PB ASSOCIATES

POWERLINK QUEENSLAND

Review of Network Service Standards

CONFIDENTIAL

Prepared for

AUSTRALIAN COMPETITION AND CONSUMER COMMISSION

PB Associates *Quality System:*

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EXECUTIVE SUMMARY

This report presents the result of a review of Powerlink's regulatory revenue cap application in respect of network service standards. The review was undertaken by PB Associates for the Australian Competition and Consumer Commission.

The main conclusions and recommendations of the review were as follows:

- Network service standards relate primarily to network reliability and quality of supply. Minimum requirements for quality of supply are precisely defined in the National Electricity Code. While the Commission must allow Powerlink sufficient revenue to comply with these minimum requirements it is not the Commission's function to monitor Powerlink's performance in relation to quality of supply;

- External benchmarking studies show that Powerlink's present level of system reliability compares well with other transmission network service providers;

- Powerlink should be fully accountable for managing all external and environmental risks that it is in a better position than other participants in the industry to mitigate. Powerlink's ability to manage such risks is a legitimate matter for regulatory oversight. On this basis Powerlink should be fully accountable for the availability of the network, and for all power outages, whether planned or unplanned, due to the failure or unavailability of network elements. Regulatory targets for service standards should reflect this accountability;

- Powerlink's system minutes not supplied shows a high level of variability from year for year and therefore has limited suitability for regulatory oversight. However a ten-year rolling average of system minutes off supply is a suitable measure. A target of 7 minutes for this ten-year rolling average is a fair reflection of Powerlink's present service level.

- The network reliability measures proposed by Powerlink are deficient in that they generally do not take account of the external and environmental risks that Powerlink must mitigate in the management of its network. They should therefore be used on an interim basis only for the 2002 regulatory period.

- The target means proposed by Powerlink for the normalised network reliability indicators measured on a monthly basis are a fair reflection of the network's current performance and should be adopted for the 2002 regulatory period;

- The use of mean values as targets for the number of loss of supply events is not meaningful. It is recommended that targets for the number of loss of supply events be expressed in terms of the number of events per year and that the targets below be used in place of the ones proposed by Powerlink.

Total number of loss of supply events greater than 0.2 system minutes – summer	3
Total number of loss of supply events greater than 0.2 system minutes – winter	2
Total number of loss of supply events greater than 1.0 system minutes – summer	1
Total number of loss of supply events greater than 1.0 system minutes – winter	0

- During the regulatory period covered by this review Powerlink should report annually the following indicators:

  System minutes not supplied,

  The ten-year rolling average of system minutes not supplied,

  Transmission circuit availability overall and for each voltage (330 kV, 220 kV, 132/110 kV) broken down into northern, central and southern areas,

  Transformer availability, overall and broken down by voltage (at the high voltage terminals) and area as above,

  Connection point interruption frequency (averaged for all connection points), overall and broken down by area,

  Connection point interruption duration (averaged for all connection points), overall and broken down by area, and

  Percentage of unplanned connection point interruptions not restored within three hours, overall and broken down by area.

  Publication of these indicators will allow a network performance history to be established that should form the basis for setting regulatory service standard targets at the next regulatory reset;

- Powerlink's proposal that indicators relating to the manner in which it relates to its customers on a day-to-day basis be included in the regulatory compact is not supported. It is not the Commission's function to monitor the day-to-day management of the Powerlink business and, from a regulatory perspective, this level of oversight is unnecessary.

1. INTRODUCTION

The Australian Competition and Consumer Commission (the Commission) is currently conducting an inquiry into the appropriate revenue cap to be applied to the non-contestable elements of the transmission services provided by the Powerlink transmission network. The revenue cap determined as a result of this inquiry will apply for a 5-year regulatory period commencing 1 January 2002.

In respect of this inquiry, Powerlink has submitted to the Commission an application for a transmission network revenue cap for the period commencing January 2002[1]. This document outlines Powerlink's views on the appropriate revenue cap to be applied by the Commission.

PB Associates has been engaged to review the Powerlink application in respect of the following areas that are pertinent to establishing an appropriate revenue cap:

- The value of the assets used by Powerlink to supply non contestable transmission services;
- Powerlink's capital expenditure (CAPEX) requirement over the regulatory period;
- Powerlink's operational expenditure (OPEX) requirement over the regulatory period;
- The appropriate standard of service that Powerlink should reasonably be expected to achieve over the regulatory period.

This report covers PB Associates' review of the Powerlink application in respect of the appropriate standard of service. The Terms of Reference for this service standard review were to:

- Carry out a high level review of the set of service standards proposed by Powerlink in respect of their relevance and adequacy relative to the transmission company's current and forecast load and assess the service standards in accordance with the requirements of the Code;
- Review the set of service standards proposed by Powerlink in terms of their suitability for a comprehensive quality of service monitoring program, taking into account taking into account other programs (imposed either by regulators or used internally for monitoring purposes) in place for Australian transmission companies; and
- Identify any deficiencies in the proposed set of service standards, including any deficiencies in the benchmark levels of performance proposed, and recommend any requirement for new service standards or change in the proposed level of performance.

In undertaking these assessments, the Terms of Reference require PB Associates to take account of Powerlink's proposed capital and operating expenditure over the review period and the likely impact of this expenditure on service standards.

The Commission's Terms of Reference do not define what is meant by the term "service standards". However, for the purposes of this review, service standards are taken to refer specifically the quality and reliability of electricity supply. Supply reliability is concerned with the availability of an electricity supply to customers while supply quality refers to the purity of the electricity waveform. These two facets of service are largely,

[1] *Application - Transmission Network Revenue Cap Commencing January 2002*, Powerlink Queensland, February 2001.

but not entirely, independent. It is conceptually possible to have a supply of high quality and low reliability or, alternatively one of high reliability and low quality.

Service standards could be considered in a broader context and extended to include the manner in which the TNSP interacts with its customers and other stakeholders. These facets of Powerlink's service standards are not considered in this review except insofar as they might impact the quality and reliability of the electricity supply.

The primary criteria for this review are the requirements of the National Electricity Code. In addition, the Commission has published a Draft Statement of Principles for the Regulation of Transmission Revenues (Draft Statement), which includes an outline of the Commission's proposed approach to the inclusion of service standards in the regulation of transmission network service providers (TNSP). This document is still in draft form and has yet to be finalised by the Commission. Nevertheless PB Associates has conducted this review in the context of the regulatory principles in the Commission's Draft Statement.

2. REGULATORY OVERVIEW

2.1 NATIONAL ELECTRICITY CODE

Section 5.1 of the National Electricity Code specifies the network performance requirements to be provided or co-ordinated by network service providers. The Code is written using general and at times legalistic language so that it is often not clear how it should be interpreted in specific situations. This is exacerbated by the fact that the Code is written to be applicable to both transmission and distribution networks and this necessarily limits the use of overly specific language.

The Code in essence requires the shared network to be planned and operated so that in the event of a single credible contingency event, the network will continue to operate with the quality of supply remaining within Code requirements, apart from a transient excursion at the time of the event. A credible contingency event is generally defined as the disconnection of any single generating unit or transmission line with or without the application of a solid two phase to ground fault on lines operating at or above 220 kV and three phase fault on lines operating below 220 kV.

At points of connection, where assets are dedicated to a single generator or off-take customer there is provision for a reduced quality of service following a single credible contingency event. This reduced quality of service may be:

- Zero power transfer (loss of supply);
- A back-up supply of defined capacity. This backup supply may be provided by another network service provider;
- A nominated portion (eg 70% of the normal power transfer capacity).

The Code also imposes requirements in relation to the quality of supply, particularly in respect of the magnitude of power frequency voltage, limitation of voltage fluctuations caused by the switching or operation of network plant, limitation of voltage harmonics caused by network plant, voltage unbalance stability and maximum fault clearing times.

The wording of the Code implicitly recognises that the quality of supply, and to a lesser extent reliability, will also be impacted by customers connected to the network and by the manner in which NEMMCO undertakes its role as system operator. The Code imposes an obligation on Powerlink to plan design and operate its plant in a manner that ensures compliance with the performance requirements set out in the Code and also to include conditions in the connection agreements it signs with customers to ensure that Code requirements in relation to quality of supply are met.

2.2 THE COMMISSION'S REGULATORY PRINCIPLES

The Commission's Draft Statement of Regulatory Principles recognises the link between service standards and network expenditure. The document notes that the Commission has concerns about undertaking what could be seen as "technical regulation" rather than "economic regulation" but states that the measurement and monitoring of service standards is essential to ensure that cost reductions derived from falling service standards are not mistaken for increases in efficiency.

The Commission has implemented a regulatory process that requires TNSPs to propose a set of service standards to be included in the regulatory compact. These proposed standards will be made available to interested parties who will have an opportunity to comment. In addition the Commission may employ a technical consultant to advise on

the appropriateness of the proposed service standards and, indeed, this review is being undertaken in accordance with this provision.

Following this review, the Commission will include a set of service standards in its Draft and Final Decisions. Commercially significant sanctions for non-performance of service standards will be imposed during a regulatory review for a TNSP that does not, in the Commission's sole opinion, maintain its service to customers at the benchmark level.

In its Draft Statement, the Commission notes that many stakeholders support TNSPs offering a range of service levels. While the Commission would like to accommodate these concerns it is unwilling to consider more than a basic level of service at this time. This indicates that this review is concerned with the ability of Powerlink to achieve a standard level of service and that the Commission is not proposing to allow revenue specifically to enable Powerlink to progressively improve its service standards with time.

If customers require a level of service over and above that set out in the regulatory compact, then this level of service must be negotiated outside the regulatory framework. Indeed Powerlink already has such agreements with some larger industrial customers. Any capital or operating costs associated with the provision of these premium services will be excluded from capital or operating costs in the setting of Powerlink's revenue cap. Further, any additional revenues obtained from providing a premium level of service should be attributed to revenue from non-prescribed services.

2.3 PERFORMANCE INDICATORS

The performance indicators proposed by the Commission for annual reporting are scheduled in Annex 8.1 of the Draft Statement. It is a comprehensive list that is generally based on the report of the Specification and Network Services (SNNS) working group. Additional indicators following from a Sinclair Knight Merz (SKM) review of the performance indicators proposed by TransGrid for its regulatory review are also included.

The SNNS working group identified a shortcoming in that traditional performance based indicators lacked a direct relevance to market impacts. It proposed that the existing physical statistics be retained but, in addition, it recommended that a number of additional measures be reported.

As an interim position the SNNS working group also proposed a range of market based measures that should be published on "for information only" basis.

As indicated in Section 2.2, the Commission in its Draft Statement stated that it will publish "consistent" annual statistics and further stated that it requires all TNSPs in the National Electricity Market (NEM) to begin compiling the required data and calculating the indicators for their transmission systems for the calendar year 1999. This is considered the first step in ensuring that a "basic" level of information exists when the Commission becomes the regulator of each TNSP.

A summary of the indicators that the Commission proposes to be reported is given below:

Existing Measures:

1. System Minutes Not Supplied.

   This is defined as energy (MWh) not supplied divided by MW peak demand and multiplied by 60 to convert to system minutes. System minutes should be calculated in respect of unplanned outages only and should not include planned outages or generation shortfalls.

2. Availability.

This is defined as the actual circuit hours available for all transmission network elements, divided by the total possible circuit hours available.

These measure should be reported broken down by both outage type (planned, unplanned) and equipment type circuit, transformer, circuit breaker)

3. Voltage Quality

Indicators to be reported in this context include:

- The number of measured excursions of the steady state voltage levels outside the limits in the NEC. The Draft Statement notes that this is largely a matter for NEMMCO;
- The estimated demand and energy lost as a result of voltage excursions outside the standard;
- The number of complaints regarding voltage quality received by the transmission TNSP;
- The number of complaints regarding voltage quality validated by measurement;
- The proportion of the valid complaints that were attributable to the transmission network;
- The number of unresolved transmission complaints regarding voltage quality;
- The number of transmission connection points monitored for voltage quality; a report on any locations monitored where voltage quality did not comply with the standard in the NEC (with derogations where appropriate).

Proposed Additional Measures

Individual connection point interruptions to service

- The total number of unplanned circuit outages that resulted in loss of supply (per year);
- The frequency of loss of supply per connection point (incidents per connection point per year;
- The maximum, minimum and average duration of loss of supply per connection point (minutes per connection point per year); and
- The amount of electricity not supplied per connection point per year (MW and MWh per connection point per year).

Interruptions affecting multiple connection points:

- The total number of unplanned circuit outages (per year);
- The total number of unplanned circuit outages which resulted in loss of supply (per year);
- The energy not supplied during each incident (MWh);
- The maximum load lost during each incident (MW); and
- The time taken to restore all load for each incident (hours).

Individual connection point reliability indicators:

- The frequency of planned interruptions (number per year);
- The frequency of unplanned interruptions (number per year);
- The duration of planned interruptions (hours);
- The duration of unplanned interruptions (minutes or hours);
- The quantity of electricity not supplied during interruptions (MW and MWh)
- The period of notice for planned interruptions (hours or days).

Shared Network Reliability Indicators:

- The frequency of disturbances that result in interruption (number per year);
- The severity of disturbance measured by the load not supplied (maximum MW and total MWh);
- The time taken to restore all load.

Market Based Indicators

- The costs to the market of transmission outages;
- The benefits to the market that would have been available / were obtained from rescheduling planned outages or increasing the restoration effort during planned outages;
- A comparison with the costs that the TNSP would have incurred / did incur by rescheduling or increasing the restoration effort;
- The projected benefit to the market of proposed augmentations or refurbishment;
- Retrospective assessments of the total benefits and costs of augmentations; and
- Outcomes from an availability incentive scheme if implemented.

Sinclair Knight Merz Proposed Indicators

System availability[2]

- The number of sustained under / over voltage excursions;
- The number of transient voltage excursions

Individual connection point interruptions to service

- Supply interruption frequency;
- Supply point interruption duration; and
- Restoration time.

[2] The Draft Statement has quoted SKM incorrectly. The SKM report correctly refers to these as quality of supply indicators.

These indicators should be averaged for all connection points and split into planned and unplanned outages.

Market based Indicators

- Number of constraint events (classified by size of constraint);
- Amount of extra generation required to overcome constraints;
- The cost of extra energy required to overcome constraints;
- A measure of interconnector availability.

This list is very comprehensive. An alternative, more limited set of indicators, which we believe would achieve the Commission's regulatory objectives, is presented in Section 2.3.1.

Extreme care needs to be taken in using reported reliability measures as a basis for comparing different TNSPs. Unless each indicator is tightly defined, both in terms of how it is measured and what events can be excluded, it is likely that direct comparisons between indicators reported by different TNSPs will not be valid. Further, indices will be impacted both by the configuration of the transmission network and by the environment in which it is constructed. For example it is understood that the TransGrid network includes a number of comparatively light lines supplying off take connection points in remote areas. However in Queensland similar circuits are owned by the distributors and are therefore not part of the transmission network. However, Powerlink's network in the north of Queensland must withstand frequent tropical cyclones, which rarely occur in New South Wales.

Nevertheless, subject to these limitations, well-designed service standard statistics can be useful. Such statistics can provide customers with an indication of the reliability of supply that can be expected from a given network. Further, trends are relevant in that they can provide valid information on how the performance of a given transmission network is changing with time.

2.3.1 Network Reliability

One approach to the regulatory monitoring of network reliability would be to limit reporting to the following indicators:

System indicators

- System minutes not supplied;
- Transmission circuit availability, overall and for each voltage (330 kV, 220 kV. 132/110 kV) broken down into northern, central and southern areas;
- Transformer availability, overall and broken down by voltage (at the high voltage terminals) and area as above.

System minutes not supplied is a generally accepted overall measure of the service level of the transmission network as perceived by customers of the network.

Measures of circuit availability and transformer availability are indicators of the ability of Powerlink to manage its network assets to meet the needs of the National Electricity Market. If a transmission line crosses an area boundary, Powerlink will need to assign the line to a specific area for the purposes of breaking down circuit availability.

Connection point indicators (averaged for all connection points)

- Connection point interruption frequency broken down by area;
- Connection point interruption duration broken down by area;
- Percentage of unplanned connection point interruptions not restored within three hours, overall and broken down by area.

These measures relate to the number of times Powerlink customers experienced a supply outage in a given year and the average duration of each outage. They thus provide a more meaningful measure of network reliability, from the perspective of the customer than the more generic measure of system minutes lost.

For a network, such as Powerlink's, that covers a large geographical area, service standards are likely to vary across the network and this variation is recognised in the publication of connection point statistics for each geographical region. As a service to customers, there is merit in a TNSP publishing annually the connection point indicators for individual connection points. However, such detailed information serves little purpose as a basis for high-level regulatory control.

2.3.2 Quality of Supply

Quality of supply is an important ingredient of the set of service standards and Powerlink can be reasonably expected to be accountable for quality of supply where that quality is primarily determined by the manner in which the network is designed and maintained.

Elements of quality of supply that fall into this category are described in Schedule 5.1 of the Code. These quality of supply requirements are of a technical nature and, further, minimum levels of quality of supply are precisely defined in the Code or in relevant Australian Standards.

It is not the function of the Commission to enforce the technical requirements of the Code, although, in its role of economic regulator, it must allow the revenue needed by a TNSP to maintain compliance with the Code's technical requirements.

This review is therefore limited to consideration of the reliability aspects of network service standards and does not consider what indicators of quality of supply are appropriate for regulatory reporting purposes.

2.4 OTHER REGULATORY DECISIONS

Two regulatory Decisions have previously been issued by the Commission in its role of regulator of the TNSPs in the national electricity market. These decisions related to TransGrid and to the transmission assets of the Snowy Mountains Hydro-Electric Authority (SMHEA). As part of this review, these Decisions, as they relate to service standards, were studied on the basis that it is reasonable to expect some consistency of approach from the Commission in its regulation of the TNSPs participating in the National Electricity Market (NEM). This is particularly important in respect of service standards since each network provides a monopoly service in a defined service area. In these circumstances there is an arguable case that, irrespective of the physical and location differences between individual networks, each TNSP participating in the market should provide a similar standard of service.

The TransGrid Decision did not include specific service standard targets, even though targets in relation to system minutes and circuit availability had been proposed by the TNSP. However, the Commission noted that the NSW Ministry of Energy and Utilities (MoEU) had embarked on a process that was expected to require all NSW electricity network operators, including TransGrid, to comply with benchmarked service levels, as part of the NSW licensing arrangements.

On this basis the Decision stated that the Commission would consider the administrative efficiencies of relying on the reports published by the Ministry as the appropriate means of satisfying its own service standard reporting requirements applicable to TransGrid for the purposes of its revenue cap decision.

In its decision the Commission noted that, at the next regulatory reset, it would consider adjusting TransGrid's revenue cap to reflect any non performance during the current period against the level of service standards set out in the NEC, as well as the service standards proposed by TransGrid during the Commission's regulatory inquiry.

The Commission also advised that, beyond the next reset, it intended to benchmark TransGrid's performance against the suite of indicators as part of its Regulatory Principles. It further advised that once this suite of indicators had been finalised, it would include these service standards in revenue caps finalised beyond that point in time.

In the SMHEA decision the Commission noted that the SMHEA transmission assets were to be transferred to TransGrid and with then come under the jurisdiction of the MoEU. On that basis the Commission proposes to rely on the MoEU reports, which presumably will cover the merged entity.

In the context of this review we note that Powerlink does not come under the jurisdiction of the MoEU and the Queensland Treasury has not mandated service standards applicable to Powerlink. It is also relevant that, in our view as discussed in Section 2.3, the suite of indicators referred to in the TransGrid decision do not, as they currently stand, form a robust basis for regulatory comparison and reporting.

3. PRESENT SERVICE LEVELS

3.1 SYSTEM MINUTES NOT SUPPLIED

Powerlink's system minutes not supplied over the period 1990 – 2000 is shown in Figure 1 below.

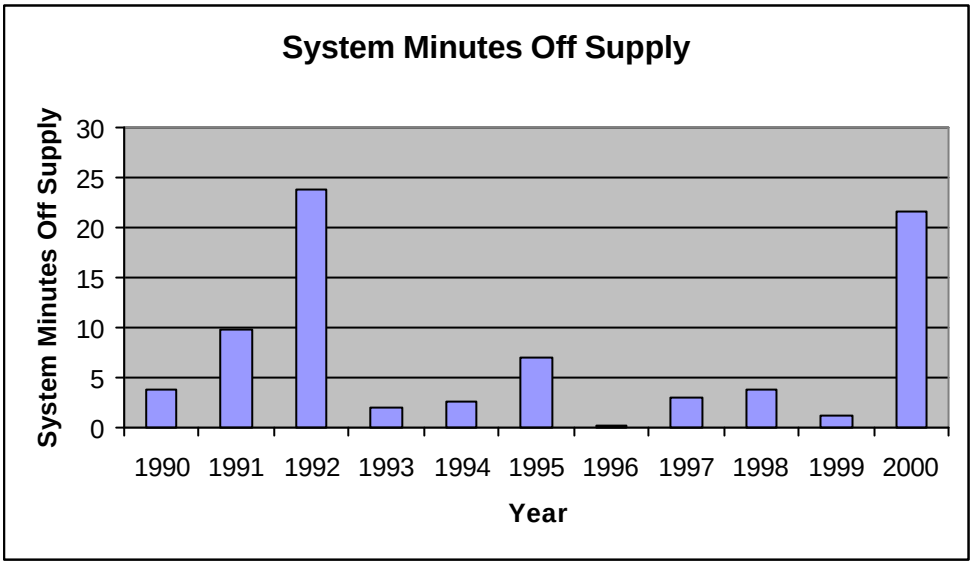

Figure 1 Powerlink System Minutes Off Supply 1990-2000.

A significant variability from year to year is apparent and no clear trend is evident. The diagram also illustrates that Powerlink is vulnerable to the effect of low probability, high impact events, as occurred in 1992 and 2000.

3.2 AVAILABILITY

Powerlink has provided data on circuit availability over the period 1993/1994 to 1999/2000 and this information is summarised for the record in Table 1 below.

Year	Availability	% Unplanned
1993/94	99.83%	8.9%
1994/95	98.57%	0.4%
1995/96	99.31%	0.5%
1996/97	99.35%	5.4%
1997/98	99.15%	9.6%
1998/99	99.24%	3.1%
1999/00	98.90%	3.3%

Table 1 Network Availability 1993/4 to 1999/2000

Availability is defined as the hours of transmission circuit availability divided by the total transmission circuit hours available. It provides a measure of overall system availability as well as the proportion of planned and fault outages.

The above table includes transmission circuits as well as supply and interconnecting transformers. Data up to and including 1997/98 also includes capacitors, reactors and SVCs. The data does not include any outage occurring at voltage below 100 kV or of less than 1 hour duration.

3.3 COMPARISON WITH OTHER TRANSMISSION NETWORK SERVICE PROVIDERS

It is possible to compare Powerlink's system reliability indicators with those of other TNSPs by comparing similar information available in the public domain. However such comparisons should be treated with caution since, different companies will define and measure various indicators in different ways. For example different companies exclude various categories of events from the statistics they use to calculate indicators on the basis that some events are deemed to be outside their control. Unfortunately there is often little consistency between different companies when it comes to determining what categories of events should be excluded.

Service standard statistics also need to be interpreted in the light of individual network configurations and the external environments in which a specific network is expected to operate. Specifically a high voltage network serving a compact densely populated area can be expected to be more reliable than a lower voltage network serving a large sparsely populated region. Networks subject to frequent storms and particularly lightning can also be expected to be less reliable.

Powerlink is a participant in an International Comparison of Transmission Performance (ICTP) study, which is co-ordinated by the UK National Grid Company and undertaken on an annual basis. The ICTP approach exerts a degree of control over the provision of data for the benchmarking process and attempts to ensure a high degree of consistency between participants in the way indicators are reported. It is therefore to be expected that comparisons of ICTP data will have a higher level of reliability than say comparisons of data taken from individual TNSP annual reports. Unfortunately the ICTP process is confidential and participants are only permitted to release limited data into the public domain.

A high level comparison of Powerlink's system reliability with that of other TNSPs, taken from the ICTP study, shows the Powerlink's network reliability compares well with that of others in the industry. This comparison, shown in Figure 2 with Powerlink identified as PQ, shows that on the basis of transmission faults per 100 circuit km, Powerlink compares well with other TNSPs.

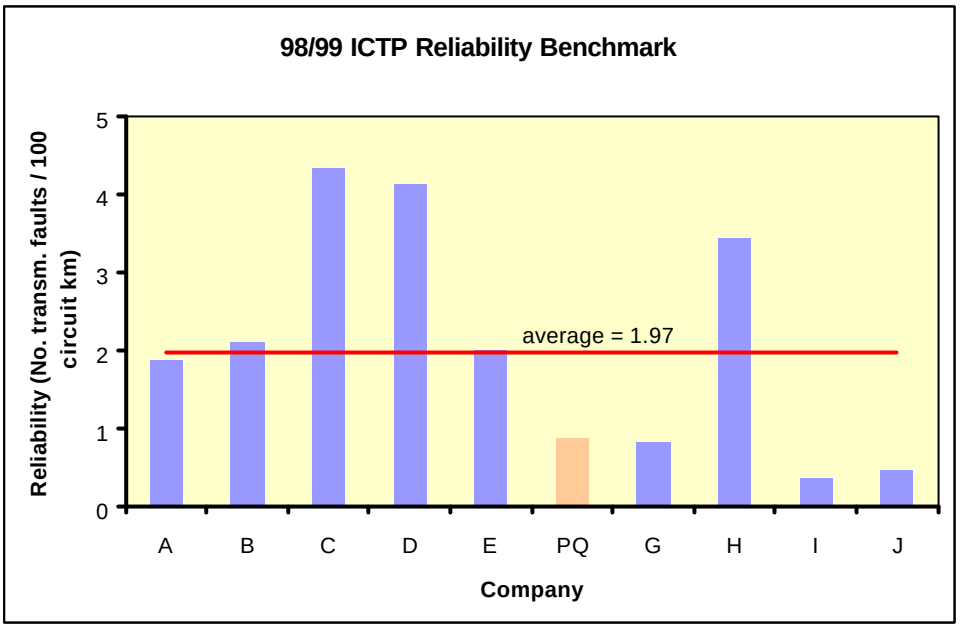

Figure 2 Faults per 100 Circuit- Km ITCP Study

4. POWERLINK'S REGULATORY APPLICATION

4.1 GENERAL PHILOSOPHY

Powerlink is of the view that traditional annual supply statistics are not a sound basis for service standard targets and therefore should not be used as the prime measure of service standards in the regulatory compact between it and the ACCC. In spite of this Powerlink would appear to accept that such statistics are "important to customers, as they are a measure of the quality of the product they receive."

Powerlink's primary concerns about the use of traditional supply statistics as a regulatory tool are twofold:

- They include the impact of events, such as the weather, that are not in the TNSP's direct control;

- They are not calculated on a basis that is statistically sound. Powerlink argues that, since traditional supply quality statistics measure either the cumulative or average effect of a large number of discrete events, the results will be adversely affected by a very small number of low-probability high-impact events. More specifically, such events make it difficult to analyse trends in a statistically meaningful way. For example average system minutes can be shown to increase as the period over which the average is measured and will tend to infinity for an infinite measuring period.

In order to address these deficiencies Powerlink submits that a new set of service standard performance indicators is required. These should be consistent with the following general philosophy.

1. The standards must reflect the "fundamental accountability principle" that one should be held accountable for things that are within one's control; and conversely, one cannot be held accountable for things that are outside one's control.

2. Performance standards must be consistent with the criteria for planning and developing the network set down in the Code. TNSPs cannot be required to meet performance standards higher than those implied by compliance with the Code.

3. Performance standards must be consistent with the standards and criteria set down for the operation of the network. Specifically a TNSP cannot be required to achieve a standard that exceeds the criteria used by NEMMCO to operate the network.

4. Standards for performance must be consistent with the CAPEX and OPEX allowed by the economic regulator.

5. Standards need to reflect both the different requirements of users connected to the network and the different environmental constraints faced by different network operators. For example, Powerlink has to contend with vast distances, cyclones and thunderstorms and difficult terrain.

In its Regulatory Application Powerlink discusses its general philosophy in relation to the setting of regulatory performance targets and the perceived deficiencies in traditional performance indicators in more detail. Furthermore Powerlink's Manager, Plant Strategies has published a number of papers detailing the deficiencies in traditional performance measures from a statistical perspective [3,4,5].

[3] Sharp B., *Bulk Supply Reliability Indicators for Performance Contracts* , Distribution 2000, 14-17 November 1995, Brisbane.
[4] Sharp B., *Monitoring System Reliability using Statistical Methods* , CEPSI Conference, 1998.

4.2 INTERNAL RELIABILITY INDICATORS

Powerlink's Regulatory Application describes the measures used internally by Powerlink as a management tool with to monitor network service standards. These include:

4.2.1 Reliability Related Measures

- Total number of loss of supply events greater than 0.2 system minutes;
- Total number of loss of supply events greater than 1.0 system minutes.

Both of the above are plotted with a 10 year history as a Poisson based control chart with control limits regularly reviewed.

4.2.2 Frequency Based Measures

- Static var compensator events;
- Equipment events per 1,000 circuit breakers;
- Secondary system events per 1,000 circuit breakers;
- Incident (human error) events per 1,000 circuit breakers;
- Total internal events per 1000 circuit breakers (sum of above);
- Ratio of loss of supply external events to total external events;
- Ratio of loss of supply internal events to total internal events.

These measures are plotted with a three-year history as Poisson based control charts with control limits updated annually.

4.3 CUSTOMER FEEDBACK MEASURES

Powerlink's management team has embarked on a program of regularly visiting each network customer. The program has been in place for the last two years and about 25 visits have taken place each year. Powerlink has appointed customer account managers to directly follow though with issues raised at these executive discussions.

In addition, Powerlink has initiated a program of direct interaction with customers affected by loss of supply events. Within one day of a loss of supply event, the customer account manager will contact the customer to outline the underlying cause of the event and, where applicable, to identify steps being undertaken by Powerlink to reduce the likelihood of a recurrence.

4.4 MARKET IMPACT MEASURES

Powerlink's regulatory application does not oppose the use of market impact measures. However it notes that it does not have access to data aimed at monitoring the impact it may have on the market other than the reliability / loss of supply measures and would therefore require data from NEMMCO. It is concerned that any measures be determined to ensure that it is a controllable measure rather than just a statistic.

[5] Sharp B., *Correct Design and Use of Performance Indicators*, Third International Conference of Maintenance Engineering, 19-21 May 1998, Adelaide.

4.5 POWERLINK'S SERVICE STANDARD PROPOSAL

In its Regulatory Application, Powerlink has proposed a three-step approach.

1. It proposes to compile annual supply quality statistics relating to the total network and individual connection points. These would be provided on an annual basis and would align generally with the suite of indicators shown in Annex 8.1 of the Commission's Draft Statement. However Powerlink emphasises that these measures have extremely limited value as TNSP performance measures.

2. It further proposes that the Commission adopt, as part of the regulatory compact, the set of performance standards Powerlink uses for its own monitoring process and decision making. It has proposed targets for each indicator. The indicators are as listed in Section 4.2.1 and 4.2.2 with the exception of the two loss of supply ratios, which are not included. The targets proposed are discussed further in Section 5.5.2.

3. Finally Powerlink proposes to work with the Commission to develop measures and targets that are linked to market impacts and any other relevant measures. It envisages this as a longer term exercise which will form part of the process associated with finalising the Statement of Regulatory Principles

5. REVIEW OF POWERLINK APPLICATION

5.1 INTRODUCTION

In the context of the current regulatory environment there are a number of issues in relation to Powerlink's application that require detailed comment and review. These include:

- Powerlink's philosophical approach and, in particular the concept of accountability and controllability in relation to regulatory service standard indicators;
- Impact of the National Electricity Code;
- The statistical soundness of traditional transmission service standard indicators;
- The suitability of Powerlink's proposed approach to the regulatory monitoring of service standards; and
- The targets proposed by Powerlink.

These issues are discussed in the sections below.

5.2 POWERLINK'S PHILOSOPHICAL APPROACH

In its regulatory application Powerlink argues that it should be accountable only for what is in its control and it cannot be held accountable for things or events that are outside its control. Events that it believes that it should not be accountable for include:

- Weather / natural events
- NEMMCO intervention
- Constraints and problems resulting from the long term historical development of the network;
- Action of other participant in the industry who are able to take decisions without regard to network security.

In its regulatory application Powerlink states:

"Supply quality statistics are important to customers, as they are a measure of the quality of the product they receive. However because the traditional measures are not all related to events under the TNSP's control, nor are they presented in a form that is statistically sound in terms of measuring performance, they are not recommended as the prime measure of service for the regulatory compact between the ACCC and the TNSP".

Leaving aside the issue of statistical soundness, which is discussed in Section 5.4 we believe this statement reflects an incomplete understanding of the regulatory function in relation to natural monopolies such as electricity networks. In a monopolistic environment the primary function of the regulator is to compensate for the lack of power of the customer. In a competitive market a customer that does not like the service that is provided is able to exert power in the market by choosing another supplier. Therefore there is a real incentive for market participants to improve the efficiency of their operation by reducing price and improving the standard of service. However in a monopolistic situation, there is no alternative supplier and so, in the absence of regulation, the incentives to improve efficiency are substantially reduced. The primary purpose of the

regulator is therefore to ensure that similar efficiency incentives to those found in a competitive market environment are in place. In this sense the regulator is a proxy for the competitive market whose primary function is to compensate for the lack of market power available to the customer.

If this premise is accepted then it cannot logically be argued that measures that are important to the customer are not relevant in a regulatory context.

The argument that a TNSP should not be held accountable for events outside its control is also not consistent with what happens in a competitive market. A shareholder, for example, holds a company's board and management accountable for its profitability and the value of its shares. The shareholder expects the board and management to manage the risks inherent in the company's operation and will generally not accept the fact that the company could not directly control the risks to which it is exposed as an excuse for poor performance. In this sense, while the "fundamental accountability principle" is applicable at lower levels of management, it becomes less and less relevant as one moves up the management hierarchy.

From a regulatory perspective this issue is not one of controllability but of which industry participant is in the best position to mange the risks that face the industry. We therefore consider that Powerlink should be held fully accountable for managing those risks that it is in a better position than other industry participants to mitigate. The regulatory compact should reflect this accountability.

If this approach is accepted, then the service standard measures must include the impact of weather and natural events on the performance of the network and also service impacts resulting from the planning and design of the historic network, as Powerlink is in a better position to manage these risks than its customers or other industry participants. Indeed we do not accept that many of these risks are not controllable, particularly over the longer term. As a competent network owner, Powerlink should be developing capital investment strategies to reduce these risks. If appropriate it should seek the necessary funding provisions in its regulatory revenue cap applications.

In this context it must be noted that that the above discussion is intended only to be a commentary on Powerlink's regulatory application. It should not be taken to represent our views on Powerlink's risk management strategies. During this review nothing came to our attention to indicate that Powerlink was not managing its exposure to external risks in accordance with standard industry practice.

It follows also that Powerlink should not be held accountable for risks that are better managed by other participants in the industry and its service standard performance measures should exclude events that are directly more appropriately mitigated by other participants. For example, Powerlink should not be held accountable for load shedding due to a lack of generation since this is a risk that it is not in a position to mitigate.

It is acknowledged that Powerlink's approach was not an attempt by Powerlink to withdraw from its accountabilities for the total quality of its service – in fact it was evident from this and other reviews undertaken by PB Associates that Powerlink does have sound risk management strategies in place to manage its exposure to external risk. The Powerlink approach was rather one aimed at identifying a closer link between operational cause and effect. However we do not agree that this approach is appropriate for the Commission's regulatory purposes.

5.3 NATIONAL ELECTRICTY CODE

In its regulatory application Powerlink notes that standards for network performance must be consistent with the standards and criteria set out in the NEC for planning, developing and operating the network. It argues that a TNSP cannot be accountable for achieving a standard that exceeds the criteria set down in the NEC for the planning and development

of the network, or for achieving a standard that exceeds the criteria used by NEMMCO to operate the power system.

It is noted that the NEC sets down minimum standards and that there is no regulatory constraint on TNSP achieving standards above this level. However the Commission in its Draft Statement of Regulatory Principles states that it is unwilling to consider more than a basic level of service at this time[P99]. It follows that the Commission is unwilling to provide funds in the revenue cap to achieve more than a level of service that is consistent with the minimum requirements of the Code.

However, in the context of this regulatory application these arguments are largely irrelevant since the justification for much of the revenue is that the expenditure is required to meet the requirements of the code. Historically the standards to which the Queensland network has been managed would appear to have been below those now required by the Code as Powerlink is arguing that much of the CAPEX and additional OPEX it requires during this regulatory period are needed to meet NEC requirements. For example, increased OPEX is requested to allow more planned maintenance to be done at weekends, since NEMMCO is, for system security reasons, increasing denying equipment maintenance outages during normal working hours. It follows that, assuming that the requested additional expenditure is approved, inability to perform maintenance during normal working hours is not a valid reason for reduced service standards. Indeed the additional expenditure should lead to an improvement in service standards as network planning and operation are upgraded to meet Code requirements.

Given the risk management philosophy discussed in Section 5.2, and the relative responsibilities of the TNSP and NEMMCO as set out in the Code, we consider that Powerlink should be fully accountable for the availability of the network and for all power outages, whether planned or unplanned, due to the unavailability or failure of network elements.

5.4 STATISTICAL BASIS FOR PERFORMANCE MEASURES

The most commonly used measure of transmission network reliability is annual system minutes lost. This is the total energy (MWh) unsupplied from all outages in a year divided by MW peak demand and multiplied by 60 to convert to system minutes.

This is a composite measure that takes account of the three main facets of poor network performance; the number of supply interruptions on a network in any one year, the length of each interruption and the customer demand not supplied as a result of each interruption. It is a measure of the service level of a transmission network as perceived by its customers and is a generally accepted basis for comparing the performance of different networks.

The annual system minutes not supplied on the Powerlink network for each calendar year over the period 1984-2000 is given in Table 2. below.

Powerlink System Minutes Lost

Year	Minutes Lost	10 year Average
1984	7.6	
1985	5.9	
1986	3.5	
1987	6.3	
1988	15.1	
1989	1.3	
1990	3.9	
1991	9.9	
1992	23.9	
1993	2.0	7.94
1994	2.6	7.44
1995	7.1	7.56
1996	0.2	7.23
1997	3.1	6.91
1998	3.8	5.78
1999	1.3	5.78
2000	21.7	7.56

Table 2: System Minutes Not Supplied

It can be seen that there is a wide variation from year to year. In 1996 the total system minutes not supplied was 0.2 minutes whereas in 1992 the total system minutes not supplied was 23.9 minutes, a reliability apparently one thousand times worse. The worst case reliability over the 7-year period 1993-99 was in 1995 when 7.1 system minutes were not supplied. However in 1992 and 2000, the two years immediately outside this period, the annual system minutes lost was 23.9 and 21.7 respectively. Clearly there is a wide variation in system minutes not supplied from year to year. As a result, it is difficult to discern a trend in network reliability by examining the annual system minutes lost over the period 1984-2000.

Powerlink proposes that this be addressed by focusing on the frequency of loss of supply events. Intuitively it would appear that Powerlink's approach would largely ignore the relative magnitude of individual events. It may also appear that this approach would eliminate distortions caused by the effect of high impact, low probability events and remove the regulatory incentive for Powerlink to do what it can to minimise the probability of such high impact events, and, when they do occur, to do what it can to minimise their impact.

However Powerlink claims that its detailed extreme value analysis approach, as outlined in its paper "Monitoring System Reliability using Statistical Methods"[6], does in fact take account of system events of all magnitudes even though only two extreme values are used to define the locus of all other magnitude events.

Notwithstanding Powerlink's mathematical analyses, it is our view that the traditional and widely used system minutes approach be followed.

A preferred approach would be to base a target on a ten year rolling average of system minutes lost. Over the period 1993/2000 the ten-year rolling average of system minutes lost varied between 5.78 and 7.94 and there were no statistical outliers. Examination of Table 4.4 shows a clear improvement in reliability over the period 1993-99, although the equipment failures in 2000 brought this improvement to a halt. Nevertheless the 10-year rolling average in 2000 was still comparable to that over the period 1993-95.

If a ten-year rolling average of system minutes lost is accepted as a reasonable measure of network performance, it is still necessary to determine a reasonable target. The average annual system minutes lost over the period 1984-2000 were 7 minutes. Achievement of an annual system minutes lost of 7 minutes in 2001 would bring the 10-year rolling average back down below 7 minutes. This suggests that a 7 minute 10-year

[6] Sharp B., *Monitoring System Reliability using Statistical Methods* , CEPSI Conference, 1998.

rolling average is a fair reflection of the current level of reliability on the Powerlink network. It is therefore proposed as a suitable regulatory target, given the Commission's intention to regulate only for a basic level of service at this time.

5.5 ASSESSMENT OF THE POWERLINK PROPOSAL

Powerlink's three step proposal for the regulatory monitoring of service standards is described in Section 4.5.

5.5.1 Publication of Supply Quality Statistics

Powerlink proposes to publish supply quality statistics relating to the total network and individual connection points. These would be provided in an annual basis and would align generally with the proposed data set published by the Commission in Annex 8.1 of its Draft Statement.

This data set is discussed in Section 2.3 where it is concluded that it does not constitute a suitable basis for regulatory reporting. This was further confirmed during the course of the review when Powerlink was unable to provide the nominated statistics for the year 2000 for reasons similar to those discussed in Section 2.3.

However it is recommended that the regulatory compact include a provision where Powerlink is required to report on an annual basis the more limited set of performance measures outlined in Section 2.3.1. In calculating these indicators all outages due to the unavailability or failure of any transmission network element should be included, irrespective of the primary cause of the outage.

It is further recommended that the measures itemised in Section 2.3.1 be extended to include the average system minutes off supply for the ten years leading up to the reporting year.

5.5.2 Performance Measures and Targets

Powerlink proposes that the set of performance measures it currently uses for its monitoring processes and decision making be adopted. These measures and the proposed targets are given in Table 3

Measure	Target Mean	Comment
Total number of loss of supply events per quarter greater than 0.2 system minutes per quarter.	1.3 (summer) 0.8 (winter)	Target means based on performance from January 1984 – December 1998. Improvement since about 1994 and indicates targets could be reduced.
Total number of loss of supply events per quarter greater than 1.0 system minutes per quarter[7].	0.4 (summer) 0.07 (winter)	Target means based on performance from January 1984 – December 1998. There is an indication that the frequency of such events has increased since 1999 indicating a need for increasing asset refurbishment or replacement.
Number of static var compensator events per month.	2.2	Target mean based on period from October 1991 to Mach 1996. Stable trend indicates target still relevant. Indicator is not normalised, as number of SVCs is stable.
Equipment events per 1000 circuit breakers per month.	4.3	Target mean has been reduced from that previously used due to performance improvement in recent years.
Secondary system events per 1000 circuit breakers per month.	3.1	Data since October 1997 indicates that the trend is stable and that proposed target mean reflects current performance.
Human error events per 1000 circuit breakers per month.	2.4	Data since October 1997 indicates trend is stable and that target mean reflects current performance.
Total internal events per 1000 circuit breakers per month.	10.1	Sum of equipment, secondary system and human error events.
Total external events per 1000 circuit breakers per month.	0.6 (summer) 0.4 (winter)	Existing targets reflect reduced lightning activities in recent years. Increased lightning levels may require targets to be increased.

Table 3: Proposed Performance Measures and Targets

The target means proposed would seem to be a fair reflection of current performance given the measures proposed. They have been developed on the basis of the network's historical performance over an extended period of time.

Powerlink has indicated that it will report to the Commission the annual mean of all the above indicators to allow direct comparisons with the targets. This would seem to be a satisfactory approach for the five indicators normalised by circuit breaker numbers. These are read monthly and twelve readings in a year will generally be sufficient to ensure that interpretation of results is not distorted by an occasional outlier.

In the case of loss of supply events annual targets based on the mean performance over a long period of time have limited usefulness as annual targets, where only the events that occur in a single year are taken into account. This can be illustrated by considering the proposed target of point 0.07 for the winter loss of supply events per quarter. There are only two winter quarters in any one year and you cannot have a fraction of an event. If there are no qualifying winter outages in any year the reported mean will be 0.0. If

[7] There is an error in Table 11.1 of Powerlink's regulatory application. The target means for the total number of loss of supply events greater than 1.0 system minutes relate to the number of events per quarter rather than per month.

there is one qualifying outage the reported mean will be 0.5. No intermediate values between 0.0 and 0.5 are possible so, in this context, a target of 0.07 is meaningless.

One approach to overcome this difficulty would be to report a rolling average over a number of years, using a similar approach to that proposed for system minutes. Powerlink does not favour this approach and argues that it is not sound as it does not effectively filter out background noise to give an underlying reliability trend. As discussed in Section 5.4, we do not believe this would be a problem providing the rolling average is taken over a sufficiently long period.

An alternative approach would be to express the target in terms of the number of events in a particular year. If this approach is taken the annual targets could be expressed as shown below:

Total number of loss of supply events greater than 0.2 system minutes – summer	3
Total number of loss of supply events greater than 0.2 system minutes – winter	2
Total number of loss of supply events greater than 1.0 system minutes – summer	1
Total number of loss of supply events greater than 1.0 system minutes – winter	0

We consider these targets to be more meaningful for regulatory purposes than those proposed by Powerlink and recommend that they be adopted in the interim.

However the performance measures and targets that Powerlink proposes for regulatory oversight are the same measures and targets that are used internally by management to monitor the performance of the network. The measures are primarily used as management tools and have been selected because Powerlink has a high degree of control over the measured performance. We accept that performance of the measures in Table 3 will also have a significant influence on the reliability of supply from a customer perspective.

However it is this reliability of supply from a customer perspective, rather than internal performance measures that must be the primary target for regulatory oversight. This reliability of supply will be determined not only by how well Powerlink manages those risks within its direct control, as represented by the above measures, but also by how successful Powerlink is at mitigating those external risks, such as the weather, over which it has less direct control.

Mitigation of external risk is therefore a significant responsibility of Powerlink's management. As Powerlink's success at risk mitigation has a direct impact on its service standards, it is a legitimate issue for regulatory monitoring.

On this basis it is recommended that the measures and targets set out above be used as the basis for the regulatory monitoring of service standards for this regulatory period only. At the next reset targets for service standards should be set on the basis of the indicators proposed in Section 2.3.1. On the basis that these measures are to be reported annually, at the time of the next reset a history will be available that will allow realistic targets to be agreed.

In its regulatory application Powerlink has also suggested that the following measures be adopted in the regulatory compact as matters for regulatory oversight:

- Frequency of customer visits;
- Significant issues raised by customers;
- Steps taken to deal with issues;

- Performance of an annual customer satisfaction survey;
- Timely notification of interruption advice to customers.

This section of the Powerlink application is not as well developed as the section on performance measures. Targets are not proposed and detailed proposals are not provided on how such oversight would operate.

It is not the function of the Commission to regulate the day-to-day management of Powerlink's business. We believe that Commission involvement in issues such as how frequently Powerlink visits its customers and how it handles issues raised during these visits is overly intrusive. Further, from a regulatory perspective, such oversight is unnecessary.

5.5.3 Market Impact Measures

In its Regulatory Application, Powerlink offered to work with the Commission to develop measures and targets that are linked to market impact. It considered that it is important that such measures are carefully determined so as to measure a "controllable" variable rather than a statistic.

APPENDIX A
Glossary of Terms

Glossary of Terms

ACCC	Australian Competition and Consumer Commission
Code	National Electricity Code
Commission	Australian Competition and Consumer Commission
CAPEX	Capital Expenditure
Draft Statement	*Statement of Principles for the Regulation of Transmission Revenues* – Draft; ACCC, 27 May 1999
ICTP	International Comparison of Transmission Performance
MoEU	New South Wales Ministry of Energy and Utilities
NEC	National Electricity Code
NEM	National Electricity Market
NEMMCO	National Electricity Market Management Company
NSW	New South Wales
SKM	Sinclair Knight Merz
SMHEA	Snowy Mountains Hydro-Electric Authority
SNNS	Specification and Network Services
TNSP	Transmission Network Service Provider
UK	United Kingdom