IMPLEMENTING ECONOMIC DISPATCH:

BACKGROUND PAPER

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Definitions

"Economic dispatch"	means the central dispatch (or calling into or taking out of service) of generation, based in some way on the relative cost of the generation units involved.
"Energy balancing"	means the process of maintaining a balance between the transfer of electrical energy into an electricity network by a generator or generators and the transfer out of electrical energy from the electricity network by end-use customers, taking into account network energy losses.
"Energy usage period"	means an interval of time (eg. half hour or five minutes) determined in accordance with good electricity industry practice.
"Load following services"	means the energy balancing (and frequency support) services provided by a generator or generators to ensure that energy generated in the system and the overall system load at any point in time are in an acceptable balance.
"MW"	means the unit of electrical power where one megawatt equals one million watts.
"MWh"	means a unit of electrical work, equal to a power of one MW being absorbed for one hour.
"National electricity market (NEM)"	means the wholesale electricity market operating in Australia and established by the National Electricity Code.
"Network losses"	means the energy loss incurred in the transportation of electricity from an entry or transfer point to an exit point or another transfer point on an electricity network.
"Out-of-balance energy"	means the energy supplied by (or to) the load following generators to make up any difference between the transfer of electrical energy into an electricity network by a particular generator and the transfer out by the customers of that generator, taking into account network energy losses.
"Power system controller"	means the person licensed under Part 3 of the *Electricity Reform Act 2000* to monitor and control the operation of the power system with a view to ensuring that the system operates reliably, safely and securely.
"Standby power"	means the amount of electrical energy which could be supplied to a generator in accordance with the terms of a standby generation agreement, with the aim of ensuring that a generator is able to meet its load following obligations at all times.

CHAPTER 1

INTRODUCTION

Background

1.1 This paper identifies matters arising for the Commission (and the power system controller) following generation-related amendments to the Network Access Code ("the Code") which took effect on 1 July 2001. The relevant amendments to the Code involve the requirement to develop economic dispatch arrangements to replace the initial out-of-balance arrangements.

1.2 In particular, this paper aims to both:

- inform the power system controller and the generators of the matters that the Commission will take into account when considering whether to approve the detailed 'economic dispatch' and settlement arrangements developed by the power system controller; and
- explore issues associated with possible imbalance pricing guidelines to be developed by the Commission.

Timetable

1.3 The relevant amendments to the Code revolve around the provision that:

> *"... the economic dispatch arrangements to give effect to the pricing principles of Chapter 9 of the Code are to be fully operational by 1 July 2002."* (Clause 87A)

1.4 To this end, the Commission is working towards the following timetable.

Due by Date	Action
15 March 2002	Submissions due
15 April 2002	Draft pricing guidelines released for comment
15 May 2002	Power System Controller's proposed changes to the System Control Technical Code to give effect to economic dispatch submitted to the Commission for approval; and Comments due on Draft Pricing Guidelines
1 June 2002	Final pricing guidelines published; and Deadline for the Commission's approval of changes to the System Control Technical Code
1 July 2002	New arrangements commence

1.5 Depending upon feedback from interested parties, the Commission will consider arranging a roundtable to facilitate discussion of the issues, either just before submissions are due or just after the draft guidelines have been released.

Call for submissions

1.6 Public involvement is an important element of regulatory decision-making processes. Submissions are therefore invited from interested parties concerning the issues that need to be addressed before the precise economic dispatch arrangements appropriate in the Territory context are implemented.

1.7 Submissions, comments or inquiries regarding issues raised in this paper should be directed in the first instance to the Executive Officer, Utilities Commission at any of the following addresses:

Postal address:
GPO Box 915
DARWIN NT 0801

Telephone:
(08) 8999 5480

Fax:
(08) 8999 6262

Email:
utilities.commission@nt.gov.au

1.8 The **closing date** for submissions is **Friday, 15 March 2002**.

Confidentiality

1.9 In the interests of transparency and to promote informed discussion, the Commission intends to make submissions publicly available. However, if a person making a submission does not want their submission to be public, that person should claim confidentiality in respect of the document (or any part of the document). Claims for confidentiality should be clearly noted on the front page of the submission and the relevant sections of the submission should be marked as confidential, so that the remainder of the document can be made publicly available.

Public access to submissions

1.10 Subject to the above, submissions will be made available for public inspection at the office of the Commission at Level 9, 38 Cavenagh Street, Darwin, or on its website at: www.utilicom.nt.gov.au

1.11 To facilitate publication on the Commission's website, submissions should be made electronically by disk or email. However, if this is not possible, submissions may be made in writing.

1.12 Information about the role and current activities of the Commission, including copies of reports, papers and submissions may also be found on the Commission's website.

CHAPTER 2

INITIAL ENERGY BALANCING ARRANGEMENTS

Background

2.1 The small size of the Territory's electricity supply industry meant that, when competition was introduced in April 2000, it was not feasible to establish a wholesale electricity pool in the Territory as now operates in the national electricity market (NEM) in south-eastern Australia.

2.2 To ensure that retail contestability takes place in the Territory without a wholesale electricity market, new entrants into the market (whether they be third-party generators and/or retailers) are expected to follow a 'bilateral contracting' model involving them:

- arranging supply directly with contestable end-use customers; and
- supplying all the power needs of individual contracted customers under normal circumstances.

2.3 It is not always practical or appropriate to achieve the perfect 'load following' that these arrangements imply. Any mismatches between a generator's transfers of energy into the network and the demand profile of the generator's customers involve the generator being 'out of balance'.

2.4 The Commission has been involved in regulating the 'out-of-balance' elements of the initial energy balancing arrangements. These arrangements are discussed in more detail below. [The relevant parts of the Code are shown in full in Appendix A.]

Initial load following obligations and dispatch arrangements

2.5 As initially implemented, the Code obliged all generators to use reasonable endeavours to ensure that energy inputs and off-takes for entry and exit connection points subject to an access agreement were in balance (allowing for losses).[1]

2.6 In support of this obligation, in addition to each generator's own operating and load following arrangements, generators were responsible for arranging any standby power necessary to ensure that each generator could always meet its energy requirements and that its use of the network was in balance.[2]

2.7 Rather than the end-use customers of an out-of-balance generator having their supply interrupted, the initial arrangements involved Power and Water Authority (PAWA) Generation being mandated to act as the residual generator in the power system, absorbing any excesses and making up any shortfalls that arise from the operation of bilateral contracting. In this way, PAWA Generation has been required to follow the overall system load (and in doing so has been providing frequency support

[1] Clause 26(1)

[2] Clause 26(2)

services), while all other generators have been required to follow their own customers' load.

Initial out-of-balance settlement arrangements

2.8 As the mandated supplier of load following services, PAWA Generation was compensated by the payment of out-of-balance charges by the generator benefiting from the supply of that energy.[3]

2.9 The power system controller had responsibility for:

- determining the amount of out-of-balance energy supplied by a generator during each 'energy usage period'; and
- undertaking settlement of the resultant charges between generators on a monthly basis.[4]

2.10 Initially, the power system controller was guided by methods set out in a schedule to the Code.[5]

Initial out-of-balance pricing

2.11 The prices used by the power system controller for determining the out-of-balance charges were initially a set of prices:

- aimed at encouraging the avoidance of out-of-balance energy occurrences; and
- subject to the approval of the Commission as regulator.

2.12 As originally provided, a tolerance limit was set to separate relatively minor out-of-balance occurrences ("within-tolerance") from more significant occurrences ("outside-tolerance"). In particular, each generator was expected to keep its generation within a 1½% tolerance of its customers' load.[6]

2.13 This requirement was reflected in a pricing structure that effectively imposed penalties for moving outside this tolerance limit through significantly different pricing levels. In April 2000, the Commission approved the following out-of-balance prices on the basis it expected these prices "…should be sufficient initially to have a neutral effect upon standby availability and pricing at the same time as discouraging price arbitrage".

	within-tolerance	outside-tolerance
PAWA Gen's buy price	5¢/kWh	3¢/kWh
PAWA Gen's sell price	6¢/kWh	8¢/kWh

Commission's interpretation of the initial arrangements

Aim of arrangements

2.14 The initial arrangements were focussed on ensuring that there was the maximum possible incentive on third-party generators to meet their load following

[3] Clause 27(1)

[4] Clause 83(1)

[5] Schedule 12

[6] Clause 84

obligations and not to rely on the mandated energy balancing generator to meet some of those obligations. Relative efficiency played no direct role in dispatch.

Load following and dispatch

2.15 Under the initial arrangements, all generators essentially self dispatched. PAWA Generation – as the mandated energy balancing generator – followed overall system load, while all other generators were responsible for following their own customers' load. The only role for central dispatch – i.e. where the power system controller initiates the call up or closing down of a generator – was strictly limited to situations where system security may be at risk.

Basis of energy balancing prices

2.16 Under the initial arrangements, out-of-balance prices were to be established by PAWA Generation as the mandated supplier of out-of-balance energy and subject to the approval of the Commission. In practice, this has seen the Commission determining the out-of-balance prices being used.

Settlement arrangements

2.17 PAWA Generation, as the mandated supplier of out-of-balance energy, and the other generators have used the power system controller calculations to settle out-of-balance energy charges directly with each other. As such, settlement remains 'off market'.

Contrasts with the NEM

2.18 In essence, the dispatch arrangements under the NEM involve:

- central dispatch, with generators dispatched in least-cost merit order;
- generators, rather than being involved in load following as such, being responsible for supplying amounts of energy sold into the wholesale pool, although frequency support services are provided by generators contracted to the independent system operator;
- energy balancing prices being market based, with successful marginal bids determining the prices at which energy is bought and sold into the pool; and
- the independent system operator being responsible for operating the wholesale market, with settlement for energy balancing services between generators effectively taking place 'on market'.

2.19 By contrast, the initial dispatch arrangements in the Territory involved:

- self dispatch;
- load following;
- energy balancing prices which in practice have been set by the regulator; and
- settlement taking place 'off market'.

Problems with the initial arrangements

2.20 From an early stage, the Commission recognised limits to the initial dispatch and out-of-balance settlement arrangements. In September 2000, the Commission acknowledged that rigid application of the load following principle – and the discouragement of out-of-balance occurrences – ran the risk that:

- the reserve plant margin required across the entire power system may be higher than possible (either presently, or under a pool-like arrangement) – and this would be economically inefficient;
- generators may be dispatched irrespective of their relative efficiency (and therefore underlying 'merit order'); and
- if out-of-balance energy is, for regulatory purposes, priced at a significant margin over costs, PAWA Generation could have the incentive and the means to operate in a manner that was in conflict with the regulatory objective of minimising imbalances.[7]

2.21 As to pricing, when making its initial out-of-balance pricing decision,[8] the Commission noted that for out-of-balance prices to be an effective deterrent against out-of-balance occurrences, a detailed knowledge of the cost structure of third-party generators was required. To be an effective deterrent to out-of-balance occurrences, sell prices should be equal to or above the user's cost of generation and buy prices equal to or below the cost of generation. This gave rise to commercial confidentiality considerations.

2.22 The National Competition Council (NCC) has also reviewed the Code's effectiveness under the *Trade Practices Act 1974* (Cwth) and compliance with the Competition Principles Agreement.[9] The NCC identified the initial out-of-balance arrangements as not meeting the CPA criteria.

2.23 The NCC was concerned with certain features of the initial out-of-balance arrangements, notably:

- the mandating of PAWA Generation as supplier of out-of-balance energy, on the grounds that other generators might also be capable of efficiently providing such a service;
- the ±1½% tolerance limit for distinguishing between 'normal' and 'excess' out-of-balance energy occurrences, on the grounds it may be arbitrary and too inflexible; and
- the explicit penalty component, on the grounds that PAWA Generation could be over-compensated and third-party generators discouraged by such penalty arrangements.

2.24 The NCC considered that settlement of out-of-balance energy could occur through bilateral contracts if the arrangements included, most notably:

> *"• a competitively neutral means of determining, pricing and settling energy imbalances, including accounting for line losses; and*
>
> *• a generator of last resort (or load following generator) that is constrained by contestability or by imbalance price regulation with efficient cost objectives."*[10]

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[7] "An Update on the NT's Electricity Reform Program", speech by the Utilities Commissioner to the Northern Australian and PNG Power Conference, Darwin, September 2000, pp.13-14.

[8] "Out-of-balance Energy Prices for PAWA Generation: Determination", 27 March 2000.

[9] NCC, "Northern Territory Electricity Networks Access Code: Draft Decision", September 2000, pp.38-41.

[10] NCC, "Northern Territory Electricity Networks Access Code: Draft Decision", September 2000, p.39. The NCC also flagged its concern about the importance of "a system controller without conflicts of interest". The Commission considers this issue to have been effectively dealt with for the moment by the Ring-Fencing Code, and so has not considered this matter further in this Paper. The scope and need for an independent system operator will be considered by the Commission prior to the expiry of PAWA's current system control licence on 30 June 2003, including in light of experience under (and issues arising from) the economic dispatch arrangements to commence on 1 July 2002.

CHAPTER 3

REVISED ENERGY BALANCING ARRANGEMENTS

Revisions effective from 1 July 2001

3.1 Principally in response to the NCC's concerns, the Territory Government introduced a number of amendments to the initial energy balancing arrangements, with effect from 1 July 2001. [The relevant parts of the Code are shown in full in Appendix A.]

3.2 These amendments were aimed at replacing the following features of the initial arrangements:

- the mandating of PAWA Generation as the provider (purchaser) of load following services;
- the ±1½% tolerance limit for distinguishing between 'normal' and 'excess' out-of-balance energy occurrences; and
- regulatory approval of out-of-balance prices.

3.3 The amendments involved:

- third-party generators being given the option to contribute to the provision of load following services;
- the ±1½% tolerance limit being dropped; and
- the Commission no longer having an ongoing role in approving out-of-balance prices, and instead being given the role of issuing relevant guidelines.

3.4 *In principle*, the revised arrangements sought to:

- improve the efficiency in pricing, by providing economic incentives to efficient load following at the margin;
- make the supply of load following services effectively contestable, with such energy being supplied instead on the basis of the relative efficiency of plant; and
- improve the ability to collectively manage the system to realise economies of scale, by focusing the 'load following' obligation on provision of the necessary capacity rather than energy.

3.5 *In practice*, the arrangements are a matter to be negotiated between the various generators, the power system controller and the Commission as regulator. The revised Code allows until 1 July 2002 for final detailed arrangements to be negotiated and agreed.

3.6 Until the revised dispatch arrangements are in place and fully operational, clause 87A(2) of the Code provides that out-of-balance prices are to be determined by

the Commission as the schedule of prices that the Commission considers will promote efficient provision of load following services. [11]

Revised load following obligations and dispatch arrangements

3.7 Effectively, the initial load following obligation (under deleted clause 26(1) of the Code) has been replaced by a set of obligations in clauses 25A and 25B.

3.8 Under clause 25A(1), a generator must have sufficient generating capacity available to meet its customers' load, which may include capacity provided via standby arrangements with other generators.[12]

3.9 Under clause 25B(1), the obligation on the generator is to use its best endeavours to ensure that it is not responsible for other generators having to supply the energy necessary to ensure the power system remains in balance.

3.10 To meet this obligation, clause 25B(2) provides that a generator must either:

(a) nominate a proportion of its generation capacity as being available to supply load following services to the power system as a whole; or

(b) opt to provide its own load following services by using reasonable endeavours to ensure that its own use of the network is in balance.

3.11 The initial arrangements involved (b) only. If a generator opts to provide its own load following services, clause 25B(4) – similar to the deleted clause 26(1) – provides that the use of the network will be in balance if, after allowing for network energy losses, the quantity of electrical energy transferred into the electricity network for the connection points in respect of the aggregate of its access agreements for each energy usage period is equal to the quantity of electrical energy transferred out of the electricity network for those connections for that period.

3.12 The revised arrangements have introduced the (a) possibility. The choice between (a) and (b) is at the discretion of each generator. A generator may alter its nomination with 30 days notice to the power system controller.

3.13 Clause 25B(3) provides that a generator nominating a proportion of its generation capacity to supply load following services to the power system as a whole is to be subject to economic dispatch arrangements developed by the power system controller as part of the System Control Technical Code and approved by the Commission.

3.14 Clause 87A provides that the economic dispatch arrangements to give effect to the revised pricing principles of Chapter 9 of the Code are to be fully operational by 1 July 2002.

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[11] Clause 87A (as do all the clauses in Chapter 9 of the Code) refers to 'out-of-balance energy services', rather than 'load following services' (the term used in Chapter 3 of the Code). The Commission regards the two terms as being inter-changeable. The term 'load following services' is used throughout this Paper.

[12] The revised arrangements make much more explicit the obligations on generators regarding their generation capacity. Moreover, clause 25A empowers the Commission (not evident under the initial arrangements) to both:

- develop and publish guidelines regarding the assessment of the adequacy of generation capacity (sub-clause (2)), and
- assess a generator's actual capacity against the capacity required under the guidelines (sub-clause (4)) and, if necessary, issue a directive to the generator to eliminate any deficiency (sub-clause (5)).

These matters are subject to separate consideration by the Commission. The focus of this Paper is instead on the energy (c.f. capacity) balancing requirements of clause 25B.

3.15 Following the first 12 months of operation of the economic dispatch arrangements, the Commission is to review these arrangements in consultation with all licensed generators. In conducting that review, the Commission:

- must assess the extent to which the arrangements are meeting the requirements of clause 85; and
- may make recommendations to the Regulatory Minister regarding changes that the Commission considers necessary to the economic dispatch arrangements to meet the requirements in clauses 85 (a) and (b).

Revised out-of-balance settlement arrangements

3.16 Under clause 25A(8), if a generator's energy usage is shown to have been out of balance, so that it has benefited from load following services provided by other generators, that generator must reimburse the generator (or generators) responsible for supplying the balancing amount of energy. The measurement of out-of-balance energy, and any charges imposed on a generator, are regulated by amended provisions of Chapter 9 of the Code.

3.17 Chapter 9 only regulates the pricing of load following services to generators. Clause 82(2) defines load following services[13] as involving:

- the electrical energy dispatched by a generator into the power system at the request of the power system controller that has the effect of meeting any mismatch between the transfer of electrical energy into and out of the electricity network by the parties to an access agreement; and
- the provision of any generation capacity by a generator in response to a request of the power system controller to meet a shortfall between a generator's own effective generation capacity and its customers' load.

3.18 Clause 85A(1) provides that a generator that produces an amount of energy different to its customers' demand in an energy usage period must pay to the generator (or generators) responsible for providing or purchasing the energy difference an amount equal to the product of:

- the applicable system imbalance energy price; and
- the difference between the actual and required amount of energy.

3.19 Under clause 85A(2), where any out-of-balance energy is produced by generation plant in excess of the plant necessary to meet the generator's own aggregate customer load, the generator that produces less than its customers' demand must pay to the generator (or generators) responsible for providing the necessary additional generation capacity an amount equal to the product of:

- the applicable system imbalance capacity price; and
- the additional generation capacity involved.

3.20 The power system controller is responsible for establishing the amounts to be settled between generators as a result of any generating capacity or energy usage imbalances, using system imbalance prices regulated under Chapter 9 of the Code.

3.21 The power system controller, in consultation with licensed generators, is to develop arrangements for the settlement of any out-of-balance payments between the generators, and the role to be played by the power system controller in the settlement process.

[13] All references in Chapter 9 of the Code are to 'out-of-balance energy services', rather than the 'load following services' term used in this Paper.

3.22 The Commission is to approve these arrangements only if the Commission considers the arrangements to be consistent with the pricing principles in clause 85.

Revised system imbalance prices

3.23 Clause 85 sets out the pricing objectives to be observed by the Commission and the power system controller when determining guidelines or dispatch arrangements which may affect the prices for any load following services. Specifically, the Commission and the power system controller must ensure that these guidelines and arrangements result in prices which best promote:

- the efficient provision of load following services (both capacity and energy); and
- the efficient operation and ongoing development of the power system as a whole.

3.24 Under clause 85A(3), the system imbalance prices are to take into consideration:

- the type of out-of-balance transfer involved;
- the magnitude of the loading or deloading of generation plant providing the load following service; and
- the time of day, day of week and season of the year in which the load following service provision occurred.

3.25 Under clause 87A(2), until the consultations necessary to ensure the satisfactory implementation of the economic dispatch arrangements to give effect to the pricing principles in this Chapter are completed and those arrangements are in place and fully operational, the various system imbalance prices are to be determined by the Commission as the schedule of prices that the Commission considers will promote efficient provision of load following services.

3.26 The Commission may develop and publish guidelines in connection with the operation of Chapter 9 of the Code. Generators and the power system controller must comply with any guidelines developed and published by the Commission. In developing and publishing such guidelines, the Commission must consult with all licensed generators and, in doing so, must allow a reasonable time for consideration of the issues and development of a consensus on the nature of the economic dispatch arrangements to give effect to the pricing principles in clause 85.

System imbalance energy price

3.27 Under clause 85B, the system imbalance energy price to apply in a particular energy usage period will depend upon whether or not dispatch of generation units is affected by system constraint or system security considerations.

3.28 Where dispatch of generation units is unaffected by system constraint or system security considerations, the system imbalance energy price is defined by reference to the marginal operating costs of generation units instructed by the power system controller to deviate from their expected level of output. Generators that are on load following duty are deemed to be instructed.

3.29 In these circumstances, the price is to be either:

- the highest marginal operating cost of any generation unit instructed to increase output, in the event that additional supply is required; or
- the lowest marginal operating cost of any generation unit instructed to decrease output, in the event that the market is oversupplied.

3.30 Where system constraints or system security requirements affect the dispatch of particular generation units, the power system controller is to both:

- instruct the dispatch of generation units; and
- set the associated system imbalance energy price,

in accordance with constraints management and system security procedures approved by the Commission. In approving these procedures, the Commission is to ensure that the procedures and associated pricing are, in the Commission's opinion, as consistent as is practicable in the circumstances with the efficient operation of the power system.

System imbalance capacity price

3.31 Under clause 85C, the system imbalance capacity price to apply in a particular energy usage period is defined by reference to the incremental capital cost of generation units instructed by the power system controller to commence output. The price must be the highest incremental capital cost of any additional generation unit instructed to commence output, in the event that additional supply is required. Generators that are on load following duty are deemed to be instructed.

Commission's interpretation of the revised arrangements

Aim of revised arrangements

3.32 In principle, the revised arrangements seek to improve the efficiency in pricing by providing economic incentives to efficient load following *at the margin*, making the supply of load following services effectively contestable and improving the ability to collectively manage the system to realise economies of scale. PAWA Generation is no longer the mandated provider of load following services, the tolerance limit is removed and prices are no longer regulator approved (although subject to Commission guidelines).

Load following and dispatch

3.33 The revised arrangements remain focused on the provision of energy balancing and generators are obliged to use best endeavours to ensure that the power system controller does not have to dispatch other generators to maintain system balance.

3.34 While the initial arrangements solely involved self dispatch by generators, the revised arrangements have introduced some role for central dispatch by the power system controller where third-party generators opt to provide load following services. Even so, the central dispatch by the power system controller may be as limited as is necessary to meet the small operational energy balancing requirements where a generator is not able to maintain balance in spite of its 'best endeavours'.

Basis of energy balancing prices

3.35 Imbalance prices for energy and capacity are to be cost based. They are not determined by the interactions of buyers and sellers through the matching of offers to supply and offers to purchase.

3.36 The revised system imbalance pricing structure recognises the variable and fixed cost drivers by defining a two element pricing structure:

- system imbalance energy price based upon the marginal operating cost; and
- system imbalance capacity price established by reference to the incremental capital cost of directed generation units.

3.37 This revised arrangement recognises that a business should be able to earn a financial return on the provision of generation capacity used for energy balancing purposes as well as on the energy supplied itself.

Settlement arrangements

3.38 The load following generator and the other generating parties use the power system controller calculations to settle directly with each other. As the independent system operator, the power system controller is not directly involved in the financial settlement process other than to provide information to the parties. As such, settlement remains 'off market', although settlement now involves amounts related to imbalances initiated by the power system controller as well as involuntary out-of-balance energy amounts.

Remaining contrasts with the NEM

3.39 The remaining contrasts essentially are that:

- central dispatch remains limited – there is no central dispatch specifically aimed at fostering least-cost merit order dispatch;
- energy balancing prices are cost based and have two parts (energy and capacity) – there is no role for comprehensive, market-based prices; and
- energy settlement is 'off market' – there is no role for 'on market' settlement.

The Commission invites comment or submissions on the following questions arising from this Chapter:

Are there any aspects of the Commission's interpretation of the revised arrangements (in this Chapter) which are unclear or disputed?

Are there any other remaining contrasts with the NEM that deserve to be noted in this context?

CHAPTER 4

IMPLEMENTING THE REVISED ARRANGEMENTS

Requirements of the Code

4.1 The revised Code imposes some particular requirements when it comes to implementing the revised load following arrangements. In particular, the power system controller is to develop (for approval by the Commission):

- as part of the system control technical code – the economic dispatch arrangements to apply to a generator that nominates a proportion of its generation capacity to supply load following services to the power system as a whole (clause 25B(3)); and
- in consultation with licensed generators – the arrangements for the settlement of any out-of-balance payments between the generators, and the role to be played by the power system controller in the settlement process (clause 85A(4)).

4.2 In addition to approving these arrangements developed by the power system controller, the Commission is empowered to develop and publish guidelines in connection with the pricing and settlement arrangements (i.e. as they relate to the operation of Chapter 9 of the Code).

4.3 When determining guidelines or dispatch arrangements which may affect the prices for any load following services, the Commission and the power system controller must:

- consult with all licensed generators and, in doing so, must allow a reasonable time for consideration of the issues and development of a consensus on the nature of the economic dispatch arrangements to give effect to the pricing principles in clause 85 (clause 87(2)); and
- ensure that the resultant prices are those that best promote:
  - (a) the efficient provision of out-of-balance capacity and energy; and
  - (b) the efficient operation and ongoing development of the power system as a whole (clause 85).

Immediate tasks

4.4 The power system controller is faced with developing two sets of arrangements, namely:

- arrangements which give effect to economic dispatch of generation units nominated to provide load following services; and
- arrangements for the settlement of any out-of-balance payments between the generators, and the role to be played by the power system controller in the settlement process.

4.5 As both these sets of arrangements can only apply once they have received the approval of the Commission, the next chapter of this Paper (Chapter 5) provides further guidance as to the criteria the Commission intends to apply when assessing the proposals put forward by the power system controller.

4.6 Likewise, the Commission is also charged with considering whether to develop guidelines with respect to the setting of imbalance prices (and the associated settlement of imbalance charges). Chapter 6 of this Paper explores the issues associated with the cost-based pricing of load following services.

CHAPTER 5

ASSESSING ECONOMIC DISPATCH OPTIONS

Introduction

5.1 This chapter discusses the issues that the Commission will consider – and the criteria it could apply – when assessing proposals put forward by the power system controller giving practical effect to the revised Code's adoption of 'economic dispatch' and the related settlement arrangements.

Legislative requirements

5.2 When considering the development of any regulatory or management arrangements for energy balancing, the Commission must take account of the objects of the *Electricity Reform Act 2000* and the *Utilities Commission Act 2000*.

5.3 The objects of the *Electricity Reform Act* are:

> *"(a) to promote efficiency and competition in the electricity supply industry;*
>
> *(b) to promote the safe and efficient generation, transmission, distribution and selling of electricity;*
>
> *(c) to establish and enforce proper standards of safety, reliability and quality in the electricity supply industry;*
>
> *(d) to establish and enforce proper safety and technical standards for electrical installations;*
>
> *(e) to facilitate the maintenance of a financially viable electricity supply industry; and*
>
> *(f) to protect the interests of consumers of electricity."*

5.4 The object of the *Utilities Commission Act* is:

> *"…to create an economic regulatory framework for regulated industries that promotes and safeguards competition and fair and efficient market conduct or, in the absence of a competitive market, that promotes the simulation of competitive market conduct and the prevention of the misuse of monopoly power".*

5.5 In undertaking its role in any regulated industry, the *Utilities Commission Act* requires the Commission to have regard to the need:

> *"(a) to promote competitive and fair market conduct;*
>
> *(b) to prevent misuse of monopoly or market power;*
>
> *(c) to facilitate entry into relevant markets;*
>
> *(d) to promote economic efficiency;*
>
> *(e) to ensure consumers benefit from competition and efficiency;*
>
> *(f) to protect the interests of consumers with respect to reliability and quality of services and supply in regulated industries;*
>
> *(g) to facilitate maintenance of the financial viability of regulated industries; and*

(h) to ensure an appropriate rate of return on regulated infrastructure assets."

5.6 Finally, and in particular, clause 85 of the Code requires the Commission and the power system controller, when determining guidelines or dispatch arrangements which may affect the prices for any load following services, to ensure that the resultant prices are those that best promote:

"(a)the efficient provision of out-of-balance capacity and energy; and

(b) the efficient operation and ongoing development of the power system as a whole."

5.7 It follows that, in implementing economic dispatch arrangements (and associated pricing), consideration needs to be given to a number of key principles that underlie the operation of competitive and efficient arrangements. In particular, the arrangements should, to the maximum extent feasible:

- be transparent to participants;
- reduce barriers to entry;
- result in efficient and competitive price setting and charging mechanisms;
- involve mechanisms for scheduling and dispatch that are efficient and non-discriminatory; and
- be economic, reflect true market conditions and capable of being readily implemented.

What is economic dispatch?

5.8 To go beyond these broad criteria depends significantly on the meaning to be attributed to 'economic dispatch'.

5.9 In general terms, the Commission interprets economic dispatch as involving the central dispatch of generation, with such dispatch being based in some way on the relative cost of the generation units subject to central dispatch.

5.10 Clause 25B(2)(a) permits a generator to:

"…nominate a proportion of its generation capacity as being available to supply load following services to the power system as a whole."

5.11 At issue is: how large a proportion of a generator's capacity and how many of a generator's units could be made available to supply load following services and thereby be subject to economic dispatch arrangements? The proportion could be small (not much different than the out-of-balance proportion observed to date, say up to 3% of the energy market), or it could be as large as the output of the largest single generation plant or 15-20% of the market.

5.12 In the context of the revised energy balancing arrangements, it is therefore possible to put either a narrow or a broad interpretation on economic dispatch:

- The narrow interpretation involves central dispatch by the power system controller of the ***small*** operational energy balancing requirements associated with generators not being able to maintain balance in spite of their 'best endeavours'.
- The broad interpretation involves central dispatch of ***nominated*** generation plant, with the plants involved centrally dispatched based in some way on economic (i.e. least-cost) merit order.

5.13 Under the broad interpretation of economic dispatch, the power system controller would have a series of costs or bids (price and associated volume) that form a merit order 'stack'.

5.14 The power system controller would maintain energy balance by increasing or decreasing the output of any generators participating in economic dispatch – subject to system technical requirements and constraints.

5.15 It should be noted that this broad interpretation – while encompassing some of the NEM characteristics – would continue to differ in some important respects from the wholesale pool arrangements under the NEM, notably unlike the NEM:

- it does not involve central dispatch of ***all*** generators; and
- it does not involve an on-market settlement process where the independent system operator effectively buys and sells (wholesale) power.

5.16 On this latter point, it should be noted that the Commission is not canvassing the scope for 'on market' settlement in the Territory's electricity generation market, where a power system controller would buy and sell electricity from generators, with the generators in turn becoming debtors and creditors to the power system controller. An 'off market' low cost settlement process for the increased imbalances must remain a contrast with the NEM.

5.17 The area of interpretation focussed on in this chapter, and the matter most open in the revised Code, is the extent of central dispatch and the role to be played in particular by least-cost merit order dispatch.

Case for broad interpretation

5.18 There are several lines of argument in support of a broad interpretation of economic dispatch in the Territory context.

5.19 First, subject to the contractual constraints on fuel supply, scope exists even in the Northern Territory for priority scheduling of the most efficient, lower cost generating units. The Darwin/Katherine system is supplied by six power stations with a total output of 343MW. There are a total of 21 generating units ranging from 2.5MW to 44MW.

5.20 Secondly, the broad interpretation is similar to the arrangements in markets such as the Victorian gas market operated by Vencorp and the electricity markets in Norway, Sweden and Finland (NordPool) that combine self dispatch under bilateral contracts and central dispatch of the balancing energy requirements. Markets characterised by bilateral physical contracts and some form of wholesale trading market (sometimes referred to as bilateral trading markets or net pool markets) have tended to be implemented where trade has previously been based on bilateral contracts between producers or generators and retailers or end users. In net pool markets, suppliers self dispatch and an independent system operator dispatches further suppliers in least-cost merit order to maintain an overall system supply/demand balance. The differences between the bilateral physical contract quantities and the total quantities are trades in the wholesale market at prices established by the market processes. In these markets, most of the energy is supplied via bilateral contracts with typically 5-15% of energy being traded at the wholesale level. These markets are voluntary and, aside from the management of imbalances between an individual participant's supplies and off-takes, there is no obligation to buy or sell energy in the spot market. A real time balancing market is used to dispatch and set prices for energy balancing.

5.21 Finally, a broader interpretation of economic dispatch could reduce barriers to entry into the Territory's generation (and so retail) market. New generators face substantial market barriers to entry where bilateral contracting and self dispatch

predominate. [14] The market for standby power in the Territory is a wholesale market between generators. However, the use of standby purchases is restricted to circumstances where the purchasing generator is unable to meet its obligations for reasons outside its own control. A new generator considering entering the Territory market with new technology, highly efficient plant currently needs to establish bilateral physical contracts with retailers or end users. Without a merit order-based load following services market, there are no other means of selling what may be efficient, low cost electricity generation. The current supply contract positions of end users may also act as barriers to entry. Because of the current bilateral physical contracting, a new generator may size plant to match its contract position. If another sales channel such as an expanded load following market was available, different investment decisions may be made and economies of scale potentially achieved. Improved industry efficiency and increased competition could result.

5.22 In summary, broadening the load following market – so providing for a mechanism for energy to be sold and purchased to complement the current bilateral contracting arrangements – may serve to:

- better ensure priority utilisation of the most efficient plant;
- reduce barriers to market entry by new generators and retailers;
- encourage incumbent generators to reduce costs; and
- improve economic efficiency in generation investment.

5.23 If a broader form of economic dispatch was implemented in effect to provide for wholesale trading at the margin, the energy requirement for load balancing would not be distinguishable from market trades. The load following generation requirement

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[14] Retailers face lower barriers to entry than generators to the extent that some elements of 'wholesale trading' already exist in the Territory's electricity market (certainly more than may have been originally envisaged by some). In particular, the Ring-Fencing Code put in place by the Commission means that, in relation to generation, the incumbent generator (while it remains the dominant generator) must offer to sell energy to retailers on a non-discriminatory basis. Any retailer can therefore approach the incumbent generator and expect to receive an offer to sell energy on terms than do not reflect the affiliation of the retailer. The Commission has issued Guidelines on the matter of contestable pricing in the NT context. These Guidelines state, in part:

> "11. To avoid a finding by the Commission that PAWA Generation has engaged in discriminatory pricing conduct when setting the energy price it is charging, or intended to charge, PAWA Retail, PAWA Generation must be able to demonstrate to the Commission's satisfaction that the basis of its pricing for PAWA Retail involves:
>
> (a) any delivered gas cost advantages accruing to PAWA Generation – on account of the gas contracts negotiated by the Territory Government prior to opening up of the Territory's electricity market to competition – being shared among retailers (including PAWA Retail) in a manner that does not favour PAWA Retail; and
>
> (b) recovery of non-gas costs – both capital costs and operating costs – in a manner that does not favour PAWA Retail.
>
> 12. The Commission recognises that non-discriminatory pricing does not necessarily involve offering or charging the identical (average) price per kWh for energy sold to a third-party retailer as for energy sold to PAWA Retail or to a third-party generator, with justified differentials arising on account of differences between purchasers with respect to, among other things:
>
> (a) the required duration of the power purchase agreement;
>
> (b) the required total (additional) quantum of energy to be purchased under that power purchase agreement, but not counting the quantum of energy purchased by the franchise retail segment or the quantum of energy purchased on account of supply to 'contestable' customers under contracts entered into prior to the customer becoming contestable;
>
> (c) the required daily, weekly and annual load profile of the (aggregate) energy being purchased under the power purchase agreement; and
>
> (d) the purchaser's relative credit rating."

This prohibition on discriminatory pricing (and exclusive dealing) provides retailers with competitively priced arrangements for the purchase of energy through bilateral physical contracts with generators.

would be contestable and established by the market. All generators may seek to provide these balancing services.

5.24 In this way, the broad interpretation could better satisfy the requirements of clause 85. While the narrow interpretation may, to an extent, satisfy the criteria in clause 85(a), namely the promotion of efficient provision of out-of-balance capacity and energy, the criteria in clause 85(b) involves assessing arrangements that best promote the efficient operation and ongoing development *of the power system as a whole*. In terms of the benefits it could provide, the broad interpretation is clearly preferable to the narrow interpretation when it comes to the efficient operation and ongoing development of the power system as a whole.

Case against broad interpretation

5.25 Most of the arguments for the broad interpretation of economic dispatch focus on the *benefits* that might ensue. One line of argument against the broad interpretation could be the extra administrative *cost* that may be involved. However, as economic dispatch arrangements are to be put in place *at a minimum* for narrow load following purposes, it is conceivable that there may be little additional cost involved in extending the scope of economic dispatch to include a greater level of least-cost merit order dispatch. Much depends upon the precise arrangements envisaged. These matters are discussed in more detail in the next chapter.

5.26 A second line of argument against the broad interpretation may be that the cost-based nature of imbalance pricing in the Code places some limits on economic dispatch. As explained in the next chapter, an extended form of economic dispatch may only function efficiently if clearing prices were established between participants themselves. In the NEM, all energy is traded on the market through the matching of participant sell and purchase bids, based upon those bids. As currently drafted, the Code envisages cost-based pricing arrangements. Code changes may therefore be required to implement a broad interpretation of economic dispatch. This is also the subject of the next chapter.

The Commission invites comment or submissions on the following questions arising from this Chapter:

Is the list of criteria for assessing economic dispatch options complete, or are there other relevant considerations?

Has the Commission specified the 'narrow' and 'broad' interpretations of economic dispatch adequately?

Is the list of possible *benefits* of the 'broad' interpretation complete, and are any of the benefits mentioned overstated or mis-specified?

What additional administrative and other *costs* are likely in progressing from a 'narrow' to a 'broad' implementation of economic dispatch in the NT context?

In what circumstances might a new entrant to the NT electricity generation market be prepared to nominate a proportion of its generation capacity for load following service purposes? What risks would such participation present to new entrants?

CHAPTER 6

ASSESSING IMBALANCE PRICING OPTIONS

Introduction

6.1 In addition to approving the economic dispatch arrangements, the Commission may also develop guidelines with respect to the setting of imbalance prices (and the associated settlement of imbalance charges). This chapter explores the issues associated with the Code's emphasis upon *cost-based* pricing of load following services.

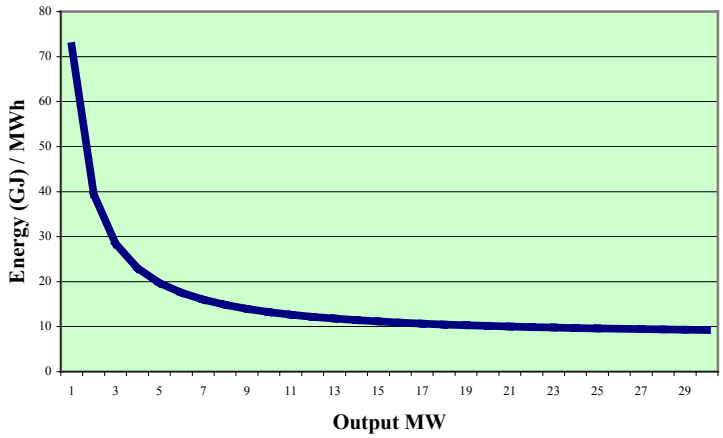
Generating plant characteristics

6.2 Given the predominance of gas turbine generation in the Territory, an understanding of the operating and cost characteristics of gas turbine generating units is beneficial when considering energy balancing pricing arrangements.

6.3 Gas turbines can generally be classified as 'fast start' electricity generators as they can be brought on line very quickly to meet demand. Similarly, they can quickly be withdrawn from service. This feature assists the energy balancing process and provides the flexibility and opportunity to optimise total generation costs through dispatch of the most economical generation units.

6.4 The efficiency of gas turbine plants varies according to the load – represented by the heat rate curve that plots the energy required per MWh of generated electricity output as a function of the generator's MW output (Figure 1).

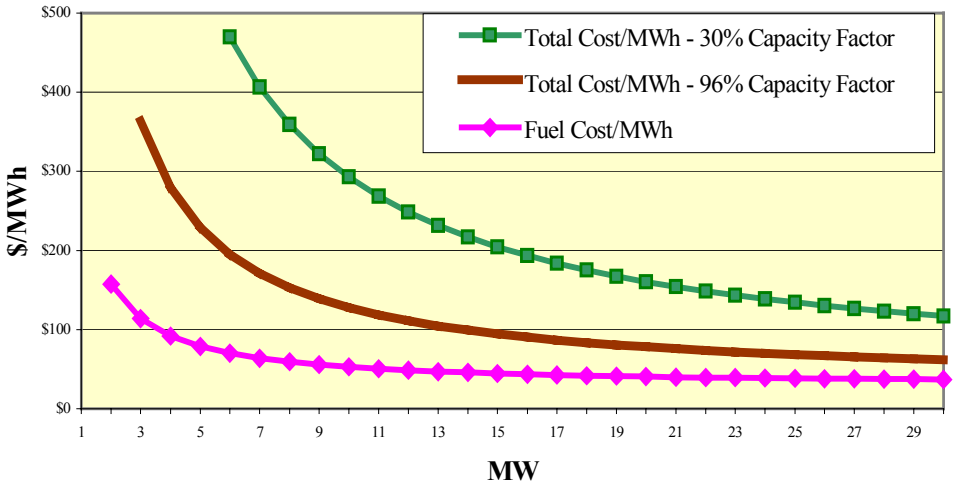
Figure 1 – Typical Gas Turbine Heat Rate Curve



6.5 The heat rate curve indicates the efficiency of a unit over its operating range. As can be seen from Figure 1, efficiency is particularly poor at low output levels.

6.6 From the heat rate curve, the cost of fuel for the gas turbine as a function of MW output can be established – the fuel cost curve (Figure 2).

Figure 2 –Illustrative Gas Turbine Cost Curves



6.7 The other elements of cost are capital and operating and maintenance costs. In general, maintenance costs vary with hours of operation. To the first order of approximation, these maintenance costs may be viewed as largely 'fixed' on a time basis and independent of where the plant is operating on the heat rate curve.

6.8 Also, capital costs (returns on debt and equity and depreciation expense) are typically a 'fixed cost' ie not directly linked to the output or hours of operation.

6.9 Consequently, recovery of these 'fixed' capital and maintenance costs through a generation charge per MWh will be related to the total output of the plant. The lower the actual capacity factor (proportion of total possible output), the higher the cost per output unit ($/MWh) required to recover fixed costs.

6.10 Thus, in addition to the marginal cost (which is essentially fuel cost), a generator must also consider the impact of increased (or decreased) generation output upon the capacity factor and thus the recovery of fixed costs. At the most efficient part of the curve, fuel cost may at most be 50% of the total cost for a high capacity factor generator. With lower utilised plant operating at relatively poor efficiency, fuel may only be 10% of the total cost per MWh (illustrated by the cost curves in Figure 2).

Energy balancing pricing

Code requirements

6.11 Clause 85A(1) of the Code provides that a generator that produces an amount of energy different to its customers' demand in an energy usage period must pay to the generator (or generators) responsible for providing or purchasing the energy difference an amount equal to the product of:

- the applicable system imbalance energy price; and
- the difference between the actual and required amount of energy.

6.12 Under clause 85A(3), both types of imbalance prices are to take into consideration:

- the type of out-of-balance transfer involved;

- the magnitude of the loading or deloading of generation plant providing the load following service; and
- the time of day, day of week and season of the year in which the load following service provision occurred.

6.13 Under clause 85B, where dispatch of generation units is unaffected by system constraint or system security considerations, the system imbalance ***energy*** price is defined by reference to the marginal operating costs of generation units instructed by the power system controller to deviate from their expected level of output. Generators that are on load following duty are deemed to be instructed. In these circumstances, the price is to be either:

- the highest marginal operating cost of any generation unit instructed to increase output, in the event that additional supply is required; or
- the lowest marginal operating cost of any generation unit instructed to decrease output, in the event that the market is oversupplied.

6.14 Under clause 85C, the system imbalance ***capacity*** price to apply in a particular energy usage period is defined by reference to the incremental capital cost of generation units instructed by the power system controller to commence output. The price must be the highest incremental capital cost of any additional generation unit instructed to commence output, in the event that additional supply is required. Generators that are on load following duty are deemed to be instructed.

Nature of marginal costs

6.15 The Code does not envisage the use of 'short-run marginal cost pricing'. Short-run marginal cost:

- varies significantly between units of plant and fuel types;
- for a gas turbine – is largely the marginal fuel cost;
- at a particular time will depend upon which point on the heat rate curve (and thus the cost curve) the generator is operating at that time (refer Figure 2); and
- no (or limited) allowance is made for capacity availability or fixed costs (short-run marginal costs may only be 10–50% of total costs).

6.16 Any pricing structure based solely upon short-run marginal costs risks disadvantaging the generator providing the energy in the market place. As well as not providing any or significant absorption of fixed costs, the prices would be very attractive to other generators or retailers as they would represent a fraction of the real total cost of generation. Supply under this type of price structure could be used in the market to undercut the generator providing the service.

6.17 The Code's system imbalance pricing structure recognises the variable and fixed cost drivers by defining a two element pricing structure:

- system imbalance energy price based upon the marginal operating cost; and
- system imbalance capacity price established by reference to the incremental capital cost of directed generation units.

This arrangement recognises that a business should be able to earn a financial return on the provision of generation capacity used for energy balancing purposes as well as on the energy supplied itself.

Cost-based pricing

6.18 The system imbalance energy price is established by the marginal operating cost of the instructed plant. The system imbalance capacity price is defined by reference to the incremental capital cost of generation units instructed to increase

output. Both price elements are dependent upon multiple variables such as the load point on the cost curve, capacity factor and plant type. In combination, the elements of the cost-based revised pricing arrangements reflect the 'full cost' of providing the energy balancing service.

6.19 The Code therefore requires that imbalance prices for energy and capacity be *cost based*.

Alternatives to cost-based pricing

6.20 The features of cost-based pricing are usefully established by contrasting cost-based price determination with the determination of prices in competitive markets.

6.21 Prices in competitive markets are usually:

- determined via the interactions of buyers and sellers; and
- comprehensive in nature (rather than two part).

Focus on bids rather than 'full' cost

6.22 Market prices are determined by the interactions of buyers and sellers through the matching of offers to supply and offers to purchase. The NEM represents a market-based arrangement that allows the offers of buyers and sellers to be matched. Typically, the arrangements involve:

- the submission of bids by market participants to the system operator comprising a MW quantity and a $/MWh price for the time period;
- the bids are of two types – to increase output if a certain price is received or to decrease output if the market can supply at prices lower than a certain price; and
- technical data necessary for the system operator to operate the system (including constraints, ramp times etc).

6.23 The most important feature of market-based pricing is that the seller can choose its own pricing structure and the volumes that it wishes to sell under that structure. Similarly, the buyer has choice as to its supply source (own generation, bilateral contracts and market), volumes and the price it is prepared to pay.

6.24 This choice is important as a generator seeks to also manage its fuel supply issues. Gas supply and pipeline constraints such as maximum daily quantities and take-or-pay minimum annual quantities will influence the behaviour of a generator. These constraints may limit extra generation or require the generator to operate when it would otherwise purchase from a market.

6.25 Markets with multiple generators with various units of plant often use marginal costing to establish prices. As a price needs to be attractive to a buyer, a seller may choose to establish a sales price that is based upon short-run marginal cost plus a margin. Any price above marginal cost provides a contribution to the fixed costs of the seller and may be less than the marginal cost of generation for the purchaser – a win/win outcome that is likely to result in trade. In addition, the generating unit may then be operating on a more efficient part of the cost curve. Indeed, the market prices in the NEM are frequently in the range between marginal cost and full cost.

6.26 The seller may choose to limit the potential for a 'free ride' upon marginal pricing by another industry participant by defining the volume available at these prices. Importantly, each market participant is free to make commercial decisions that it considers to be in its own best interests.

Focus on a comprehensive rather than a two-part price

6.27 Under the NEM, a single energy price for a period is determined by reference to the generators/participants that have been instructed by the power system controller to deviate from their original output or demand. It is either:

- when additional supply is necessary, the highest marginal bid cost of any participant instructed to increase output or to reduce demand;
- when over supply occurs, the lowest marginal bid cost of any participant instructed to decrease output or to increase demand.

6.28 The single energy price established by the marginal price as described above is used as the clearing price for all transactions during a period. Even if a participant had bid a different price, all its trades in the market are settled at this marginal price. This is the price setting mechanism used in the NEM and the Victorian gas market.

6.29 Bidding behaviour in this type of market generally has efficient generators bidding relatively low prices (even below marginal cost) to ensure dispatch in the expectation that a higher cost participant is likely to also be dispatched thus establishing a marginal price that is higher than the efficient generator's bid. This results in an overall efficient outcome.

6.30 Some markets have introduced a different price setting arrangement where dispatch is still by merit order but where the participant settles at the price of its own bid – not the marginal price.

6.31 Under this alternative basis, commercial returns are dependent upon the bids submitted by a participant. This generally results in changed bidding behaviour where participants try to estimate the total demand and likely competitor bids in order to construct their bids and maximise their returns. This can result in some inefficient outcomes where the participant estimates are not correct.

6.32 As it tries to ensure that it will receive a good price and optimise its returns, a generator will endeavour to estimate the total demand and bid at a price marginally below the expected next bid in a merit order. Relatively small errors in forecasting can result in a low cost generator not being dispatched. A higher cost generator may be supplying the market when lower cost plant is available – an inefficient outcome.

Difficulties arising in implementing cost-based pricing

6.33 To be efficient and competitive, a market ideally needs multiple sellers and buyers. As the Territory industry currently has a limited number of generators, an efficient market-based solution may not be available. Consequently, regulated energy balancing pricing arrangements may be required.

6.34 As a result, the Code's pricing structure is cost based and requires the definition of marginal costs and incremental capital costs over the operating range of each generation unit. The Commission recognises a number of problems arise in implementing cost-based pricing including:

- such pricing may remove the operational and pricing flexibility available to a generator in a market;
- the difficulty of establishing the incremental capital costs at particular operational outputs for all generating units on a transparent and verifiable basis; and
- the confidentiality of generator operational and commercial information in a market with few participants.

6.35 For example, costs may vary over time. Marginal costs may vary with the cost of fuel supplies such as distillate or gas which may have fixed and variable components. The power system controller may be required to periodically change or review the economic merit order.

6.36 To simplify matters, consideration may need to be given to possible departures from a pure cost-based system, including perhaps by:

- incorporating supply and purchase 'bids', with generators free to establish their own bids and pricing structures. In this way, generators would be free to pursue their own strategies including marginal pricing, full-cost bidding or profit optimisation; and
- mechanisms for establishing 'standing bids' for each generator with restrictions on changes. This may simplify the power system controller process to establish and maintain the least-cost merit order.

6.37 While the Commission considers there is some scope to interpret the existing wording of the Code, consideration may also need to be given to some of the departures being validated by amendments to the Code. Provided such amendments were clearly aimed at achieving the pricing objectives in clause 85, the need for such amendments should not be considered an insurmountable problem.

The Commission invites comment or submissions on the following questions arising from this Chapter:

Can marginal operating costs be readily established for each generating unit?

Can the incremental capital cost be readily established for each generating unit across its operating range?

Are there any operational or management differences for the power system controller between operating with a merit order based upon generator bids rather than a merit order based upon marginal costs and incremental capital costs?

If economic dispatch is based solely on marginal operating costs and incremental capital costs, are there any competition issues that may arise when there are only two or three participating generators?

Is the Commission's list of problems associated with the implementation of cost-based pricing (at para. 6.34) complete, and are any of the problems noted under- or over-stated in the NT context?

Is there scope for increased emphasis on 'bid' based dispatch arrangements in the NT context? In what respects may the Commission be overstating the advantages of a bid-based approach to economic dispatch?

What options for a 'bid' based system of dispatch could be added to the list at para. 6.36 in the NT context?

What conditions/thresholds would have to be reached in the NT electricity market before scheduling and dispatch arrangements could be expanded to involve some form of 'wholesale trading' at the margin?

APPENDIX

A

EXTRACTS FROM NETWORK ACCESS CODE

Below is an extract from the Northern Territory's *Electricity Networks (Third Party Access) Code*, as it relates to economic dispatch. It is presented as a marked-up version showing the revisions to the Code which took effect on 1 July 2001, where ***additions*** to the Code at that time are shown as underlined text (e.g. underlined text) and ***deletions*** are indicated as strikethrough text (e.g. ~~strikethrough text~~).

Chapter 3 – Access terms

24. General

(1) The broad technical terms and conditions on which access to the electricity network is to be made available to network users are set out in this Chapter.

(2) The technical terms and conditions on which access to an electricity network is to be made available as set out in this Chapter can be supplemented in an access agreement.

(3) A reference in this Chapter to an access agreement includes an award made by an arbitrator under this Code.

25. Contract maximum demand and declared sent-out capacity

(1) A load user must use reasonable endeavours to ensure that the user's actual demand at a connection point does not exceed the contract maximum demand for that connection.

(2) A generator user must use reasonable endeavours to ensure that the quantity of electricity transferred to the electricity network by or on behalf of the generator user at the connection point does not exceed the declared sent-out capacity from the generator user in respect of that connection.

25A. Network user's load balancing responsibilities

(1) A network user must have sufficient generating capacity available to meet its customers' load, which may include capacity provided via standby arrangements with other generators.

(2) The network user must comply with any guidelines developed and published by the regulator in connection with the assessment of whether a network user's generating capacity is sufficient to meet the user's obligations under sub-clause (1).

(3) Any guidelines developed and published under sub-clause (2) must:

(a) take account of the impact on economic efficiency, and therefore have regard to factors including the efficient location of and level of overall capacity, reserve capacity and imbalance capacity on the system; and

(b) have regard to the efficient allocation of costs of capacity to different customers supplied by the power system.

(4) The regulator may review a network users' actual generating capacity against the capacity required by compliance with the guidelines.

(5) If as the result of a review under sub-clause (4) the regulator considers that the network users' actual generating capacity is materially less than required by compliance with these guidelines, the network user must comply with any orders issued by the regulator aimed at ensuring compliance with the guidelines which may include, but are not limited to, procurement of contracts for anticipated demand, reserve and imbalance services to eliminate this deficiency.

(6) The regulator may require that a network user furnish the power system controller in advance with satisfactory evidence that the user has contracted, or otherwise secured sufficient capacity, to the extent that this is required to assist the power system controller in operation of the power system.

(7) The regulator may determine the form of the evidence required under sub-clause (6).

(8) If a network user's generating capacity is shown to have been out of balance, the network user must reimburse the generator or generators responsible for supplying the balancing amount of generating capacity.

(9) The measurement of out of balance capacity, and any charges imposed on a network user under sub-clause (8), are regulated by the provisions of Chapter 9 of this Code.

25B. Network user's responsibility to keep energy usage in balance

(1) A network user must use its best endeavours to ensure that it is not responsible for the power system controller having to dispatch other generators to supply the energy necessary to ensure the power system remains in balance.

(2) To meets its obligations under sub-clause (1), a network user must either:

(a) nominate a proportion of its generation capacity as being available to supply load following services to the power system as a whole; or

(b) opt to provide its own load following services by using reasonable endeavours to ensure that its own use of the network is in balance.

(3) A network user who nominates a proportion of its generation capacity to supply load following services to the power system as a whole will be subject to economic dispatch arrangements developed by the power system controller as part of the system control technical code and approved by the regulator.

(4) A network user's use of the network will be in balance under sub-clause (2)(b) if, after allowing for network energy losses, the quantity of electrical energy transferred into the electricity network for the connection points in respect of the aggregate of its access agreements for each energy usage period is equal to the quantity of electrical energy transferred out of the electricity network for those connections for that period.

(5) A network user may alter its nomination under sub-clause (2) with 30 days notice to the power system controller.

(6) If a network user's energy usage is shown to have been out of balance, and so has benefited from load following services provided by other generators, that user must

reimburse the generator or generators responsible for supplying the balancing amount of energy.

(7) The measurement of out of balance energy, and any charges imposed on a network user under sub-clause (6), are regulated by the provisions of Chapter 9 of this Code.

26. ~~Network user's responsibility to keep energy usage in balance~~ Standby power arrangements

(1) ~~A network user must use reasonable endeavours to ensure that its use of the network is in balance in that, after allowing for the network energy losses expected between the entry and exit points, the quantity of electrical energy transferred into the electricity network for the connection points in respect of each of its access agreements for each energy usage period is equal to the quantity of electrical energy transferred out of the electricity network for those connections for that period.~~ {Deleted}

(2) Network users are responsible for arranging the supply and transportation of standby power to satisfy ~~this obligation~~their obligations under clauses 25A and 25B by contracting the supply of standby power with a generator.

(3) Network users must keep the power system controller informed of arrangements the network user has made to obtain standby power and must promptly provide to the power system controller any information concerning those arrangements that the power system controller reasonably requests.

(4) When a network user becomes aware that an existing standby arrangement will terminate (other than by expiration of the terms of the existing arrangement) or will change in a material particular, the network user must promptly notify the power system controller and provide details of substitute arrangements to provide standby power to be put in place by the user.

27. Role of power system controller when generating capacity or energy usage is out of balance

(1) ~~If a network user's energy usage is shown to have been out of balance, the power system controller may impose charges on the generator user relating to that imbalance in order to reimburse the generator~~s ~~responsible for supplying the balancing amount of electricity.~~ The power system controller is responsible for setting the charges to be met by network users as a result of any generating capacity or energy usage imbalances.

(2) The setting of those charges ~~when the out-of-balance energy is supplied by PAWA Generation~~by the power system controller is regulated under Chapter 9 of this Code.

(3) If the power system controller becomes aware that a network user's energy usage is out of balance by an amount that, in the power system controller's view, is likely to result in the operation of the power system being materially affected or other users being materially affected, the power system controller may interrupt or curtail the transfer of electricity to and from one or more connection points in respect of the associated access agreement in a manner consistent with efficient operation of the power system in order to reduce that material adverse effect.

27A. System control technical code

(1) In exercising the powers conferred under clause 27(3), the power system controller must do so in a manner consistent with a system control technical code approved by the regulator.

(2) The system control technical code may set out:

(a) operating protocols;

(b) arrangements for system security and dispatch;

(c) arrangements for disconnection; and

(d) any other matters necessary to the efficient operation, monitoring and control of the power system

(3) The power system controller may amend the system control technical code at any time, but only with the prior approval of the regulator.

(4) The power system controller must consult with all generators operating in the power system, network users and other interested parties when establishing and amending the system control technical code.

Chapter 9 – ~~Out of balance energy prices~~Charges for out-of-balance energy services

82. General

(1) The~~generation~~ services provided by ~~PAWA Generation~~licensed generators that are subject to~~price~~ regulation under this Chapter ~~are restricted to the supply~~relate only to the provision of out-of-balance energy ~~to the network user by PAWA Generation.~~services to network users.

(2) Out-of-balance energy services involve:~~involves~~

(a) the electrical energy dispatched by a generator into the power system at the request of the power system controller that has the effect of meeting any mismatch between the transfer of electrical energy into and out of the electricity network by the parties to an access ~~agreement.~~agreement; and

(b) the provision of any generation capacity by a generator in response to a request of the power system controller to meet a shortfall between a network user's own effective generation capacity and its customers' load.

(2A) The power system controller's assessment of the out-of-balance energy supplied or demanded by a generator must take full account of network energy losses~~between the relevant entry and exit points on the network~~ where such energy losses are:

(a) estimated in accordance with Schedule 13; or

(b) as otherwise determined from time to time by the regulator.

(3) The prices of any electrical energy supplied by ~~PAWA Generation~~licensed generators in accordance with the terms of an access agreement or a standby generation agreement are subject to commercial negotiation between the parties concerned and are not subject to regulation under this Code.

~~(4) All prices approved by the regulator under this Chapter are the exact prices that network users or PAWA Generation must pay for the out-of-balance energy supplied.~~

83. ~~Structure of regulated out-of-balance energy prices~~ {Deleted}

~~(1) In accordance with clause 27, the power system controller has responsibility for measuring the amount of out-of-balance energy supplied by a generator and for undertaking the settlement of the resultant charges between generators.~~

~~(2) The power system controller must apply the methodology in Schedule 12 to establish the total charges to be paid by or to PAWA Generation.~~

~~(3) This Chapter only regulates the prices to be used by the power system controller in establishing the total charges as they apply to PAWA Generation.~~

~~(4) PAWA Generation is to be responsible for establishing the prices to be used by the power system controller in administering arrangements under this clause.~~

~~(5) To enable the power system controller to apply the methodology in Schedule 12, PAWA Generation must establish the following out-of-balance energy prices applicable in a network and for dispatch from nominated generation units distinguishing as appropriate between time of use –~~

~~(a) a within-tolerance sell price of energy;~~

~~(b) an outside-tolerance sell price of energy;~~

~~(c) a within-tolerance buy price of energy; and~~

~~(d) an outside-tolerance buy price of energy.~~

84. ~~Permitted tolerance limit~~ {Deleted}

~~(1) Out-of-balance energy may be provided in amounts that are within or in excess of a permitted tolerance limit.~~

~~(2) For the purpose of this Chapter, the permitted tolerance limit for a generator user other than PAWA Generation in respect of a group of connections associated with an access agreement is equal to –~~

~~(a) the greater of –~~

~~(i) an amount expressed in kilowatts (kW) averaged over an energy usage period equal to 1.5% of the aggregate of the contract maximum demand for all the exit points of load users associated with the access agreement; and~~

~~(ii) 2 kilowatt-hours (kWh) per minute of each energy usage period; or~~

~~(b) any other limits that are determined from time to time by the regulator.~~

85. Pricing ~~principles~~objectives

~~(1) The prices for any out-of-balance energy are to be established by PAWA Generation so as to provide the price signals necessary to encourage network users to keep their energy usage in balance, in particular by –~~When determining guidelines or dispatch arrangements which may affect the services, the regulator and the power system controller must ensure that these guidelines and arrangements result in prices which best promote:

(a) the efficient provision of out-of-balance capacity and energy; and ~~setting out-of-balance sell prices so that the situation does not arise where PAWA~~

~~Generation could be called upon to sell energy at such a price that another party would benefit by opting to purchase out-of-balance energy from PAWA Generation instead of generating the required energy itself;~~

(b) the efficient operation and ongoing development of the power system as a whole.~~setting out-of-balance buy prices so that the situation does not arise where PAWA Generation could be called upon to purchase energy at such a price that another party would benefit by opting to sell out-of-balance energy to PAWA Generation instead of refraining from generating excess energy itself; and~~

~~(c) setting prices for purchases (and sales) of energy outside the permitted tolerance limit relative to those for purchases (and sales) within the limit so that the situation does not arise where PAWA Generation could be called upon to buy (or sell) energy at such prices that another party would benefit by opting to sell (or buy) out-of-balance energy to (or from) PAWA Generation instead of taking all measures reasonably available to that party to prevent sales (or purchases) of energy outside the tolerance limit.~~

~~(2) Out-of-balance energy prices must be set at levels which, to the maximum extent consistent with encouraging load following by network users, reflect efficient costs and ensure competitive neutrality.~~

~~(3) PAWA Generation is to pay any regulatory component of the out-of-balance charge into Consolidated Revenue, being that portion of the net proceeds it receives from out-of-balance energy charges in each month that in the regulator's opinion is in excess of the amount necessary to compensate PAWA Generation for the efficient costs of providing the out-of-balance energy.~~

85A. Settlement of out-of-balance energy services

(1) A network user that produces an amount of energy different to its counter-parties' demand in an energy usage period must pay to the generator or generators responsible for providing or purchasing the energy difference an amount equal to the product of:

(a) the applicable system imbalance energy price; and

(b) the difference between the actual and required amount of energy.

(2) Where any out-of-balance energy is produced by generation plant in excess of the plant necessary to meet the generator's own aggregate customer load, the network user that produces less than its counter-parties' demand must pay to the generator or generators responsible for providing the necessary additional generation capacity an amount equal to the product of:

(a) the applicable system imbalance capacity price; and

(b) the additional generation capacity involved.

(3) The system imbalance prices are to take into consideration:

(a) the type of out-of-balance transfer involved;

(b) the magnitude of the loading or deloading of generation plant providing the out-of-balance energy; and

(c) the time of day, day of week and season of the year in which the out-of-balance energy service provision occurred.

(4) The arrangements for the settlement of any out-of-balance payments between the generators, and the role to be played by the power system controller in the settlement process:

(a) are to be developed by the power system controller in consultation with licensed generators; and

(b) are subject to the approval of the regulator.

(5) The regulator must approve the arrangements developed under sub-clause (4)(a) only if the regulator considers the arrangements to be consistent with the pricing principles in clause 85.

(6) The means of establishing the system imbalance prices referred to in this clause are set out in clauses 85B and 85C.

85B. Determination of the system imbalance energy price

(1) The system imbalance energy price to apply in a particular energy usage period will depend upon whether or not dispatch of generation units is affected by system constraint or system security considerations.

(2) In circumstances where dispatch of generation units is unaffected by system constraint or system security considerations, the system imbalance energy price is to be defined by reference to the marginal operating costs of generation units instructed by the power system controller to deviate from their expected level of output.

(3) In the circumstance applying under sub-clause (2), the price must be either:

(a) the highest marginal operating cost of any generation unit instructed to increase output, in the event that additional supply is required; or

(b) the lowest marginal operating cost of any generation unit instructed to decrease output, in the event that the market is oversupplied.

(4) Where system constraints or system security requirements affect the dispatch of particular generation units, the power system controller is to both:

(a) instruct the dispatch of generation units; and

(b) set the associated system imbalance energy price

in accordance with constraints management and system security procedures approved by the regulator.

(5) In approving the procedures authorised under sub-clause (4), the regulator is to ensure that the procedures and associated pricing are, in the regulator's opinion, as consistent as is practicable in the circumstances with the efficient operation of the power system.

(6) For the purpose of this clause, generators that are on load following duty are deemed to be instructed.

85C. Determination of the system imbalance capacity price

(1) The system imbalance capacity price to apply in a particular energy usage period must be defined by reference to the incremental capital cost of generation units instructed by the power system controller to commence output.

(2) The price must be the highest incremental capital cost of any additional generation unit instructed to commence output, in the event that additional supply is required.

(3) For the purpose of this clause, generators that are on load following duty are deemed to be instructed.

86. ~~Publication of out-of-balance energy prices~~ {Deleted}

~~At least 30 days before the start of each financial year, PAWA Generation must publish a pricing schedule setting out the various out-of-balance energy prices that are to apply during the financial year with respect to a network.~~

87. Role of regulator

(1) The regulator ~~must provide regulatory oversight of PAWA Generation's out-of-balance energy prices, to ensure that prices published in PAWA Generation's pricing schedule are consistent with the pricing objectives of this Code and the requirements of this Chapter.~~may develop and publish guidelines in connection with the operation of this Chapter (in addition to the guidelines specifically required in this Chapter).

~~(2) At least 60 days before the start of each financial year, PAWA Generation must provide a statement to the regulator setting out its proposed out-of-balance energy prices for that financial year.~~

~~(3) The statement must set out the key assumptions, forecasts and estimates upon which the calculations are based.~~

~~(4) The regulator must approve the proposed prices unless, in the opinion of the regulator, the proposed prices would result in PAWA Generation not complying with the requirements in this Chapter or is inconsistent with requirements elsewhere in this Code.~~

~~(5) If the regulator has not notified PAWA Generation within 30 days of receiving the statement that the regulator disapproves of the prices, the regulator is to be taken to have approved the prices.~~

~~(6) If the regulator notifies PAWA Generation that the regulator has not approved the price for a particular out-of-balance energy price component with respect to the initial year of operation of this Code within the 30 day period, prices will be set at levels determined by the regulator until the regulator approves prices submitted by PAWA Generation.~~

~~(7) If, in respect of any of the financial years following the initial year, the regulator notifies PAWA Generation that the regulator has not approved the price for a particular price component within the 30 day period, the price for the immediately preceding year (or any other price that the regulator determines) will apply until the regulator approves a price for that price component.~~

~~(8) Before the regulator approves the price applying to an individual price component, the pricing schedule to be published by PAWA Generation must incorporate such modifications as the regulator directs~~

(1A) Network users and the power system controller must comply with any guidelines developed and published by the regulator under this Chapter.

(2) In developing and publishing any guidelines under this Chapter of the Code, the regulator must consult with all licensed generators and, in doing so, must allow a reasonable time for consideration of the issues and development of a consensus on the

nature of the economic dispatch arrangements to give effect to the pricing principles in clause 85 .

(3) The regulator is to review the economic dispatch arrangements giving effect to the provisions of this Chapter in consultation with all licensed generators following the first 12 months of operation of the arrangements.

(4) In conducting the review, the regulator must assess the extent to which the arrangements are meeting the requirements of clause 85, and may make recommendations to the Regulatory Minister regarding changes that the regulator considers necessary to the economic dispatch arrangements to meet the requirements in sub-clauses 85 (a) and (b).

87A. Transitional arrangements

(1) The economic dispatch arrangements to give effect to the pricing principles in this Chapter are to be fully operational by 1 July 2002.

(2) Until the consultations necessary to ensure the satisfactory implementation of the economic dispatch arrangements to give effect to the pricing principles in this Chapter are completed, and those arrangements are in place and fully operational, the various system imbalance prices are to be determined by the regulator as the schedule of prices that the regulator considers will ensure a more efficient provision of out-of-balance energy services than associated with the prices in place immediately prior to the commencement of the revisions to this Chapter.

SCHEDULE 12 {Deleted}

~~**OUT-OF-BALANCE ENERGY CHARGES**~~

~~**1. Introduction**~~

~~(1) In establishing charges for out-of-balance energy actually supplied, the power system controller is to apply the charging structure in this Schedule.~~

~~(2) For the purposes of this Schedule –~~

~~(a) the energy loss factor for a connection point is the factor established by the network provider at the start of each year by applying the steps set out in Schedule 13 or as otherwise determined from time to time by the regulator;~~

~~(b) a group of connections in respect of the network user's access agreement consists of the entry points and exit points specified in the access agreement and the entry points from which energy is being supplied to one or more of those connections (if different to the entry point in the access agreement);~~

~~(c) an energy usage period is a time interval (eg. half hour) specified from time to time by the network provider in line with good electricity industry practice;~~

~~(d) the permitted tolerance limit amount in respect of a group of connections associated with the network user's access agreement is as defined in Chapter 9 of the Code;~~

~~(e) the total out-of-balance energy usage amount (in kWh) for an energy usage period for a group of connections is an amount, after considering network energy losses, equal to the energy exit amount for that group for the energy~~

usage period minus the energy entry amount for that group for the period, where –

the energy (entry or exit) amount (in kWh) for the group of connections in respect of an access agreement for a period is measured by applying the following formula to entry and exit values respectively –

$$\sum_{j=1}^{j=n} (A_j * B_j)$$

where –

A_j (in kWh) is the quantity of electricity transferred at entry (or exit) point j to the electricity network during the period;

B_j (a rate) is the network energy loss factor for the entry (or exit) point j and or for the transfer point supplying entry (or exit) point j, as appropriate;

the variable "j" represents an entry (or exit) point which is one of the group of connections; and

the variable "n" represents the number of entry (or exit) points in the group of connections; and

(f) the terms 'permitted tolerance limit', 'within-tolerance sell price of energy', 'outside-tolerance sell price of energy', 'within-tolerance buy price of energy' and 'outside-tolerance buy price of energy' all have the meaning defined for them in Chapter 11 of the Code.

2. Balancing and settlement of the supply of uncontracted energy

If a mismatch occurs during any energy usage period, after account is taken of energy losses, between energy imports into and energy exports from an electricity network in connection with an access agreement during that period, certain energy usage charges (or refunds) will apply.

3. Within-tolerance energy usage charge (or refund)

(1) The portion of the total out-of-balance energy usage amount for an energy usage period that is within the permitted tolerance limit for the group of connections, accumulated over a monthly period, will attract a within-tolerance energy usage charge (or refund).

(2) The within-tolerance energy usage charge for a month (in $) is established by applying the following formula –

$$A * B * 0.01$$

where –

A (in kWh) is the sum of the within-tolerance out-of-balance energy usage amounts for all the energy usage periods falling within the month, where the within-tolerance out-of-balance energy usage amount for an energy usage period is defined as follows –

(a) if the total out-of-balance energy usage amount for an energy usage period is positive, that total amount or the permitted tolerance limit amount, whichever is less; or

(b) if the total out-of-balance energy usage amount for an energy usage period is negative, that total amount or the permitted tolerance limit amount expressed as a negative value, whichever is the greater; and

B (in ¢/kWh) is the within-tolerance sell price of energy set out in the out-of-balance energy pricing schedule for the financial year in question if the monthly within-tolerance out-of-balance amount is positive, or the within-tolerance buy price of energy stated in that schedule if that monthly amount is negative.

(3) If the within-tolerance energy usage charge for a month is positive, then that amount is payable by the generator user to PAWA Generation.

(4) If the within-tolerance energy usage charge for a month is negative, then an amount equal to that negative number multiplied by –1 is payable by PAWA Generation to the generator user.

4. Outside-tolerance energy usage charge (or refund)

(1) If the total out-of-balance energy usage amount for an energy usage period exceeds the permitted tolerance limit for the group of connections, an outside-tolerance energy usage charge (or refund) is also payable.

(2) The outside-tolerance energy usage charge for an energy usage period (in $) is established by applying the following formula where the total out-of-balance energy usage amount exceeds the permitted tolerance limit –

A * B * 0.01

where –

A (in kWh) is the outside-tolerance energy usage amount for the energy usage period defined as follows –

(a) if the total out-of-balance energy usage amount for an energy usage period is positive, that total amount less the permitted tolerance limit amount; or

(b) if the total out-of-balance energy usage amount for an energy usage period is negative, that total amount less the permitted tolerance limit amount expressed as a negative value; and

B (in ¢/kWh) is the outside-tolerance sell price of energy set out in the out-of-balance energy pricing schedule for the financial year in question if the outside-tolerance energy usage amount in the energy usage period is positive, or the outside-tolerance buy price of energy stated in that schedule if that excess amount is negative.

(3) If the sum of any outside-tolerance usage charges for all the energy usage periods in a month is positive, then that amount is payable by the generator user to PAWA Generation.

(4) If the sum of any outside-tolerance usage charges for all the energy usage periods in a month is negative, then an amount equal to that negative number multiplied by –1 is payable by PAWA Generation to the generator user.