOA) applies in order that GOAL runs correctly.

Four Scottish blocks are reserved for MaxGen use only, and these are called Premium Generation Trading Blocks. Two Scottish and two French blocks are reserved for Ancillary Services use, and called Emergency Support Trading Blocks. All of these special blocks are reserved for use relating to system support services, and the rules ensure that they are never scheduled in the Unconstrained Schedule.

25.1 Obligations of Interconnectors

This is a legal section detailing rights and obligations, most of which have already been mentioned above.

If the capacity of an interconnection is contracted by one External Pool Member to another, it is treated as if the Grid Operator had agreed to make the interconnection available to this other External Pool Member.

25.2 Obligations of Externally Interconnected Parties

By 10.00 daily each External Pool Member must submit availability in a Day Ahead Offer File under 6.1, and a Schedule of Demand under 4.2. Each Externally Interconnected Party is required to coordinate with its External Pool Members in their preparation. It must also ensure that Export and Import Interconnection Capabilities defined in 25.3 are not exceeded at any time.

If either of these capabilities are exceeded by this Day Ahead Offer, then the relevant Availability Declaration or Schedule of Demand is reduced pro rata until the appropriate capability is matched. The Grid Operator must notify the SSA of the abatement, and the SSA must pass the same information to the External Pool Member involved. All liabilities of the Grid Operator, SSA and Pool Members not involved then cease.

25.3 Export and Import Interconnection Capabilities

By 09.00 hrs daily, the Grid Operator must determine these for the following ADP. They are in MW, and based on the technical specification of the lines and system security requirements, which include temporary factors such as defects or maintenance.

If this reduction in capability means that the Interconnector Demand (5.8) exceeds export capability, then figures for demand are reduced pro rata until interconnection capacity is matched. A similar procedure applies in the import case, with availability of Generation Trading Blocks deemed redeclared lower.

25.4 Interconnection Capacity Limitations

The Grid Operator must inform the SSA and Externally Interconnected Party of any changes to capacity. Where these are split between different External Pool Members, the proportions involved must also be notified.

In the export case, the demand submitted by an External Pool Member under 4.2, and by the Externally Interconnected Party on behalf of the EPM under 5.8 must not exceed the export capacity agreed between the Grid Operator and the EIP; capacity has a similar meaning to Capability.

As for an ordinary genset, the Genset Registered Capacity (GRC_i) of each Generation Trading Block is held as Standing Data. The total GRC_i for all blocks must not exceed the Maximum Import Capacity. The provisions of this paragraph are currently suspended, while the temporary changes from Appendix 7 described above are in operation.

26 INTERCONNECTOR METERING AND PAYMENTS

Due to the fact that interconnectors link systems capable of both generation and demand, an External Pool Member is considered able both to generate (send imports into the NGC transmission system) and take demand (receive exports from the NGC transmission system). As a result, External Pool Members are treated as both generators and suppliers, and their payments are handled accordingly. Note the way in which the Pool Rules use the terms export and import from the point of view of the system in England and Wales, not that of the interconnected system.

When considering generation, the interconnector is divided into a number of notional Generation Trading Blocks, as introduced in Section 25. In general terms, these blocks are treated in settlement as normal gensets. The difference is that the notional trading block cannot be physically metered, as only the total flow across the interconnector is measured. Instead, trading blocks are credited with their instructed generation and any difference between this and the total Metered Generation of the interconnector is handled via separate error blocks, called Generator Trading Error Accounts.

When considering demand, the External Pool Members are credited with the demand agreed with the Grid Operator. Once again, any difference between this demand and Interconnector Demand is handled by separate error blocks called Demand Trading Accounts.

Payments in relation to these Trading Accounts are made to or by the Externally Interconnected Party, and are subsequently apportioned to the External Pool Members outside the Settlement System.

26.1 Trading Accounts and Transfer Error

By 12.00 hrs daily, the Externally Interconnected Party must submit to the SSA the data below for the previous Settlement Day, in respect of each Settlement Period. If not, default values are estimated by the SSA liaising with the Grid Operator.

(a) Based on the final demand programme (5.8), each External Pool Member is allocated a share of the demand, called Agreed Demand (EDL_{cj}), units MWh.

(b) Based on any generation instruction given by the Grid Operator to the Externally Interconnected Party, each Generation Trading Block is allocated a share, called Estimated Instructed Generation (EDI_{ij}), units MWh.

(c) The Interconnector Instructed Net Transfer in MWh is calculated as:

$$IINT_{ej} = \Sigma_i^e EDI_{ij} - \Sigma_c^e EDL_{cj}$$

Note that the sums are over all generation blocks and consumers for the Externally Interconnected Party.

(d) The Interconnector Transfer Error (TE_{ej}), representing Interconnector Metered Flow (IMF_{ej}) monitored via CDCS, less planned figure $IINT_{ej}$.

Trading accounts are set up (units MWh) to cover separately the demand and generation error blocks detailed further in 26.2 and 26.3.

26.2 Allocation of Metered Flow for Net Imports

The net import situation arises when $IINT_{ej}$ is positive or zero, in other words when England and Wales is due to receive energy.

This produces four values used in settlement A_{ij}, ND_{cj}, $GTEA_{ej}$ and DTA_{ej}:

$$A_{ij} = EDI_{ij}$$
$$ND_{cj} = EDL_{cj}$$

The Generator Trading Error Account ($GTEA_{ej}$) is set equal to the Interconnector Transfer Error (TE_{ej}) from 26.1 if zero or positive. If TE_{ej} is negative (ie imports are less than instructed) the Demand Trading Account (DTA_{ej}) is set equal to $-TE_{ej}$.

26.3 Allocation of Metered Flow for Net Exports

The net export situation arises when $IINT_{ej}$ is negative. Energy is being despatched from the NGC transmission system, and the interconnector is receiving energy. A slightly different logic to 26.2 applies, which can lead to negative values to the error accounts:

$$A_{ij} = EDI_{ij}$$
$$ND_{cj} = EDL_{cj}$$
$$GTEA_{ej} = TE_{ej} \text{ if } IMF_{ej} \geq 0 \text{ (otherwise it is zero)}$$
$$DTA_{ej} = -TE_{ej} \text{ if } IMF_{ej} < 0 \text{ (otherwise it is zero)}$$

26.4 Frequency Support

Because of payment implications, the Grid Operator has to notify the Ancillary Services Provider and the SSA of any ancillary services provided to, or supplied by, the Externally Interconnected Party. These include primary or secondary response to and from the External System, or emergency support to or from the NGC Transmission System.

26.5 Clearing the Trading Accounts

This is done through CDCS under 3.3, using variables calculated in 26.2 and 26.3. The only complexities are $GTEA_{ej}$ and DTA_{ej}. To account for this unforeseen generation, a notional Non-Centrally Despatched Generating Unit and a notional consumer is allocated to each Externally Interconnected Party, such that its Metered Generation (A_{ij}) is set equal to $GTEA_{ej}$ and its Consumer Metered Demand (ND_{cj}) is set to DTA_{ej}.

27 GENERATOR RISK MANAGEMENT SCHEME

Small generating companies are allowed to smooth the effect of the Capacity Element on their Pool payments by registering plant prior to commissioning under the Risk Management Scheme. The arrangements for the scheme are contained in the PSA, and the Pool Rules contain the provisions for calculating payments due under the Scheme, although to date there have been no applications. Costs, either positive or negative, are recovered in the following financial year by adjustments to PSP_j.

Clauses 53-56 of the PSA give details of generators who qualify to join:

- Pool Member with maximum of four gensets
- maximum capacity combined of 1500 MW
- gensets of part owners and any outside England and Wales are included when the points above are considered
- the genset must not yet be commissioned
- the Scheme is binding for seven years
- the planned availability for each Settlement Period must be supplied in advance of each Scheme Year.

The subsections are self-contained:

Average Revenue Comparator ARC_{iY} (27.1)
Genset Actual Income GAI_{iY} (27.2)
Revenue Equalisation Payment (27.3)
Risk Management Uplift and Daily Payment (27.4)

The Genset Actual Income in £ based on Actual Availability is summed over the Scheme Year:

$$GAI_{iY} = \sum_{j}^{Y} \{XP_{ij} * LOLP_j * [VLL - \max(BP_{ij}, SMP_j)]\}$$

$$\{ \quad \text{minimum of zero} \quad \}$$

This actual figure is compared with the Average Revenue Comparator, which is the revenue which would have been received based on the average Availability Payment through the year:

$$\underset{£}{ARC_{iY}} = \underset{MW}{XAR_{iY}} * \underset{£/MWh}{AAP_{iY}} * n_{iY} * \underset{½h}{SPD}$$

AAP_{iY} is the Average Availability Payment throughout the year. Genset Average Availability (XAR_{iY}) represents the MW equivalent of XP_{ij} averaged throughout the n_{iY} Settlement Periods of the Scheme year when there is planned availability.

If GAI_{iY} exceeds ARC_{iY} the generator pays 90% of the difference to the Pool, the sum going to reduce Uplift. If ARC_{iY} is higher, a similar proportion is paid to the generator, and the sum is credited to Uplift.

28 SETTLEMENT IN A SECURITY PERIOD

A Security Period follows from the Secretary of State exercising his powers to control capacity, fuel and periods of operation under subsection 34(4)b of the Electricity Act 1989.

The provision, with further details in sections 34 and 35 of the Act, is a reserve power held to cope with a national emergency or major disruption to fuel supplies. Licences for Power Stations covering 50 MW and above (except those fuelled by waste or manufactured gases) provide that the licensee must comply with the Fuel Security Code.

During Security Periods, the Secretary of State may instruct generators to operate at specified power levels and/or use alternative fuels. As full commercial judgements are temporarily restricted, the major parameters of settlement are determined from historic values from the months before the Security Period began. Provisions are included in the Fuel Security Code whereby generators may recover their additional costs from consumers.

In the Pool Rules the descriptions are extensive and self-contained, with many new acronyms, though essentially the principles of settlement are maintained. Subsections are:

- Modification to Settlement (28.1)
- Generators' Prices (28.2)
- $LOLP_j$ (28.3)
- Genset Failure Indicator (28.4)
- SMP_j, PPP_j, PSP_j (28.5)
- Settlement Security Period Uplift (28.6).

To find a suitable historic Day Ahead Offer File for each genset, the three months starting six months before the first day of the Security Period are considered. For each Schedule Day in the three months the maximum of Genset Bid Price (BP_{ij}) is found, and these are ranked in price order. The value selected is the median value, for which rules are given in 28.2; it is not the same as the arithmetic mean.

To quote an example, if the three months contain 92 Schedule Days, maximum Genset Bid Price ranked 47th in the set is used. All the matching historic values for the Day Ahead Offer File related to that particular Schedule Day are then found and used, after uprating by the Retail Price Index (RPI).

Every financial year, within 21 days of its start, the Executive Committee is required to supply to the SSA a matrix of System Marginal Prices (SMP_j) forecast

for the year, based on actual historic values for the previous financial year and typical load curves based on days of the week, seasons, and prevailing weather conditions.

During a Security Period, the SSA has to choose appropriate System Marginal Prices from the matrix values above and the Executive Committee has to determine a value for $LOLP_j$. After uprating by RPI the usual Pool Purchase Price calculation proceeds:

$$PPP_j = SMP_j + LOLP_j * (VLL - SMP_j)$$

The difference between PSP and PPP in the matrix is uprated by RPI and added to the Security Period PPP_j above to give the Security Period PSP_j above.

During a Security Period gensets affected have Genset Failure Indicator GFI_{ij} and Inflexibility Indicators $GIRG_{ij}$ and $GIRS_{ij}$ set to zero.

As mentioned above, the generators subject to the Fuel Security Code can recover additional costs of running during the Fuel Security Period. To avoid a large payment at the end of the period and to ensure that more accurate price signals are available to consumers, provision is made for additional payments to generators and recovery of these costs from consumers.

The generators subject to the Fuel Security Code make an estimate each month of the additional payment to which they are entitled. This is paid to the generators and is used to calculate the additional sums due from consumers. This calculation is designed to minimise any reconciliation, under the Fuel Security Code, at the end of the period.

Generators not subject to the Fuel Security Code are paid as normal.

29 BLACK START CONDITIONS

Not used.

30 SETTLEMENT RUNS

The SSA produces a Provisional Run of the Settlement System for each trading day about 10-12 days after the end of that day, with a Final Run generally 24 days after the trading day in question: see Figure 12. The timing of the Provisional Run is intended to allow for the collection of the necessary metered data by the SSA for demand and generation. This metered data is mainly collected electronically and is consolidated by CDCS. Reports on the Provisional Run are sent both to generators and suppliers. This allows them time to raise disputes on the accuracy of the data. The timing of the Final Run allows for the resolution of

any registered disputes and for the collection of, or the determination of, additional data.

In certain circumstances, further Dispute Final Runs may be required. Following the Final Run, or any Dispute Final Run, reports are sent to the generators and suppliers. Payments due in respect of each trading day are advised to Pool Members by the Pool Funds Administrator who sends out invoices based on information from the SSA. Settlement of amounts due under the Pool trading arrangements usually takes place 28 days after the trading day. Monies are paid by consumers to a central Pool clearing account administered by the Pool Funds Administrator, and distributed to generators and the Ancillary Services Provider according to their entitlement.

All data covering the total system and most covering each genset's availability are also on general release. Day-ahead provisional PPP_j, Final PPP_j and PSP_j for each period are published in the press. Fuller details of all these are shown on page 75 onwards.

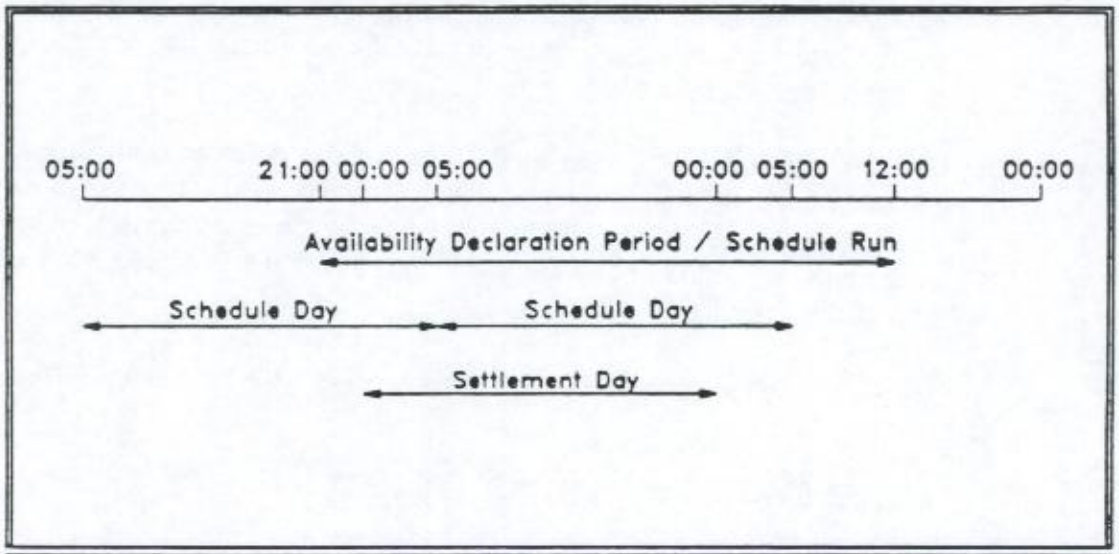


Figure 12 - Settlement timetable

30.1 Definitions of Terms

This subsection covers Provisional Run, Final Run, and Dispute Final Run, but simply refers forward to 30.3, and also mentions Appendix 4 where reporting requirements are listed. The essential details of the timing are shown in Figure 12.

30.2 Reporting of Data by SSA

In accordance with Agreed Procedure AP01, the SSA provides all Pool Members by 16.00 hrs daily with the data listed in Appendix 4, for the following Schedule Day. The data comprises:

- SMP_j
- $LOLP_j$
- Table A and B Periods
- $TGSD\#_j$ and Nominal Demand (NO_j) for each period
- National XG_{ij} and VC_{ij}
- National Five Minute Reserve.

Most of these are also on general release; a brochure is available from the CEO (see page 75). The provisional PPP_j for each period is also advertised in the national press, currently the "Financial Times".

30.3 Timing of Settlement Runs

Agreed Procedure AP01 provides for delivery of the Provisional Run to each Pool Member no later than the twelfth day following the Settlement Day. The delivery for the Final Run must be no later than the 24th day. There is no set time for the Dispute Final Run, which applies only on occasions when 30.4 is implemented.

30.4 Disputes Affecting Settlement Runs

If any Pool Member disputes data in the Provisional Run or Final Run, it must promptly notify the SSA, and comply with Agreed Procedures AP8, AP11, AP102 and AP111. Nearly all disputes are raised at the Provisional stage, and are resolved in time for the Final Run.

Under Clause 83 of the PSA, the Electricity Arbitration Association may be appointed as arbitrator by either party if the dispute remains unresolved, and the Association may direct a Dispute Final Run. This run may also be directed by the Executive Committee. However, to date Dispute Final Runs have rarely proved necessary, and arbitration has never been requested.

Determinations under the Dispute Final Run can give rise to underpayment to and from Pool Members, and these are paid with interest paid or charged as appropriate, at specified rates.

The Executive Committee also has powers to correct errors without a Dispute Final Run. Payment corrections are then be made in accordance with Agreed Procedures.

31 EMERGENCY PROCEDURES

These exist to cover situations where data cannot be collected or the systems are unable to run or are delayed. The time limits of Section 31 enable the Final Run to be implemented on time. Fortunately, to date the provisions in this section have not had to be used.

31.1 Occasions of Use

The appropriate sub-section will be used in the case of delay or failure of:

- Production of $LOLP_j$
- Settlement GOAL
- CDCS or PORTHOLE
- Determination of SMP_j, PPP_j, PSP_j, or payments to/from Pool Members and Parties.

31.2 $LOLP_j$ Emergency Procedures

If the problem cannot be rectified within 22 days of the Settlement Day, the value is determined by the Executive Committee as if a Security Period applied, using 28.3.

31.3 Settlement GOAL Emergency Procedure

If a failure cannot be rectified, the SSA must notify the Executive Committee and Director, with a programme of repairs to enable production of the Unconstrained Schedule within 20 days of expiry of the appropriate ADP.

If this is not possible, the Executive Committee may direct the SSA to prepare the Unconstrained Schedule manually, with the same time limit as above, to enable a Final Run to be implemented.

The Executive Committee also has powers to estimate values according to Agreed Procedures, but this is only taken up if other arrangements prove unsatisfactory.

31.4 CDCS/PORTHOLE Emergency Procedures

The SSA must accept instructions from the Executive Committee regarding rectification and derivation of missing variables from those known. The Executive Committee may also estimate values. In respect of PORTHOLE, the Grid Operator must assist.

31.5 $SMP_j/PPP_j/PSP_j$ Emergency Procedures

If the procedures cannot be rectified within 22 days of the Settlement Day, SMP_j and PPP_j are calculated as if a Security Period applied, using 28.5. PSP_j is prepared manually so that payments and receipts balance. In other words, the sum of Consumer Sales must equal payments to generators, the Ancillary Services Provider, and the Daily Pool Payment DPP. The Final Run may then take place.

If this proves impossible, as a last resort, the Executive Committee must determine values, after consulting the Director and the Secretary of State.

31.6 Reserve Powers of Executive Committee

These reserve powers consist of "reasonable directions" and apply to the SSA and all Pool Members, if no Agreed Procedure exists.

32 SETTLEMENT IN A POOL CIVIL EMERGENCY PERIOD

Under Clause 61 of the PSA, the Executive Committee may declare the start of a Pool Emergency Period if:

- Materially changed Pool Prices exist/are likely to exist, and are likely to continue
- There is a major failure affecting the national network of transmission, supply or generation
- The failure is due to a defined emergency, such as natural disaster or strike.

The aims of the provisions are to avoid "abnormal" prices during times when normal market operation is interrupted in this way, and to ensure that as much generation as possible is made available, with legitimate costs being met. Also, as far as is practical, the additional cash flow burdens on suppliers in meeting legitimate higher costs are made sustainable.

The Secretary of State and the Director General Electricity Supply are notified of the Pool Civil Emergency Period, and both have a power of veto. The Director is responsible for ending the Period, after consultation.

When a Pool Civil Emergency Period starts, the loss of availability and seven day average Pool Price are monitored daily, and if thresholds for both are passed, a Pool Rules Civil Emergency Period is called. Again, the Secretary of State and Director have a power of veto, as does the Executive Committee (a 65% majority is necessary). The Executive Committee also bears responsibility for ending the Pool Rules Civil Emergency Period, although it automatically ceases if the Pool Civil Emergency Period is ended.

OFFER has access to generators' bids, and is likely to scrutinise these with particular care during such Periods.

32.1 Thresholds for a Pool Rules Civil Emergency Period

The Unavailability Measure (UM_T) is a measure of the reduction in XMAX for the plant affected by the Civil Emergency, relative to the total XMAX for that plant on the same Schedule Day the previous year. UM_T is expressed as a fraction of the total XMAX for year (Y-1).

The Rolling Average Pool Price (RAP_T) calculates the average Pool Purchase Price for the Schedule Day and the six previous Schedule Days.

If $UM_T \geq 0.1$ (10% loss of availability) **and** $RAP_T \geq 3$ times the equivalent price the year before, Pool Rules Civil Emergency Period conditions are met, under Clause 61.4 of the PSA.

32.2 Notification of Affected Generating Units

Each generator must notify the SSA with details of affected plant at the time and in the manner agreed.

32.3 Generators' Obligations

During a Pool Rules Civil Emergency Period, the affected plant is bid as available in the Day Ahead Offer File, at the maximum Genset Offered Availability (GOA_{it}) which a prudent operator would normally offer.

The plant must then be reoffered to its anticipated true level (often likely to be zero), using Genset Redeclared Availability (GRA_{it}).

Under this arrangement, Uplift rises but the overall cost to consumers is much reduced, due to lower values of PPP_j and $LOLP_j$ than would be the case if these rules were not in place.

SUMMARY OF APPENDICES

Appendix 1 - Definitions of Variables

Part I is in alphabetic order of variable name with acronym, units and definition, or subsection where defined. This is useful as an indirect index.

Part II is in alphabetic order of acronym with variable name given. This may be used in conjunction with Part I to trace further details in the rules.

Appendix 2 - BPS GOAL and Settlement GOAL

This provides details for running the GOAL programmes (including GOALPOST), supplementing Section 8 and other references. In addition, it covers procedures for changing GOAL.

Appendix 3 - PORTHOLE Despatch Instructions

Not used.

Appendix 4 - Reporting Requirements of the SSA

This includes an annex covering the reporting of the results of Provisional and Final Runs.

Appendix 5 - Variables Established via PORTHOLE

These variables are those from the generator's Day Ahead Offer File plus the spot values every half hour for generation, reserve and availability evaluated in Settlement GOAL, or default values, where applicable. They are used in 9.5.

Appendix 6 - Aggregation of Metered Data

This includes diagrams of typical systems. Aggregation is the bringing together of various metered values which together comprise the value of a given variable.

Appendix 7 - Short Term Modifications

1 Introduction

Amendments to existing rules necessary if and when modifications of 2 to 7 below are implemented.

2 Black Start Conditions

There is no current intent to implement this.

3 Integrated Minute Availability

There is no current intent to implement this.

4 Rugby Clock Time

There is no current intent to implement this.

5 Quintic Dam

This proposed change has been suspended indefinitely, although software exists to execute it and a period of parallel running has occurred. Parallel running has now ceased - the Executive Committee judged that the results did not justify implementation.

6 Genset Spare Capacity

Implementation is likely from the start of Settlement Phase 3.3, around October 1993.

7 Interconnectors - Removal of GRC Cap

Due to run until 30 September 1993, or as extended; because of its importance, notes on this Section have been included at the beginning of main Section 25.

ANNEX

The Phase 4 Pool Rules

The Annex to the PSA contains the Pool Rules which are expected to be implemented as part of "Phase 4" on or before July 1994. The main changes which will be implemented in Phase 4 are:

a) introducing a 2% tolerance for generation above redeclared availability in Section 14.5.1 (implemented in June 1993);

b) introduction of Instruction Following Tests in Section 15 (maxgen renumbered and included as "Premium Generation" Section 18);

c) introduction of Availability Testing in Section 19.

POOL DOCUMENTS AND WHERE TO OBTAIN THEM

The publicly available documents used in compilation of this guide are sold by:

Chief Executive's Office
The Electricity Pool of England and Wales
15 Bloomsbury Square, LONDON WC1A 2LP

Telephone: 071 831 4790 (international +44 71 831 4790)
CTN: 254 202
Fax: 071 831 4813 (international +44 71 831 4813)

"Into the Future - trading in the new electricity market"	Free
Catalogue of Data on General Release (genset price/availability and demand data available on subscription)	Free
"Joining the Pool"	Free
Pool Circulars	
Genset Failure Log Procedure (011)	Free
Loss Factors for Embedded Generators: a Guidance Note (012)	Free
Treatment of CCGT Stations in Settlement: a Guidance Note (017)	Free
Typical Dataset (023)	Free
Pool Communications Strategy (030)	Free
Forecasting Nominal Demand: the Methodology and Process (032)	Free
Analysis of Uplift (038)	Free
Representative/Typical Dataset	£10
Quarterly Report (news, explanations, trends, graphs)	£10
Annual subscription	£40
Statistical Digest (quarterly) Annual subscription	£12
An Introduction to the Pool Rules	£10
Pooling and Settlement Agreement (including the Pool Rules)	£60 (£20 per section)

The National Grid Company plc, Grid Code Secretariat
Cumberland House, The Common, Redbourn, St Albans, HERTS, AL3 7NA.

Telephone: 0582-790225
CTN: 791 225
Fax: 0582-700226

Grid Code: unserviced	£38.20
serviced, with amendments to December 1995	£74.10

Energy Settlements and Information Services Limited
(formerly NGC Settlements Ltd)
Information Desk, Fairham House, Green Lane, Clifton, NOTTINGHAM, NG11 9LN

Publications telephone: 0602 456730
CTN: 450 6730
Fax: 0602 456693 /CTN 450 6693

Agreed Procedures	£50
Metering Codes of Practice One to Five: each	£25
Full set of five	£100

Office of Electricity Regulation (OFFER)

OFFER Library, Hagley House, Hagley Road, BIRMINGHAM, B16 8QG

Telephone: 021 456 6377
Fax: 021 454 7622

A library list on the industry is available, including many publications offered free. Generation and supply licences for all companies are sold.

HMSO

PO Box 276, LONDON, SW8 5DT
Bookshops: London WC1, Birmingham, Bristol, Manchester, Belfast, Edinburgh

Telephone: 071 873 9090

Electricity Act 1989	£12.75

Licences for the founding Pool Members, OFFER Annual Reports, White Papers and House of Commons Select Committee Reports are also sold.

National Press

Provisional PPP_j values are published daily in the national press (currently the "Financial Times"), and relate to the day of publication. Final Run PPP_j and PSP_j values (normally those from 28 days earlier) are also included.

GLOSSARY

Actual Availability	The availability of a genset in a Settlement Period, used for the calculation of generator payments, based on the Redeclared Availability, but modified for failures and Metered Generation following a failure.
Agreed Procedures	Numbered codes of practice available from the address on page 76. They define the required procedures for defined activities under the PSA.
Ancillary Services Provider	The organisation which contracts for the provision of ancillary services to fulfil the requirements of the transmission licence. Currently a division of the National Grid Company plc (NGC).
Availability	The MW capacity of a genset made available to the Grid Operator. For settlement, sometimes equivalent MWh per Settlement Period are used.
Availability Declaration Period (ADP)	The period from 21.00 hrs on any day to 12.00 hrs two days later, and which includes the whole of a Schedule Day.
BPS GOAL	Program used by the Grid Operator to produce the operational schedule used for actual operation on the trading day. BPS stands for Basic Plant Schedule.
Commercial Boundary	Point at which electricity passes from one company to another. If there is no meter at the point of transfer the value is estimated from the nearest meter and engineering specifications.
Capacity Element	The component of PPP which is designed to provide an incentive for capacity to be made available. It is derived from LOLP and VLL.
Central Data Collection System (CDCS)	The central computer system used by the SSA to collect metered data electronically from generators and consumers.
Centrally Despatched Generating Unit	A genset subject to central despatch, that is subject to directions from the Grid Operator. Central Despatch is mandatory for plant of 100 MW and over, and optional below that limit.
Combined Cycle Gas Turbine Module (CCGT)	Combined cycle gas turbine(s) plus related steam turbine(s), considered as one unit for settlement purposes.

Consumer Metered Demand	Demand metered for each supplier in a Settlement Period.
Consumer Sales	The payments made by consumers for demand.
Day Ahead Offer File	See Offer Data.
Declared Availability	The availability of a genset in a Settlement Period, determined from profiling its offered availability.
Director	Director General Electricity Supply, at the Office of Electricity Regulation (OFFER).
Embedded Generating Unit	A Generating Unit within a REC distribution system, with no direct connection to the NGC Transmission System.
Externally Interconnected Party (EIP)	The party operating an external system connected to an interconnection.
External Pool Member (EPM)	A Pool Member supplying or taking electricity from the transmission system through an interconnection.
EPFAL	Energy Pool Funds Administration Ltd, a wholly owned subsidiary of NGC.
Executive Committee	Sometimes known as the Pool Executive Committee (PEC). A decision making body of the Pool, consisting of representatives from Pool Members and Parties.
First Tier Supply	Supply to franchise consumers with demand under 1 MW (100 kW from 1 April 1994).
Genset	Centrally Despatched Generating Unit.
Genset Price	The price calculated for each genset in each Settlement Period used in the determination of SMP.
Genset Registered Capacity	A MW value held for each genset, representing the maximum capability of the genset.
GOAL	The computer program used to produce generation schedules. BPS GOAL is used by the Grid Operator and identical Settlement GOAL is used by the SSA.
GOALPOST	The post-processor run after the GOAL program, to schedule additional gensets if GOAL fails to meet forecast demand or reserve.

Grid Code	Major document detailing procedures and technical practice for all connected to the NGC transmission system, available from the address given on page 75.
Grid Operator	The organisation which operates the national high voltage transmission system, and implements the provisions of the Grid Code - currently the National Grid Company plc.
Grid Supply Point (GSP)	The point at which electricity is transferred from the NGC transmission system to suppliers and certain large users.
Initial Settlement Agreement (ISA)	An agreement dated 30 March 1990 which, only until 31 March 1993, modified or suspended certain provisions of the PSA.
Initial Pool Rules	The Pool Rules used until 31 March 1993, set out in Schedule 8 to the Initial Settlement Agreement.
Interconnections	Physical transmission links out of the NGC transmission system, currently to Scotland and France.
Large Consumer	A consumer with demand in excess of 250 MWh in a Settlement Period.
Loss of Load Probability (LOLP)	A value associated with the probability that in any Settlement Period available plant will be insufficient to meet demand. LOLP is used to provide a capacity element of PPP.
Marginal Genset	The genset which sets SMP in a given Settlement Period.
Marginal Set Adjustment	The payment which may be made for a genset which "pulses" and operates below its Table A Capacity.
MaxGen Instruction	The instruction from the Grid Operator to operate above normal operating conditions.
MaxGen Price	The price offered by a generator for generation above a genset's normal operating conditions whilst under a MaxGen Instruction.
Metered Station Load	The demand metered at a power station in each Settlement Period.

Minimum Generation (MG)	The minimum level at which a genset is prepared to generate for a sustained period of time once it has synchronised. This value is part of the Day Ahead Offer File.
Nominal Demand	The estimate of demand provided by the Grid Operator for the salient points of the demand curve.
OFFER	Office of Electricity Regulation.
Offer Data	The data provided by a generator to the Grid Operator constituting the offer made by 10.00 hrs on the day ahead of trading. This offer is made up of offered availability, offer prices, operating characteristics and declared inflexibility, and usually called the Day Ahead Offer File.
Period Transmission Loss	The difference between the national metered generation and national metered demand in a Settlement Period.
Pool	The electricity trading market, whose rules and procedures are contained in the PSA. Membership is compulsory for nearly all generators and suppliers - for full details obtain "Joining the Pool" from the CEO (see page 75).
Pool Funds Administrator	The person who administers the banking, billing and associated systems whereby payments under the Pool trading arrangements are made. Currently EPFAL (qv).
Pool Purchase Price (PPP)	The price at which the major part of generator revenues under the Pool trading arrangements are derived, based on SMP below and the Capacity Element above.
Pool Rules	Schedule 9 of the PSA.
Pool Selling Price (PSP)	The price which forms the basis of payments by consumers under the Pool trading arrangements, comprising overall generation cost per MWh sold.
Pooling and Settlement Agreement (PSA)	Agreement dated 30 March 1990 (immediately prior to Vesting) of founding Pool Members, NGC Settlements Ltd, EPFAL, NGC, and the two Externally Interconnected Parties, Scotland and France.

PORTHOLE	Database which allows the transfer of operational information from the Grid Operator to the SSA and Ancillary Services Provider.
Proven Availability	Has the same meaning as Actual Availability.
Range CCGT	CCGT Module where there is a physical connection by way of a steam or hot gas main between that Module and other Module(s), which contributes to efficient modular operation.
Redeclared Availability	The availability of a genset in a Settlement Period, determined from profiling its reoffered (and offered) availability.
Reserve	The generating capacity of a genset that is realisable at short notice to meet increases in demand, or losses of generation that are not forecast.
Revised Unconstrained Schedule	The Unconstrained Schedule adjusted to take account of Redeclared and Actual Availability on the day.
Schedule Day	The period from 05.00 hrs on any day to 05.00 hrs on the next. Note the spot time 05.00 hrs lies at the end of the Schedule Day.
Schedule Run	Has the same meaning as Availability Declaration Period.
Second Tier Supplier	Holder of licence to supply consumers with demand of 1 MW or over (100 kW from 1 April 1994).
Secretary of State	Originally Secretary of State for Energy; now refers to President of the Board of Trade.
Settlement Day	The period from 00.00 hrs on any day to 00.00 hrs on the next day.
Settlement GOAL	The computer program used to produce the Unconstrained Schedule.
Settlement Period	A half-hour period ending on the hour or half-hour. A Settlement Period is identified by its end time.
Settlement System	The system (mainly computerised) used to calculate payments between Pool Members under the Pool trading agreements.

Settlement System Administrator (SSA)	The body which administers the computerised system used to calculate the data and carry out the other procedures to calculate the payments due under the Pool trading arrangements. Currently Energy Settlements and Information Services Ltd.
Small Independent Generating Plant	Power Station not centrally despatched, with Registered Capacity of 50 MW or over.
System Marginal Price (SMP)	The highest price of qualifying gensets schedul in the Unconstrained Schedule in any Settlemer Period.
Table A Capacity	The most economical point at which a genset w operate, as calculated from its offer prices.
Table A Periods	Periods during the day which are not Table B Periods.
Table B Periods	Periods during a day, usually of low demand, when there is more than a pre-determined level of generating capacity scheduled than is require to meet demand at that time. The total numbe of such periods is subject to a cap.
Table B Start-Up Payment	The payment which may be made for flexible gensets which are scheduled in the Unconstrain Schedule wholly in Table B Periods.
Total Demand	The estimate of demand for each Settlement Period, derived from the Nominal Demand.
Two-Shifting Limit	The statement of how often a genset may be sh down. A zero Two-Shifting Limit indicates tha the plant cannot be shut down.
Unconstrained Schedule	The half-hour by half-hour schedule of gensets notionally required to meet forecast demand an reserve, which is produced on the day ahead of trading, ignoring transmission constraints.
Value of Lost Load (VLL)	The maximum price the supply of electricity demand is deemed to be worth, for crucial uses Set at £2000 per MWh (£2 per kWh) in 1990/9 and escalated annually by RPI. Thus the value for one year from 1 April 1993 is £2345 per MWh.
Vesting Day	31 March 1990, the starting date of the Pool.

VARIABLE FLOW CHARTS (simplified)

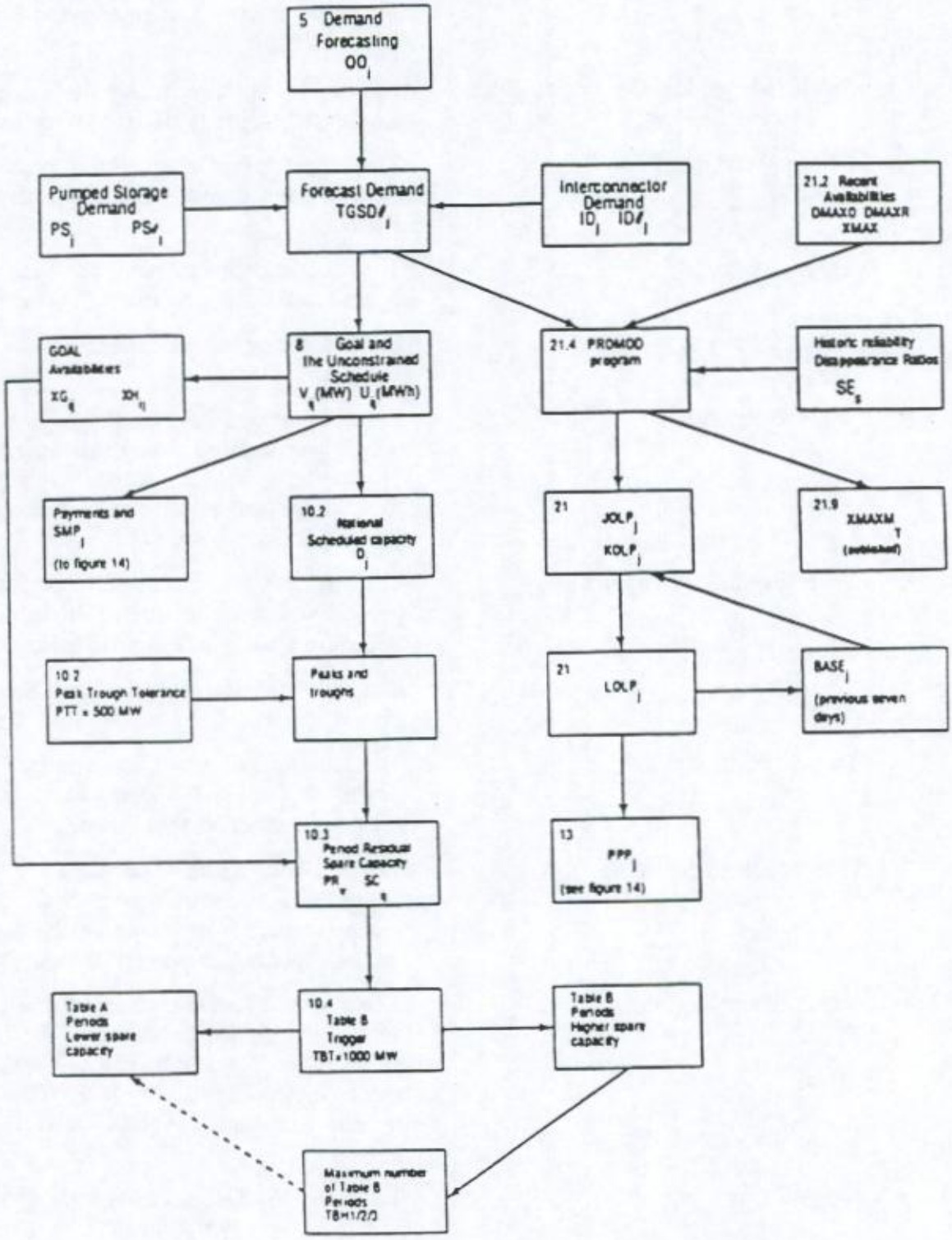
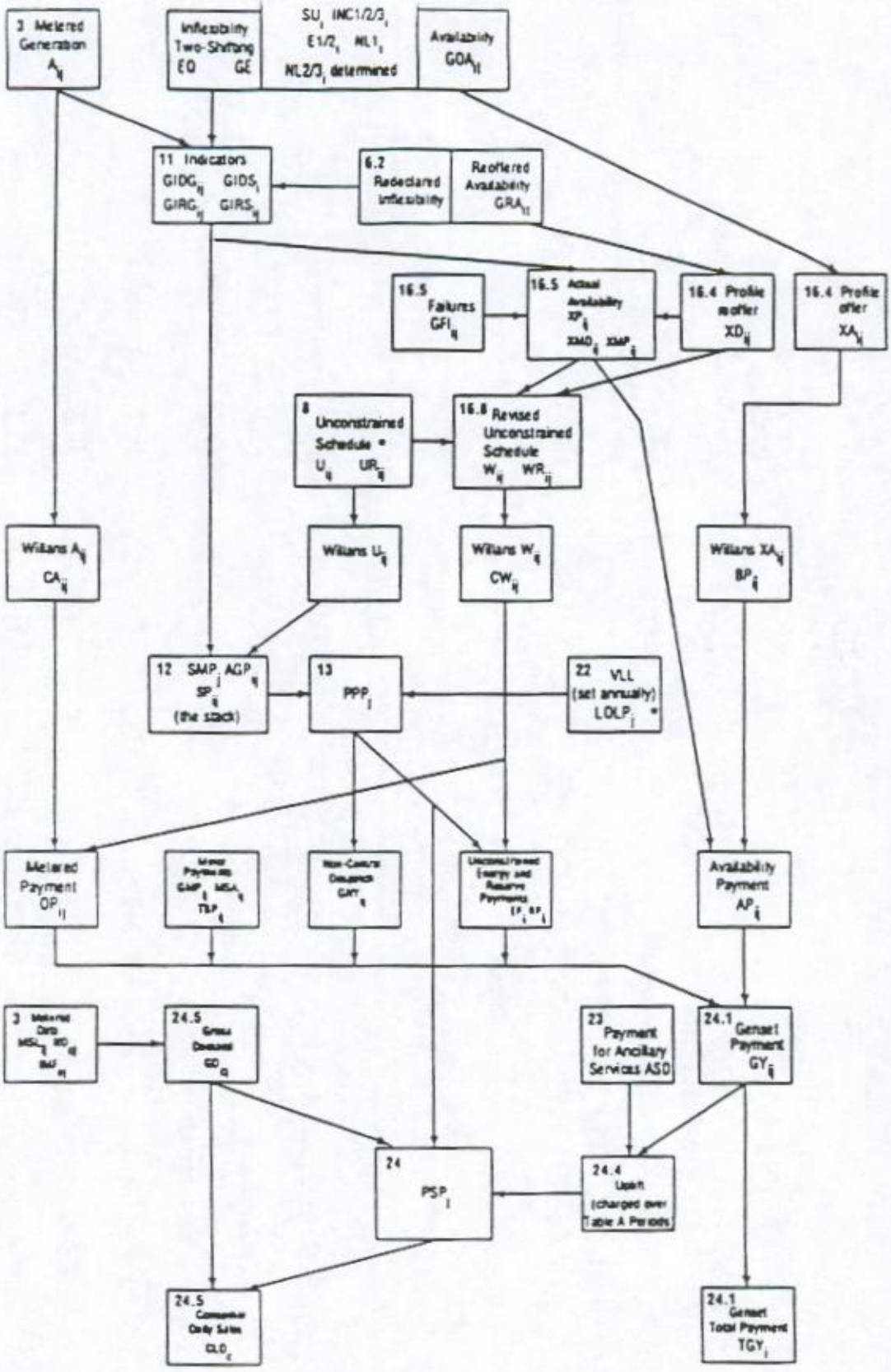


Figure 13 - Demand Forecasting, GOAL, Table A and B Periods.



* = from Figure 13 'Willans' = Start-Up, Incremental, and No-Load Costs from Day Ahead Offer, for example 'Willans A_{ij}' = SUA_{ij}, $INCA_{ij}$, NLA_{ij} evaluated at MW equivalent of A_{ij} on Willans Line (Figure 4)

Figure 14 - Offer File to Total Payment and Sales

INDEX BY VARIABLE

VARIABLE	VARIABLE NAME	UNITS	SECTIONS ETC (A = Appendix, __ = main explanation)
A_{ij}	Metered Generation, Genset	MWh	3.3, 13.3, 14.3, 14.5, 16.5, 20.1, 21.2, 26.3
AGP_{ij}	Adjusted Genset Price	£/MWh	12.3, 12.4, 12.6
AP_{ij}	Availability Payment, Genset	£	17.4, 24.1
$BASE_j$	Average Value of $LOLP_j$	Number	21.5
BP_{ij}	Bid Price, Genset	£/MWh	17.3, 17.4
CA_{ij}	Metered Cost, Genset	£	14.5
CC_{ij}	Availability Cost, Genset	£	17.2
CLD_c	Consumer Daily Sales	£	24.5
CW_{ij}	Revised Unconstrained Cost, Genset	£	14.2, 14.5
D_j	Scheduled Capacity	MWh	10.2
$DMAXO_{eT}$	Daily Offered Availability, Interconnector	MW	21.2, 21.4

$DMAXO_{iT}$	Daily Offered Availability, Genset	MW	21.2, 21.4
$DMAXO_{rT}$	Daily Offered Availability, Range	MW	21.2, 21.4
$DMAXR_{eT}$	Daily Reoffered Availability, Interconnector	MW	21.2, 21.4
$DMAXR_{iT}$	Daily Reoffered Availability, Genset	MW	21.2, 21.4
$DMAXR_{rT}$	Daily Reoffered Availability, Range	MW	21.2, 21.4
DPP	Daily Pool Payment	£	23.3
DTA_{ej}	Demand Trading Account	MWh	26
$E1_i$	Elbow Point 1, Genset	MW	6.3, 8.3
$E2_i$	Elbow Point 2, Genset	MW	6.3, 8.3
EDI_{ij}	Estimated Instructed Generation (for Generation Trading Block)	MWh	26
EDL_{cj}	Demand, Agreed (for Interconnector)	MWh	26
EP_{ij}	Unconstrained Energy Payment, Genset	£	13.4, 24.1
$GAP1_{ij}$	Table A Price 1, Genset	£/MWh	8.3
$GAP2_{ij}$	Table A Price 2, Genset	£/MWh	8.3

$GAP3_{ij}$	Table A Price 3, Genset	£/MWh	8.3
GD_{cj}	Gross Demand, Consumer	MWh	24.3, 24.5
GFI_{ij}	Failure Indicator, Genset	0 or 1	16.5
$GIDG_{ij}$	Declared Inflexibility Indicator, Genset	0 or 1	11.1, 11.2
$GIDS_{i}$	Declared Two-Shifting Indicator, Genset	0 or 1	11.1, 11.2
GII_{ij}	Inflexibility Indicator, Genset	I or F	11.5
$GIRG_{ij}$	Redeclared Inflexibility Indicator, Genset	0 or 1	11.3
$GIRS_{ij}$	Redeclared Two-Shifting Indicator, Genset	0 or 1	11.3
GMG_{ij}	MaxGen Generation, Genset	MWh	20.1
GMP_{ij}	MaxGen Payment, Genset	£	20.1, 24.1
GND_{sj}	Gross/Net Station Demand	MWh	24.2
GNY_{ij}	Non-Despatch Payment, Genset	£	13.3, 24.1
GOA_{it}	Offered Availability, Genset	MW	6.1, 6.3, 6.5, 16.4, 21.2, A7
GP_{ij}	Price, Genset	£/MWh	12.2, 12.6

GRA_{it}	Reoffered Availability, Genset	MW	6.2, 6.5, 21.2, A7
GRC_i	Registered Capacity, Genset	MW	6.1, 16.3, 16.5, 25.4, A7
$GTEA_{ej}$	Generation Trading Error Account	MWh	26
GY_{ij}	Payment, Genset	£	24.1
ID_j, $ID\#_j$ and ID_{cj}	Demand, Interconnector	MW	5.2, 5.4, 5.8, 25.3
$IINT_{ej}$	Instructed Net Transfer, Interconnector	MWh	26
IMF_{ej}	Metered Flow, Interconnector	MWh	3.3, 26.1, 26.3
$INC1_i$	Incremental Price 1, Genset	£/MWh	6.2, 8.3, 12.1, A7
$INC2_i$	Incremental Price 2, Genset	£/MWh	6.3, 8.3
$INC3_i$	Incremental Price 3, Genset	£/MWh	6.3, 8.3
$INCA_{ij}$	Metered Incremental Price, Genset	£/MWh	14.3, 14.5
$INCU_{ij}$	Unconstrained Incremental Price, Genset	£/MWh	12.1, 12.2, 20.2
$INCW_{ij}$	Revised Incremental Price, Genset	£/MWh	14
$INCXA_{ij}$	Declared Incremental Price, Genset	£/MWh	17.1, 17.2
$JOLP_j$	Loss of Load Probability before	Number	21.3, 21.4, 21.5

	elasticity and smoothing adjustments		
$KOLP_j$	Loss of Load Probability before smoothing adjustments	Number	21.5, 21.6
$LFID_c$	Loss Factors Attributable to External Pool Member	Number	5.4
LFPS	Loss Factors Attributable to NGC Pumped Storage	Number	5.5
$LOLP_j$	Loss of Load Probability	Number	13.1, 17.4, 21
MG_i	MG, Genset (Minimum Generation)	MW	6.1, 11.3
MINTD1	Minimum Total Demand 1	MW	5.5
MINTD2	Minimum Total Demand 2	MW	5.5
MOA	Merit Order Availability, Genset	MW	6.3, A7
MP_i	MaxGen Price, Genset	£/MWh	6.3, 6.6, 15.6, 20.1
MPC_j	Maximum Pumping Capability	MW	4.3, 5.5
MPL1	Maximum Pumping Load 1	MW	5.5
MPL2	Maximum Pumping Load 2	MW	5.5
MSA_{ij}	Marginal Set Adjustment	£	12.6, 20.2, 24.1

MSL_{sj}	Metered Station Load	MWh	3.3, 24.3
MTD	Maximum Total Demand	MW	4.3, 5.5
N_t	Nominal Demand	MW	5.1
ND_{cj}	Metered Demand, Consumer	MWh	3.3, 14.3
NLA_{ij}	Metered No-Load Price, Genset	£/h	14.3, 14.5
$NL1_i$	No-Load Price 1, Genset	£/h	6.3
$NL2_i$	No-Load Price 2, Genset	£/h	8.3
$NL3_i$	No-Load Price 3, Genset	£/h	8.3
NLU_{ij}	Unconstrained No-Load Price, Genset	£/h	12.1, 12.2
NLW_{ij}	Revised No-Load Price, Genset	£/h	14.1
$NLXA_{ij}$	Declared No-Load Price, Genset	£/h	17.1, 17.2
NMP	Notional Marginal Price	£/MWh	21.5
NND_{sj}	Gross/Net/Net Station Demand	MWh	24.2
NO_j	Nominal Demand	MW	5.1, 30.2
OP_{ij}	Metered Payment, Genset	£	14.6, 24.1

OSI_j	Over-Scheduled Indicator	0 or 1	14.2
PPP_j	Pool Purchase Price	£/MWh	13, 24
$PPP0_j$, $PPP1_j$ and $PPP\#_j$	Pool Purchase Prices used in estimation of Forecast Demand	£/MWh	5.2, 5.3
PR_v	Period Residual	MW	10.3, 10.4
PRP_{ij}	Pool Reserve Price	£/MWh	13.2, 13.5
PS_j, $PS\#_j$	Pumped Storage Demand	MW	4.3, 5.2, 5.5
PSP_j	Pool Selling Price	£/MWh	24
PT	Price Entry	£/MWh	5.3
PTT	Peak Trough Tolerance	MW	2.1, 10.2
$Q0_j$	Total Demand	MW	5.1, 5.3
QT	Demand Entry	MW	5.3
RAP_T	Rolling Average Pool Price	£/MWh	32.1
RP_{ij}	Unconstrained Reserve Payment, Genset	£	13.5, 24.1
RPI	Retail Price Index	Number	21.5, 22.1
SC_{ij}	Spare Capacity, Genset	MW	10.3, A7

SCD	Schedule Day Duration	h	2.1
SDD	Settlement Day Duration	h	2.1
SE_S	Seasonal Error Allowance	Number	21.2, 21.4
SG_i	Synchronising Generation, Genset	MW	6.1
SMP_j	System Marginal Price	£/MWh	6.6, 12, 13.1, 17.4, 20.2
SP_{ij}	Stack Price, Genset	£/MWh	12.4, 12.5
SPD	Settlement Period Duration	h	2.1, many
SRL_i	Spinning Reserve Level	MW	6.1
SU_i	Start-Up Price, Genset	£	6.3, 14.1, 14.3
SUA_{ij}	Metered Start-Up Price, Genset	£	14.3
SUU_{ij}	Unconstrained Start-Up Price, Genset	£	12.1, 12.2
SUW_{ij}	Revised Start-Up Price, Genset	£	14.1, 14.2
$SUXA_{ij}$	Declared Start-Up Price, Genset	£	17.1, 17.2
TAC_{ij}	Table A Capacity	MW	12.3
TAD_j	Total Assumed Demand	MW	5.5

TAP_{ij}	Table A Price, Genset	£/MWh	8.3
TBH1	Table B Hours 1	h	2.1, 10.4
TBH2	Table B Hours 2	h	2.1, 10.4
TBH3	Table B Hours 3	h	2.1, 10.4
TBI_j	Table A/B Indicator	A or B	10.4
TBP_{ij}	Table B Start-Up Payment	£	20.2, 24.1
TBT	Table B Trigger	MW	2.1, 10.4
TCC_{in}	Total Availability Cost, Genset	£	17.2
TCW_i	Total Revised Unconstrained Cost, Genset	£	14.2, 20.2
TE_{cj}	Transfer Error, Interconnector	MWh	26
$TGSD1_j$	Total Gross System Demand Forecast	MW	5.2
$TGSD\#_j$	Forecast Demand	MW	5.2, 8, 21.2, 21.4
TGY_i	Total Payment, Genset	£	24.1
TL_j	Transmission Losses, Period	MWh	24.3
TPL1	Total Pumping Load 1	MW	5.5

TPL2	Total Pumping Load 2	MW	5.5
TSL_i	Two-Shifting Limit	Number	11.2, 11.3
U_{ij}	Unconstrained Generation, Genset	MWh	8.2, 10.2, 12, 16.8
UM_T	Unavailability Measure	Number	32.1
UPS_j	Unadjusted Pumped Storage Demand	MW	5.5
UR_{ij}	Unconstrained Reserve, Genset	MWh	8.2, 10.2, 12.2, 12.6
V_{ij}	Unconstrained Spot Generation, Genset	MW	1.3, 8.2, 12.1
VLL	Value of Lost Load	£/MWh	2.1, 12.5, 13.1, 17.4, 22
VR_{ij}	Unconstrained Spot Reserve, Genset	MW	1.3, 8.2
W_{ij}	Revised Unconstrained Generation, Genset	MWh	13.4, 14, 16.4, 16.8, 17.4, 20.2
WR_{ij}	Revised Unconstrained Reserve, Genset	MWh	13.5, 16.8, 17.4, 20.2
XA_{ij}	Declared Availability, Genset	MWh	16.4, 17
XD_{ij}	Redeclared Availability, Genset	MWh	14.5, 16.4, 16.5, 16.8, 20.1
XG_{ij}	Spot GOAL Availability, Genset	MW	8, 8.2, 8.3
XH_{ij}	Average GOAL Availability, Genset	MW	1.3, 8.2

$XMAX_{eT}$	Maximum Availability, Interconnector	MW	21.2, 21.3, 21.4, 21.9
$XMAX_{iT}$	Maximum Availability, Genset	MW	21.2, 21.3, 21.4, 21.9
$XMAX_{rT}$	Maximum Availability, Range	MW	21.2, 21.3, 21.4, 21.9
$XMAXM_{T}$	XMAX Mean	MW	21.9
XMD_{ij}	Maximum Redeclared Availability, Genset	MWh	16.5
XMP_{ij}	Maximum Actual Availability, Genset	MWh	16.5
XP_{ij}	Actual Availability, Genset	MWh	16.5, 16.8, 17.4, 21.3

INDEX BY SUBJECT

Constraints, Transmission			14, 24.4
Consumer Daily Sales	£	CLD_c	24.5
Consumer Default			24.8
Daily Offered Availability, Genset	MW	$DMAXO_{iT}$	21.2, 21.4
Daily Offered Availability, Interconnector	MW	$DMAXO_{eT}$	21.2, 21.4
Daily Offered Availability, Range	MW	$DMAXO_{rT}$	21.2, 21.4
Daily Pool Payment	£	DPP	23.3
Daily Reoffered Availability, Genset	MW	$DMAXR_{iT}$	21.2, 21.4
Daily Reoffered Availability, Interconnector	MW	$DMAXR_{eT}$	21.2, 21.4
Daily Reoffered Availability, Range	MW	$DMAXR_{rT}$	21.2, 21.4
Day Ahead Offer File			6, 25.2
Declared Availability, Genset	MWh	XA_{ij}	16.4, 17
Declared Incremental Price, Genset	£/MWh	$INCXA_{ij}$	17.1, 17.2
Declared Inflexibility Indicator, Genset	0 or 1	$GIDG_{ij}$	11.1, 11.2
Declared No-Load Price, Genset	£/h	$NLXA_{ij}$	17.1, 17.2

Declared Start-Up Price, Genset	£	$SUXA_{ij}$	17.1, 17.2
Declared Two-Shifting Indicator, Genset	0 or 1	$GIDS_i$	11.1, 11.2
Default, Consumer			24.8
Demand, Agreed (for Interconnector)	MWh	EDL_{cj}	26
Demand, Consumer			4
Demand Entry	MW	QT	5.3
Demand forecasting			5
Demand, Interconnector	MW	ID_j, $ID\#_j$ and ID_{cj}	5.2, 5.4, 5.8, 25.3
Demand Trading Account	MWh	DTA_{ej}	26
Disappearance Ratios	Numbers		21.3, 21.4
Disputes affecting Settlement Runs			30.4
Elbow Point 1, Genset	MW	$E1_i$	6.3, 8.3
Elbow Point 2, Genset	MW	$E2_i$	6.3, 8.3
Emergency Procedures			31
Energy Payment, Unconstrained	£	EP_{ij}	13.4, 16.8, 24.1

EPFAL			24.9
Estimated Instructed Generation (for Generation Trading Block)	MWh	EDI_{ij}	26
Export Interconnection Capability	MW		25.2, 25.3
External Pool Members		EPM	25, 26
Externally Interconnected Parties		EIP	25, 26
Failure Indicator, Genset	0 or 1	GFI_{ij}	16.5
Forecast Demand	MW	$TGSD\#_j$	5.2, 8, 21.2, 21.4
Fuel Security Code			28
Generation Trading Blocks		GTB	1.1, 25, 26
Generation Trading Error Account	MWh	$GTEA_{ej}$	26
GOAL			8, A2
Gross Demand, Consumer	MWh	GD_{cj}	24.3, 24.5
Gross/Net/Net Station Demand	MWh	NND_{sj}	24.2
Gross/Net Station Demand	MWh	GND_{sj}	24.2
Import Interconnector Capability	MW		25.2, 25.3

Incremental Price 1, Genset	£/MWh	$INC1_i$	6.2, 8.3, 12.1, A7
Incremental Price 2, Genset	£/MWh	$INC2_i$	6.3, 8.3
Incremental Price 3, Genset	£/MWh	$INC3_i$	6.3, 8.3
Inflexibility Indicator, Genset	I or F	GII_{ij}	11.5
Inflexibility, Types of			11.2
Instructed Net Transfer, Interconnector	MWh	$IINT_{ej}$	26
Interconnectors			25, 26, A7
Interpolation, Linear			1.5
Loss Factors Attributable to External Pool Member	Number	$LFID_c$	5.4
Loss Factors Attributable to NGC Pumped Storage	Number	LFPS	5.5
Loss of Load Probabilities, preliminary	Numbers	$JOLP_j$ $KOLP_j$	21.3, 21.4, 21.5, 21.6
Loss of Load Probability	Number	$LOLP_j$	13.1, 17.4, 21
Marginal Set Adjustment	£	MSA_{ij}	12.6, 20.2, 24.1
MaxGen Generation, Genset	MWh	GMG_{ij}	20.1
MaxGen Payment, Genset	£	GMP_{ij}	20.1, 24.1

MaxGen Price, Genset	£/MWh	MP_i	6.3, 6.6, 15.6, 20.1
Maximum Actual Availability, Genset	MWh	XMP_{ij}	16.5
Maximum Availability, Genset	MW	$XMAX_{iT}$	21.2, 21.3, 21.4, 21.9
Maximum Availability, Interconnector	MW	$XMAX_{eT}$	21.2, 21.3, 21.4, 21.9
Maximum Availability, Range	MW	$XMAX_{rT}$	21.2, 21.3, 21.4, 21.9
Maximum Pumping Capability	MW	MPC_j	4.3, 5.5
Maximum Pumping Load 1	MW	MPL1	5.5
Maximum Pumping Load 2	MW	MPL2	5.5
Maximum Redeclared Availability, Genset	MWh	XMD_{ij}	16.5
Maximum Total Demand	MW	MTD	4.3, 5.5
Merit Order Availability, Genset	MW	MOA	6.3, A7
Metered Cost, Genset	£	CA_{ij}	14.5
Metered Demand, Consumer	MWh	ND_{cj}	3.3, 14.3
Metered Flow, Interconnector	MWh	IMF_{ej}	3.3, 26.1, 26.3
Metered Generation, Genset	MWh	A_{ij}	3.3, 13.3, 14.3, 14.5, 16.5, 20.1, 21.2, 26.3

Metered Incremental Price, Genset	£/MWh	$INCA_{ij}$	14.3, 14.5
Metered No-Load Price, Genset	£/h	NLA_{ij}	14.3, 14.5
Metered Payment, Genset	£	OP_{ij}	14.6, 24.1
Metered Start-Up Price, Genset	£	SUA_{ij}	14.3
Metered Station Load	MWh	MSL_{sj}	3.3, 24.3
MG, Genset (Minimum Generation)	MW	MG_i	6.1, 11.3
Minimum Total Demand 1	MW	MINTD1	5.5
Minimum Total Demand 2	MW	MINTD2	5.5
No-Load Price 1, Genset	£/h	$NL1_i$	6.3
No-Load Price 2, Genset	£/h	$NL2_i$	8.3
No-Load Price 3, Genset	£/h	$NL3_i$	8.3
Nominal Demand	MW	N_t, NO_j	5.1, 30.2
Non-Despatch Payment, Genset	£	GNY_{ij}	13.3, 24.1
Notional Availability (for interconnectors)			A7
Notional Marginal Price	£/MWh	NMP	21.5

Obligations to generate			7
Offered Availability, Genset	MW	GOA_{it}	6.1, 6.3, 6.5, 16.4, 21.2, A7
On-Site generation			24.6, A6
Over-Scheduled Indicator	0 or 1	OSI_j	14.2
Payment, Genset	£	GY_{ij}	24.1
Payments by Consumers and to Generators	£		24
Peak Trough Tolerance	MW	PTT	2.1, 10.2
Period Residual	MW	PR_v	10.3, 10.4
Period Transmission Losses	MWh	TL_j	24.3
Pool Civil Emergency Period			32
Pool Documents			List on page 75
Pool Funds Administrator			24.9
Pool Purchase Prices used in estimation of Forecast Demand	£/MWh	$PPP0_j$, $PPP1_j$ and $PPP\#_j$	5.2, 5.3
Pool Purchase Price	£/MWh	PPP_j	13, 24
Pool Reserve Price	£/MWh	PRP_{ij}	13.2, 13.5

Reporting of Data by SSA			30.2, A4
Retail Price Index	Number	RPI	21.5, 22.1
Revised Incremental Price, Genset	£/MWh	$INCW_{ij}$	14
Revised No-Load Price, Genset	£/h	NLW_{ij}	14.1
Revised Start-Up Price, Genset	£	SUW_{ij}	14.1, 14.2
Revised Unconstrained Cost, Genset	£	CW_{ij}	14.2, 14.5
Revised Unconstrained Generation, Genset	MWh	W_{ij}	13.4, 14, 16.4, 16.8, 17.4, 20.2
Revised Unconstrained Reserve, Genset	MWh	WR_{ij}	13.5, 16.8, 17.4, 20.2
Revised Unconstrained Schedule			16.8
Risk Management Scheme, Generator			27
Rolling Average Pool Price	£/MWh	RAP_T	32.1
Schedule Day Duration	h	SCD	2.1
Scheduled Capacity	MWh	D_j	10.2
Seasonal Error Allowance	Number	SE_S	21.2, 21.4
Second Tier Data Collection System		STDCS	3.2

Security Periods			28
Settlement Day Duration	h	SDD	2.1
Settlement Period Duration	h	SPD	2.1, many
Settlement Runs			30
Settlement Standing Data			2
Short Term Modifications			A7
Spare Capacity, Genset	MW	SC_{ij}	10.3, A7
Spinning Reserve Level	MW	SRL_i	6.1
Spot GOAL Availability, Genset	MW	XG_{ij}	8, 8.2, 8.3
Stack Price, Genset	£/MWh	SP_{ij}	12.4, 12.5
Start-Up Price, Genset	£	SU_i	6.3, 14.1, 14.3
Station Load, Metered	MWh	MSL_{sj}	3.3, 24.3
Station Load, treatment of			24.2
Summations - Σ symbol		Σ	1.4
Synchronising Generation, Genset	MW	SG_i	6.1

System Marginal Price	£/MWh	SMP_j	6.6, 12, 13.1, 17.4, 20.2
Table A and Table B Periods			10
Table A Capacity	MW	TAC_{ij}	12.3
Table A Price, Genset	£/MWh	TAP_{ij}	8.3
Table A Price 1, Genset	£/MWh	$GAP1_{ij}$	8.3
Table A Price 2, Genset	£/MWh	$GAP2_{ij}$	8.3
Table A Price 3, Genset	£/MWh	$GAP3_{ij}$	8.3
Table A/B Indicator	A or B	TBI_j	10.4
Table B Hours 1	h	TBH1	2.1, 10.4
Table B Hours 2	h	TBH2	2.1, 10.4
Table B Hours 3	h	TBH3	2.1, 10.4
Table B Start-Up Payment	£	TBP_{ij}	20.2, 24.1
Table B Trigger	MW	TBT	2.1, 10.4
Time conventions of SSA and Grid Operator			11.3
Timing of Settlement Runs			30.3

Total Assumed Demand	MW	TAD_j	5.5
Total Availability Cost, Genset	£	TCC_{in}	17.2
Total Demand	MW	$Q0_j$	5.1, 5.3
Total Gross System Demand Forecast	MW	$TGSD1_j$	5.2
Total Payment, Genset	£	TGY_i	24.1
Total Pumping Load 1	MW	TPL1	5.5
Total Pumping Load 2	MW	TPL2	5.5
Total Revised Unconstrained Cost, Genset	£	TCW_i	14.2, 20.2
Transfer Error, Interconnector	MWh	TE_{cj}	26
Transmission Constraints			14, 24.4
Transmission Losses, Period	MWh	TL_j	24.3
Two-Shifting Limit	Number	TSL_i	11.2, 11.3
Unadjusted Pumped Storage Demand	MW	UPS_j	5.5
Unavailability Measure	Number	UM_T	32.1
Unconstrained Energy Payment, Genset	£	EP_{ij}	13.4, 24.1

Unconstrained Generation, Genset	MWh	U_{ij}	8.2, 10.2, 12.1, 12.2, 12.6, 16.8
Unconstrained Incremental Price, Genset	£/MWh	$INCU_{ij}$	12.1, 12.2, 20.2
Unconstrained No-Load Price, Genset	£/h	NLU_{ij}	12.1, 12.2
Unconstrained Reserve Payment, Genset	£	RP_{ij}	13.5, 24.1
Unconstrained Reserve, Genset	MWh	UR_{ij}	8.2, 10.2, 12.2, 12.6
Unconstrained Schedule			8
Unconstrained Spot Generation, Genset	MW	V_{ij}	1.3, 8.2, 12.1
Unconstrained Spot Reserve, Genset	MW	VR_{ij}	1.3, 8.2,
Unconstrained Start-Up Price, Genset	£	SUU_{ij}	12.1, 12.2
Value Added Tax		VAT	1.8
Value of Lost Load	£/MWh	VLL	2.1, 12.5, 13.1, 17.4, 22
XMAX Mean	MW	$XMAXM_T$	21.9