

Transpower New Zealand Limited: Managing risks to transmission assets

This is the report of a performance
audit we carried out under section
16 of the Public Audit Act 2001

September 2011

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Auditor-General's overview

My staff audited how well Transpower New Zealand Limited (Transpower) is managing risks to the transmission system. We wanted to establish whether the owner and operator of the national electricity grid (the grid) understood well the capacity constraints facing the grid and the risks posed by the condition of the grid assets, and was using this understanding to better maintain and invest in the grid.

In 1997, Transpower decided to minimise spending on the grid and renewing assets (an approach known internally as the glide path). It thought that distributed generation (electricity generated close to where it is used) would increase and reduce the need to expand and maintain the grid.

By 2003, it had become clear that the glide path was unsustainable. Many of the grid assets were approaching the end of their useful life, and were required to deliver more power for a growing economy and population. Transpower identified that the grid backbone was nearing its capacity and that investment was needed in many other parts of the grid. Transpower made the strategic decision to focus at this time on increasing the capacity of the grid, and began a programme to advance significant investment in capacity. This programme is under way. It includes work on the Cook Strait links, the North Island grid upgrade, and the North Auckland and Northland project.

In 2008, Transpower turned its attention to the necessary replacement and refurbishment of the ageing grid assets.

In carrying out this audit, we set out to answer the following question: How well is Transpower managing risk to the grid to reduce the chances of:

- power failure in the short term; and
- adopting an inadequate or excessive investment strategy for the medium to long term?

The chances of power failure in the short term

Following the glide path, the grid became increasingly stressed and less reliable. Many of the grid assets are approaching the end of their useful life. Also, as the country's population and economy grow, these ageing assets must deliver more electricity. The grid's core network design and Transpower's contingency planning arrangements mean that Transpower is well placed to reduce the likelihood of power failure and to restore supply after a power failure. My staff found that Transpower solves problems well and fixes many day-to-day problems with the grid as they occur. Transpower has put in place robust project, technical, and commercial governance to oversee complex projects.

The chances of Transpower adopting an inadequate or excessive investment strategy for the medium to long term

Transpower lacks asset information available in the way that a modern asset management system would provide to fully inform an investment strategy for the medium to long term. It has accumulated much data about its assets, their condition, and likely failure profile, but this data is in different systems and is recorded in different formats. For example, it is difficult to form an integrated view of risk throughout a fleet of assets or group of assets at a particular site to help Transpower make decisions. There is no prioritising of risk between asset management plans. It is not possible to establish where the highest risk is and, therefore, which assets should be targeted first. This is especially important given the extent of the replacing and refurbishing work required.

Transpower has recognised this. It has begun a five-year programme to improve how it manages risks to assets. Its *Asset Risk Management Journey Plan – Strategic Plan 2010-2013* guides this work.

Transpower has begun a project to buy, install, populate and deploy a modern asset management system. Until this programme has been fully implemented, no-one can be sure how well Transpower is managing risk to the grid to reduce the chances of having an inadequate or excessive investment strategy for the medium to long term.

In February 2011, Transpower produced a unified long-term strategy. *Transmission Tomorrow* describes the key strategies (to improve grid performance, to improve system performance, and to improve reliability and resilience) that Transpower will apply to provide the increasing services the grid must provide. I consider that *Transmission Tomorrow* provides a sound basis to guide the grid's future development.

Transpower is taking steps to improve its asset and risk management. I urge Transpower to continue implementing *Transmission Tomorrow*, and the asset and risk-related strategies, plans, systems and processes that will be required to support it.

I thank Transpower and Commerce Commission staff and our expert advisor for their help and co-operation during our audit.



Lyn Provost
Controller and Auditor-General

28 September 2011

Our recommendations

We recommend that:

- 1 the board of Transpower New Zealand Limited actively monitor Transpower's progress against *Transmission Tomorrow* and the prioritised work programme; and
- 2 Transpower New Zealand Limited complete its programme for improving how it manages assets and risk; in particular, Transpower must implement:
 - an integrated system for managing assets that provides one consistent source of information about assets so that it can make good decisions about how it manages its assets;
 - a comprehensive, quantitative, risk-based approach to managing assets that allows for risk to be traded off against the costs of mitigating the risk – essential for prioritising investments; and
 - long-term targets for what Transpower considers to be the appropriate level of risk at a network level, and the associated network performance and quality measures.

Part 1

Introduction

- 1.1 In this Part, we:
- explain what the national electricity grid (the grid) is;
 - set out the role of Transpower New Zealand Limited (Transpower) with the grid;
 - explain the regulatory context for Transpower, particularly in relation to its investment in grid assets;
 - define risk management and set out the standards and guidelines for managing risk;
 - set out the scope of this audit; and
 - describe how we did the audit.

What is the grid?

- 1.2 The grid is a national network of high voltage electricity transmission assets. It comprises:
- 11,812 route kilometres of high voltage transmission line;
 - 41,450 supporting towers and poles;
 - 182 substations; and
 - 1122 transformers.

Transpower's role with the grid

- 1.3 Transpower, a State-Owned Enterprise, owns and operates the grid.
- 1.4 Transpower is responsible for:
- transmitting electricity from where it is generated (by companies such as Meridian Energy Limited and Mighty River Power Limited) to cities, towns, and some major industrial users (like New Zealand Steel Limited);
 - supplying lines companies (such as Vector Limited) that deliver electricity to New Zealand's homes and businesses; and
 - managing New Zealand's power system (as the system operator) so that electricity is delivered when and where it is needed, 24 hours a day, seven days a week.
- 1.5 Transpower is responsible for ensuring that the grid is kept in good condition. This includes refurbishing or replacing transmission assets, where needed.
- 1.6 Transpower contracts out all its construction, maintenance, and fault response services. Transpower's five maintenance contractors operate in 13 regions.

- 1.7 Transpower is responsible for planning to ensure that the grid is able to meet the needs of future generations. Planning involves predicting the level and location of growth in electricity generation and demand, and investing in additional transmission assets to meet this future need.
- 1.8 Three of Transpower's divisions have core responsibility for carrying out these roles:
- Grid Development – responsible for identifying the future needs of the grid's users, developing transmission solutions, obtaining board and regulator approval for investments, and maintaining customer relationships;
 - Grid Projects – responsible for carrying out Grid Development's projects and the asset replacement programmes for Grid Performance, managing capital works, procurement, and getting environmental approvals; and
 - Grid Performance – responsible for grid safety, maintaining and operating the grid, managing power outages, managing assets, response and recovery from outages, monitoring grid performance, and relationships with landowners.

Background to the glide path strategy

- 1.9 In 1994, Transpower was established as a State-Owned Enterprise after the split of the Electricity Corporation of New Zealand into separate business entities.
- 1.10 In 1997, it was thought that distributed generation would expand quickly, meaning there would be no need to expand the grid or, possibly, even to maintain it in the longer term.¹ Transpower made a strategic decision to adopt a "wait and see" approach. Transpower minimised spending on developing the grid and renewing assets as it set out on what became known as the glide path.
- 1.11 By 2003 and the appointment of a new chief executive, it had become clear that the expected expansion of distributed energy was unlikely to occur and the glide path was unsustainable.

Transpower's response

- 1.12 Transpower realised that it needed to start investing significantly to ensure that the grid had sufficient capacity to meet projected future electricity requirements. Transpower began work to identify a 40-year strategy to upgrade the grid and began building new transmission lines and substations.
- 1.13 Two discussion papers, in December 2003 and October 2004, examined New Zealand's likely electricity transmission needs until 2040.² It was recognised that the grid's main transmission routes (the grid backbone), built largely in the 1950s

1 Transpower does not have the role of central planner (there is no central planner), so it cannot influence where or when new generation is established.

2 Transpower New Zealand (2003), *Future of the National Grid 2003-2004 Discussion Document* and Transpower New Zealand (2004), *Future of the National Grid Discussion Document No. 2*.

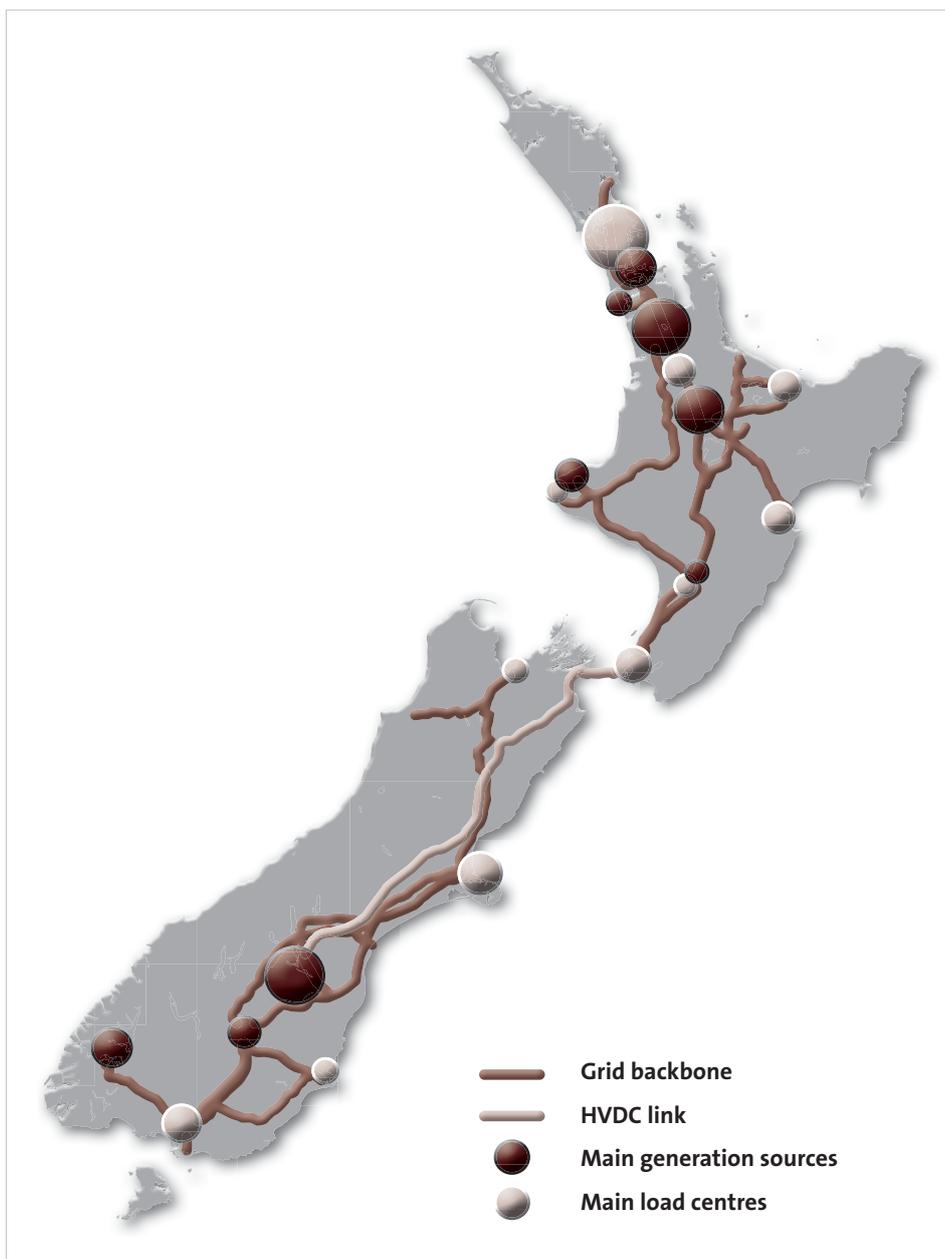
and 1960s, were nearing capacity and investment was needed in almost every part of the grid.

- 1.14 Figure 1 shows the grid backbone, High Voltage Direct Current (HVDC) link, main generation sources, and main load centres. The brown circles do not represent single generation sources. For example, the large circle in the south-central part of the South Island represents a large area of the South Island hydroelectric scheme including the Benmore and Waitaki power stations. The dark brown circle in the central North Island includes the geothermal power stations around Taupo and the hydroelectric power stations in the area.
- 1.15 Three priorities were identified:
- supply to Auckland and the upper North Island;
 - supply to Christchurch and the upper South Island; and
 - upgrading the HVDC inter-island link.
- 1.16 The 2004 discussion paper also signalled that Transpower would carry out other upgrades to meet projected growth in demand and allow enough time to introduce needed long-term solutions.
- 1.17 Transpower's decision to expand the grid coincided with the setting up of the Electricity Commission in September 2003. This meant that, while Transpower was entering a new phase and building its capacity and capability to carry out the significant investment required, the Electricity Commission was also settling into its new role and establishing a new regulatory environment. Part of the Electricity Commission's regulatory role was to approve investment in the grid.

The regulatory framework

- 1.18 When investing in assets, Transpower must operate within a regulatory framework that applies to this spending. Transpower recovers its operating and capital spending from transmission customers through the transmission pricing methodology.
- 1.19 In November 2010, the Electricity Industry Act 2010 repealed and replaced the previous regulatory framework set up under the Electricity Act 1992. The Electricity Industry Participation Code (the code) and the Electricity Industry (Enforcement) Regulations 2010 replaced the Electricity Governance Rules (made by the Minister of Energy) and the Electricity Governance Regulations 2003.
- 1.20 Before November 2010, Part F of the Electricity Governance Rules set out the requirements for grid upgrades and investments. Transpower was required to prepare, and submit to the Electricity Commission, grid upgrade plans which met the requirements of Part F. These plans set out and justified the planned investment.

Figure 1
The national electricity grid



Source: Transpower, *Transmission Tomorrow – the enduring grid*.

- 1.21 The new code includes large sections of Part F of the former Electricity Governance Rules. The responsibility for setting the requirements for Transpower's capital expenditure and approving such spending has been passed to the Commerce Commission.
- 1.22 Appendix 1 contains more detail about the regulatory framework and the changes that have occurred. It also includes details about the tests for Transpower's proposed investments.

Standards and guidelines for managing risk

- 1.23 We have assessed Transpower's practices against the following standards and guidelines:
- Joint Australian New Zealand International Standard – Risk Management – Principles and guidelines AS/NZS ISO 31000:2009;
 - Risk Management Guidelines HB 436:2004, a companion to AS/NZS 4360:2004;
 - PAS 55-1:2008 (PAS 55), *Asset management. Specification for the optimized management of physical assets*, issued by the British Standards Institution; and
 - Technical Brochure on *Transmission Asset Risk Management* published in August 2010 by Working Group C1.16 of the International Council on Large Electric Systems.

What is risk management?

- 1.24 AS/NZS ISO 31000:2009 describes risk and risk management as:
- Organizations... face internal and external factors and influences that make it uncertain whether, when and the extent to which they will achieve or exceed their objectives. The effect this uncertainty has on the organization's objectives is "risk"...*
- All activities of an organization involve risk... In general terms, "risk management" refers to the architecture (principles, framework, and process) for managing risks effectively, and "managing risk" refers to applying that architecture to particular risks.*
- ... the adoption of consistent processes within a comprehensive framework helps ensure that risk is managed effectively, efficiently, and coherently across an organization. ... Risk management can be applied across an entire organization ... as well as specific functions, projects, and activities.*

What is asset management?

- 1.25 Asset management is the process of achieving whole-of-life effectiveness of assets at minimum cost. For an asset-intensive company like Transpower, operating the grid as an infrastructure network, the concept of risk and its management are closely related to the concept of asset risk and asset management. This is generally recognised in the standards and guidelines that apply to the management of risks and assets.

The scope of our audit

- 1.26 In carrying out our audit, we set out to answer the following question: How well is Transpower managing risk to the grid, to reduce the chances of power failure in the short term, and the chances of adopting an inadequate or excessive investment strategy for the medium to long term?
- 1.27 We expected that Transpower would:
- promptly identify all asset risks;
 - appropriately assess and prioritise risks to grid assets;
 - take appropriate, timely action to reduce risks to grid assets;
 - take appropriate, timely action during and after unplanned events (risk recovery); and
 - have the most effective investment strategy for reducing risk.

How we carried out our audit

- 1.28 In our audit, we:
- interviewed staff from Transpower and the Ministry of Economic Development;
 - reviewed documents relating to what was discussed during the interviews;
 - considered reports by external consultants and regulators;
 - found out what systems Transpower had in place for identifying risks and taking appropriate action to prioritise and reduce them, including:
 - assessing what information is used in managing risk and how this information is used;
 - reading key strategies, risk registers, planning reports, and asset performance reports;
 - reading Network Risk Committee meeting agendas and minutes to assess how effective the Committee was;³
 - reviewed Transpower's investment approval process and how it identifies, prioritises, and reduces risks;

³ See paragraph 2.26 and Appendix 2 for information about the Network Risk Committee.

- established how Transpower follows up on unplanned power outages and failures, and assessed to what extent these are failures of the risk management process; and
- established what risk-recovery processes Transpower has, and how it determines whether these are appropriate.

1.29 We tested our conclusions with an independent advisor who has been involved in the electricity industry for 37 years. Our independent advisor also acted as an advisor to the team that performed the Ministerial Review of the Electricity Market in August 2009.

The structure of this report

1.30 The rest of this report is made up of three parts:

- In Part 2, we discuss and evaluate Transpower's system for managing risks to grid assets, and Transpower's planned improvements to how it manages risks to grid assets. Transpower has identified risks to contractors' capabilities. These risks could affect how the grid performs. We look at how Transpower is managing these risks. We also look at how well Transpower responds to unplanned events.
- In Part 3, we discuss how well Transpower uses its understanding of risks to grid assets to invest in the grid's capacity.
- In Part 4, we discuss and evaluate how well Transpower uses its understanding of risks to manage grid assets and improve the grid's reliability and performance.

Part 2

The current system for managing risks to grid assets

2.1 In this Part, we discuss and evaluate Transpower’s system for managing risks to grid assets. We cover:

- Transpower’s framework for managing risk;
- how Transpower identifies, analyses, and manages risks to grid assets;
- how Transpower’s board monitors risk;
- Transpower’s plans to improve how it manages risks to grid assets; and
- how Transpower manages risks to contractors’ capabilities.

Our conclusions

- 2.2 Transpower has established systems for managing corporate risk. However, to more effectively manage risks to grid assets, Transpower has identified that it must have a more detailed and integrated system for gathering and analysing data about the condition of assets.
- 2.3 We found that the “Top 10” risks (see paragraph 2.22) are reported to the board each time it meets and that the corporate risk register is presented to the board every six months. The board receives regular updates on key projects through the chief executive’s report, which includes the risks to and issues with those projects.
- 2.4 In December 2008, the Network Risk Committee asked how some of the core grid assets had come to be in a poor condition. Managers responded that the focus of governance and management had been elsewhere, rather than on the state of the assets and the risks this presented. The focus has since changed.
- 2.5 The Network Risk Committee has recently adopted a systematic approach to assessing and reviewing network risk and network risk controls.
- 2.6 We encourage the board and its relevant committees to continue to actively monitor and hold managers accountable for identifying the extent of problems with grid assets and applying timely solutions.
- 2.7 Transpower is improving its asset risk register and documented methods for assessing and quantifying risks to assets. We consider that Transpower’s adoption of PAS 55 (which includes a methodology for managing risk) should help improve how Transpower manages risks to grid assets.⁴
- 2.8 We note that Transpower has begun a quality improvement plan and safety improvement programme under which all contractors will be required to work to approved and standardised maintenance procedures. Transpower is working to improve the training of contractors.

⁴ PAS 55 is a Publicly Available Specification published by the British Standards Institution. This PAS gives guidance and a 28-point requirements checklist of good practices in physical asset management.

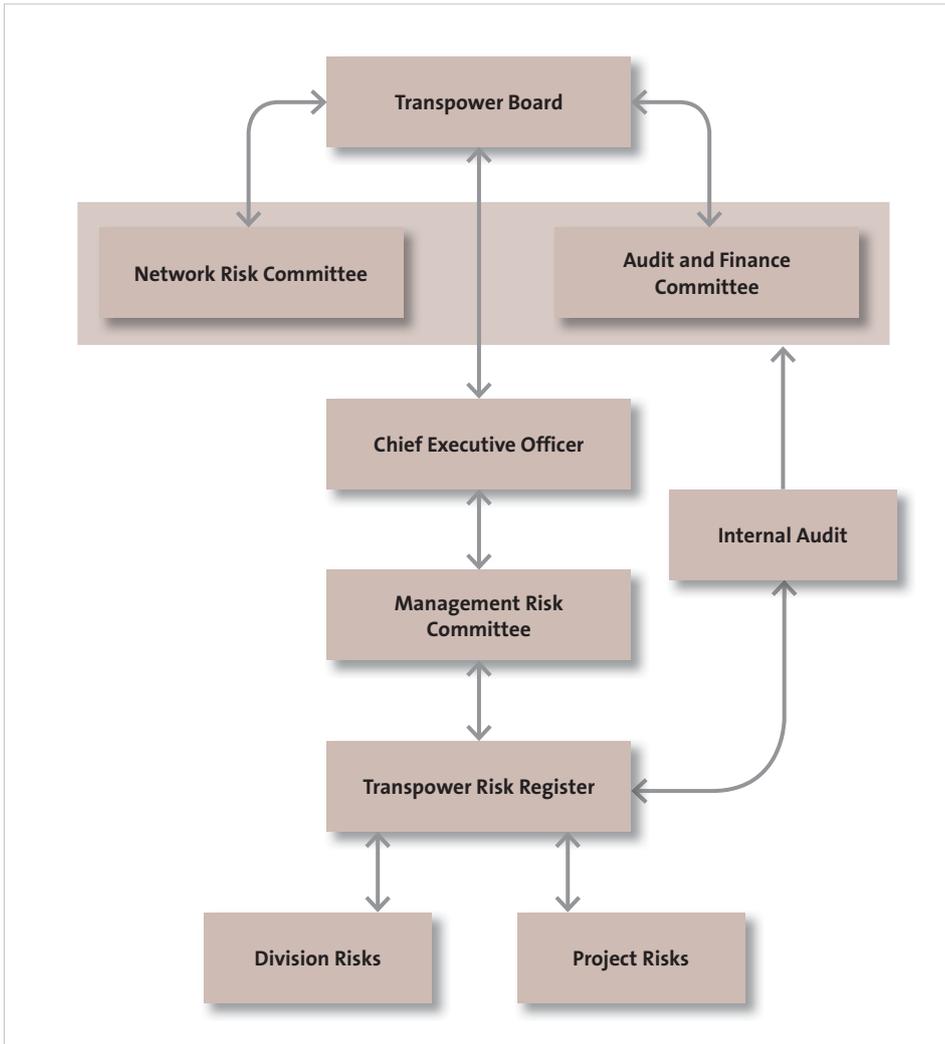
2.9 We consider that Transpower solves problems well and is well placed to respond to unplanned events (risk recovery).

Transpower’s framework for managing risk

2.10 Transpower has a Risk Management Policy (the Policy). The Policy includes the Corporate Risk Assessment Matrix, which provides guidance on the likelihood and consequences of an event so that risks can be assessed and quantified. This is aimed at ensuring consistent measuring of risks.

2.11 The Policy also sets out a governance structure for managing risk and the responsibilities of the groups within the structure. This structure is shown in Figure 2.

Figure 2
Transpower’s governance structure for managing risk



- 2.12 The responsibilities of the board, the Audit and Finance Committee, the Network Risk Committee, the chief executive, and the Management Risk Committee are set out in Appendix 2.
- 2.13 All identified risks are recorded in a corporate risk register. Project risks are included in their own project risk registers.

Identifying, analysing, and managing risk to grid assets

Identifying risk to grid assets

- 2.14 The general managers of each division and the programme and project managers are responsible for identifying, assessing, analysing, and recording risks in the corporate risk register. This includes ensuring that any changes to risks, or new risks, are identified and reported as they arise, and designating risk owners within their divisions.
- 2.15 The Grid Performance division is responsible for the maintenance and operation of grid assets and asset management. Regular group meetings identify risks through a mapping process that focuses on what could go wrong.
- 2.16 The Management Risk Committee focuses on high-impact risks that may affect or involve one or more business units. From our review of the minutes of this committee, we established that the Management Risk Committee focuses on low-probability high-impact events. These events appear to be identified reasonably well.
- 2.17 Although we consider that the focus of the Management Risk Committee on these events is appropriate, monitoring and quantifying other risks to the transmission asset base are equally important. We expected this to be done through consideration of risk at a divisional level, but there was little documentary evidence that cross-business risks were identified. We were concerned that the existing systems for managing risks did not contain enough detailed information to accurately and comprehensively analyse risks to the grid and assets.
- 2.18 In December 2010, an independent review of Transpower's asset management strategies and plans reported that there was no formal methodology for assessing risks at an asset level. The review considered that it would be advantageous to have a company-wide asset risk register and documented methods for quantified risk assessment. The review noted that:

If condition assessment indicates that an asset is displaying distress, then on safety grounds alone, the risk of failure and the implications of failure need to be quantified, and if necessary measures taken to control the risk to within acceptable limits.⁵

5 BW Consulting (2010), *Transpower's asset management strategies and plans*, page 7.

- 2.19 Transpower is taking steps to better manage risks to assets, in line with current standard industry practice, and is using its *Asset Risk Management Journey Plan 2010-2013* to guide this work.

Assessing and prioritising risks to grid assets

- 2.20 General managers and their divisions assess risks. Transpower's Corporate Risk Assessment Matrix provides guidance when assessing the likelihood of the risk and potential consequences, so that risks can be quantified and assigned a level of risk – low, medium, high, or extreme. Transpower's policy is to manage risks so that they are kept at either a low or medium level.
- 2.21 The Management Risk Committee is responsible for monitoring the company's highest risks, which includes reviewing and challenging the divisions about the highest risks and the mitigation for these risks. General managers present what they consider their division's five main risks. Each month, a different division presents its five main risks to the Management Risk Committee, so all are covered regularly.
- 2.22 The Management Risk Committee is responsible for identifying and monitoring Transpower's "Top 10" risks – those risks with the most serious consequences and that require the most managing.
- 2.23 The Top 10 risk reports did not have enough information about why a risk was included or removed from the Top 10. We expected that, to demonstrate a sound rationale for the Top 10 risks, the reports would include an explanation of the reasons for a risk being included or removed from the Top 10 risks list.

Treating and monitoring risks

- 2.24 Transpower's policy is to have treatment plans for risks that are assessed to be extreme or high. This policy is in line with Transpower's tolerance of risk, which is that all identified risks should be managed or treated to a low or medium level. We reviewed the January 2011 version of the Corporate Risk Register and found that this is yet to be fully implemented. Treatment plans had been prepared for nine out of 10 of the extreme risks, and 62% (23 out of 37) of the high risks.

How Transpower's board monitors risks

- 2.25 The Top 10 risks are reported at each board meeting and the Corporate Risk Register is presented to the board every six months. The chief executive's report provides the board with regular updates on the progress and risks of main projects.

- 2.26 The board appoints the Network Risk Committee to review particular areas of risk. The board prefers committee members to be expert in relevant technical areas. The committee, which meets quarterly, includes at least three members of the board. It is responsible for considering, assessing, and reviewing risks to assets and the network and controls for those risks.
- 2.27 In December 2008, the Network Risk Committee asked Transpower's managers how some of the core grid assets had come to be in such poor condition. The managers responded that the focus of governance and management had not been on the state of the assets or the risks this presented, but elsewhere. The focus has since changed.
- 2.28 The Network Risk Committee has recently adopted a more systematic approach to assessing and reviewing network risk and network risk controls.
- 2.29 We encourage the board and its relevant committees to actively monitor and hold managers accountable for identifying the extent of problems with the grid assets and applying timely solutions.

Plans to better manage risks to grid assets

- 2.30 Transpower acknowledges that its maintenance, renewal, and refurbishing work has not been prioritised using a structured standard industry practice approach based on risks to assets. Guided by the *Asset Risk Management Journey Plan 2010-2013*, Transpower is working to improve how it manages risks to assets.
- 2.31 Transpower's work to improve how it manages risks includes introducing an asset risk register and documented methods for assessing and quantifying risks to assets. At the time of our audit, Transpower was considering how the risks would be grouped (such as by substation or asset type or asset) and the risk tools, the risk assessment matrix, and the asset risk information that would be required.

Improving information about risks to assets

- 2.32 Good information about an asset, including how it performs, is needed to identify the risks to it. Transpower cannot easily access this information.
- 2.33 Transpower's Maintenance Management System records much asset and condition data. However, this system is primarily a maintenance workflow tool. It does not have the capabilities of a modern asset management system. Importantly, the Maintenance Management System appears to store data in a relatively unstructured way – where different data on the same asset are not linked effectively. This makes it difficult for Transpower to access all the condition data that it needs to accurately assess the health of a particular asset. Moreover,

some individual contractors have maintained their own electronic or paper-based asset condition records.

2.34 DuPont's 2008 review of maintenance practices noted that:

*Although vast amounts of condition data are collected, apart from overhead lines, little use is made of it. The main reason for this is the shortcomings of the Maintenance Management System. It does not allow easy access to data and does not have any tools for data analysis.*⁶

2.35 In addition, the Maintenance Management System lacks the predictive data analysis capability required to apply current industry standard asset management practice.

2.36 This means that, although Transpower collects much information and data relating to the condition of assets, this is not routinely used to determine the type and frequency of routine maintenance, to determine asset health, or to develop asset renewal programmes.

2.37 BW Consulting's independent review of Transpower's asset management in 2010 identified the need for more detailed assessing of risks to assets.⁷

2.38 Transpower acknowledges that although it has information about condition monitoring and failure analysis, the information is contained in several systems. This affects how Transpower manages assets. Transpower acknowledges that formal risk methodologies for specific asset classes and situations would better inform investment decisions and help meet PAS 55 requirements.

Better managing risks to assets

2.39 Transpower has begun a project to buy, install, populate, and deploy a modern asset management system. Transpower will adopt the requirements of PAS 55 as its guide to good asset management practice in establishing its new asset management system. PAS 55 includes a methodology for managing risks (which is aligned to AS/NZS ISO 31000:2009), which we consider will help to resolve issues with how Transpower manages risks to its grid assets. In Part 4, we discuss Transpower's progress in implementing its new asset management system.

2.40 The PAS 55 methodology for managing risk includes documented processes and procedures for identifying and assessing risks to assets and managing assets, and identifying and introducing necessary control measures throughout the life cycle of assets. It also requires:

- identifying more systematically:
 - physical failure risks, such as functional failure or incidental damage;

⁶ DuPont Operational Excellence: Review of Maintenance Practices & Expenditures Report, page 26.

⁷ BW Consulting (2010), Transpower's asset management strategies and plans.

- operational risks, including the control of assets, human factors, and all other activities which affect the performance, condition, or safety of assets;
 - environmental events (such as storms and floods, including the likely effects of environmental change); and
 - risks associated with the different phases of the life cycle of assets;
 - using information about risks to assets to improve strategies and plans for managing assets; and identifying adequate resources, including staffing levels; and
 - improving Transpower's processes to monitor and measure how well the asset management system performs, and the performance and condition of assets.
- 2.41 PAS 55 requires asset-risk information to improve other strategies and plans, such as asset management plans, and identify training and competency needs.
- 2.42 Transpower aims to get external certification of its asset management systems by March 2013.

Improving Transpower's ability to manage risks to assets

- 2.43 Transpower has identified the following steps to improve its ability to manage risks to assets in its *Asset Risk Management Journey Plan – Strategic Plan 2010-2013*:
- aligning and complementing Transpower's risk management policy with PAS 55 and NZS 7901:2008;
 - identifying and quantifying risks to the asset base;
 - adopting effective methods for assessing strategies for managing assets to control identified risks;
 - establishing and embedding context and risk criteria for investment and operational strategies – thus explicitly linking network investment decisions to the risk framework; and
 - analysing risks to justify options for managing risks for different types and sizes of projects, including risks associated with deferring projects.
- 2.44 To do this, Transpower will need to:
- define the asset level at which risks will be recorded;
 - identify any additional information about risks to assets (such as asset criticality and loss events) to be gathered in addition to standard asset information and standard risk information;
 - refine the risk assessment matrix to include asset risk consequence descriptors;
 - work out how to gather and maintain information about risks to assets, including identifying sources of information (such as condition assessment); and

- identify the information about risks to assets that should be in the company-wide risk register.

Implementing an asset-based system for managing public safety

- 2.45 As a result of the amendments to section 61A of the Electricity Act, Transpower is required to implement an asset-based system for managing public safety. Transpower is required to consider and document asset risks to public safety and risks to public property. To do this, Transpower will comply with NZS 7901:2008.

Managing risks to contractors' capabilities

- 2.46 The Commerce Commission engaged Geoff Brown & Associates Limited to review Transpower's forecast operating and capital expenditure for the 2012 to 2015 period.⁸ Under the outsourcing model, it was intended that contractors would be fully responsible for maintaining the condition of the assets within their areas of control. Geoff Brown & Associates Limited consider that this will not happen because the division of responsibility for maintenance outcomes between Transpower and its contractors is not well defined. As a result, it is not clear how accountable contractors are for their performance. Furthermore, contractors' work practices vary widely.
- 2.47 To address these issues, Transpower's staff have taken responsibility for strategically managing maintenance work.

Improving quality and standards

- 2.48 Transpower has started a quality improvement programme and an occupational health and safety improvement programme, under which all contractors will be required to work to approved and standardised maintenance procedures. Transpower is building on its service specifications that set out the minimum levels of competence for transmission workers who carry out the following work for Transpower:
- inspecting, building, maintaining, testing, or dismantling transmission lines on the grid (implemented July 2009);
 - operating power system equipment on the grid (implemented January 2008); and
 - inspecting, constructing, maintaining, testing, or dismantling transmission substations and communications equipment on the grid (implemented July 2010).
- 2.49 These service specifications are to be applied with a further service specification, Minimum Requirements for Transpower Fieldwork (most recently reviewed in

⁸ Geoff Brown & Associates Limited (15 June 2011), *Review of Transpower's Forecast Operating and Capital Expenditure for 2012-15*, prepared for the Commerce Commission.

September 2010). This service specification sets out the responsibilities and policies for the delivery and maintenance of the technical competencies that contracting staff working on the grid must have.

2.50 Specifications for what is required during a substation inspection have been prepared. There are guides to requirements for:

- assessments of the condition of transmission line assets; and
- tree control near transmission assets and accessways.

2.51 In February 2011, Transpower published a routine maintenance strategy.

Training contractors better

2.52 Since 1994, Transpower has been involved in the International Transmission Operations and Maintenance Study (ITOMS).⁹ Since 2003, Transpower's benchmarking results have shown worsening performance. Transpower recognises that its poor service level performance in the ITOMS benchmarking could be partly because of a lack of suitably trained maintenance staff and technicians. Transpower is acting to improve training.

2.53 Since 1984, Transpower has operated its own training facilities. In 2006, Transpower extended its training regime to cover all aspects of field work. Transpower provides qualified trainers, the training venues, equipment, managers, and materials. Transpower requires its contractors to manage competence and to certify the competence of its field employees. The contractors provide their staff with the on-the-job experience needed and give them the relevant certification when they have the required competency.

2.54 We note that Geoff Brown & Associates Limited reported that the initiatives that Transpower is putting in place in respect of health and safety, quality improvement, and contractor training:

... will result in overall improvements in the management of the assets by increasing the professionalism of contracting staff, improving job satisfaction, increasing ownership of work processes and substantially improving the overall quality of the work.

⁹ ITOMS is a consortium of international transmission companies that retains a consultant (UMS Group) to facilitate the International Operations and Maintenance Study. The study compares performance and practices in the transmission industry worldwide. The study compares the performance (including practices, service levels, and costs) of about 27 international transmission companies.

- 2.55 Geoff Brown & Associates Limited consider that the new procedures:
... will address the deficiencies in the “how” component of Transpower’s current maintenance policy documents and ensure that work by different contractors is undertaken to a consistent standard.

Responding to unplanned events

- 2.56 The core network design and contingency planning mean that Transpower is well placed to respond to unplanned events.

Core network design

- 2.57 The need for security of supply lies at the heart of New Zealand’s grid. N-1 security describes the level of security required. N-1 security means that, at any particular location in the core grid, the loss of one system component can be tolerated without loss of service.
- 2.58 In practice, this means that, if an unexpected equipment loss occurs because of a lightning strike or a fault with substation equipment, the system is robust enough and has enough back-up capacity to keep transmitting electricity until the problem is fixed.

Designing for natural hazards

- 2.59 Transpower’s design practices to cope with natural hazards have evolved over many years, taking into account the environment, the historical performance of past designs, and international good industry practice.
- 2.60 A management paper submitted to the Network Risk Committee in June 2008 examined how the assets had been designed to respond to wind, snow and ice, earthquakes, flooding, and lightning. Transpower’s core grid lines and substations are designed and built to comply with international standards.

Contingency planning

- 2.61 Transpower’s maintenance contractors prepare contingency plans to respond to various situations. We note from the Management Risk Committee’s minutes that contingency plans are still being prepared for some substations but are in place for critical substations.
- 2.62 Transpower has three strategically located stores where spares are available. These spares include equipment such as circuit breakers, bushing, and relays. Emergency towers are available for responding to major lines incidents.

Analysing significant incidents

- 2.63 Transpower has reviewed all significant incidents (those where there was a significant safety or security risk) to establish their causes, and made recommendations to prevent similar incidents occurring. These reviews were thorough and lessons were identified. Policies and procedures were reviewed to ensure that they reflected these lessons.
- 2.64 Transpower investigates accidents that cause serious injury and serious incidents affecting public safety or the power system to find their direct and indirect causes, make recommendations, and improve procedures.

Part 3

Building the grid's capacity

3.1 In this Part, we look at how Transpower is managing risk while investing in the grid's capacity. We discuss and evaluate:

- the development of a long-term strategy;
- how Transpower is identifying what major investment is needed;
- the investment approval process;
- Transpower's investment programme;
- Transpower's project management; and
- the risk of Transpower adopting an inadequate or excessive investment strategy.

Our conclusions

3.2 Following the glide path, the grid became increasingly stressed and less reliable. Many grid assets are nearing the end of their useful life. Also, as the country's population and economy grow, these ageing assets must deliver more electricity. Therefore, the grid is becoming more stressed and less reliable.

3.3 We expected that Transpower would have a unified long-term strategy for future development and investment in the grid. Further, we would have expected that this strategy would have been developed in close consultation with Transpower's board. Given the problems identified with the age of the grid assets, the declining performance of these assets, and the capacity constraints with the grid, we expected that the strategy would have been a priority for the board and managers.

3.4 In 2003 and 2004, Transpower began developing a long-term strategy and published two discussion documents. Until 2010, the focus of these documents was on the first stage of development of the grid and the specific projects Transpower was putting in place. In early 2011, Transpower published a unified long-term strategy – *Transmission Tomorrow*.

3.5 Transpower staff told us that the 2004 discussion paper and the Annual Planning Report (which has been published each year since 2006) were used as a guide in place of a unified long-term strategy. However, because neither of these documents provides the necessary detail and direction that we would expect from a long-term strategy, we are concerned about the late developing of *Transmission Tomorrow*.

3.6 The 2003 and 2004 discussion documents focused on building capacity. This meant the work that Transpower has done on grid reliability since then has been tactical rather than strategic. It has not been informed by a unified long-term strategy that brings capacity together with reliability.

- 3.7 Transpower has begun a programme of major projects to increase the grid's capacity and resilience. Since the end of 2007, more than \$2.7 billion of investment spending has been approved, with further investment expected during the next decade. Although we consider that the project approval process ensures that each of these projects is cost-effective and worthwhile in its own right, we cannot be sure that Transpower has the most cost-effective investment strategy until it completes implementing:
- an effective integrated system for managing its assets;
 - a comprehensive risk-based approach to managing its assets; and
 - long-term targets for what Transpower considers to be an appropriate level of risk for the network and the associated network performance quality measures.
- 3.8 We note that some projects under way were identified in 2003/04 and were obvious priorities.
- 3.9 We noted that the Commerce Commission intends to monitor and assess Transpower's performance. Every year, Transpower will be required to report its progress improving performance and in implementing its main business improvement initiatives. This requirement to report and the Commerce Commission's monitoring role make us more confident that the work will be done in a timely way.

Developing a long-term strategy

- 3.10 In 2003, Transpower began developing a strategy. As a first step, in 2003 and 2004, Transpower published discussion documents. These discussion documents were not long term or unified in addressing capacity and reliability.
- 3.11 In late 2008, Transpower began a project – Transmission 2040 – to review its strategy for developing the grid. At its August 2008 meeting, Transpower's board approved up to \$3.9 million for this project.
- 3.12 The board was updated on progress with the long-term strategy throughout its development. By September 2009, the following three main themes had been identified:
- getting the right grid;
 - managing technological change; and
 - keeping future options open.
- 3.13 In November 2010, the strategy, now renamed *Transmission Tomorrow*, was presented to the board, which was pleased with the framework and tenor of the document.

- 3.14 In December 2010, the board was told that external reviewers had reviewed the strategy. A launch was planned for February 2011.
- 3.15 At its February 2011 strategy day, *Transmission Tomorrow* was presented to the board. The board noted and discussed the need for a framework to measure how Transpower performed against the goals by locking them into Transpower's key performance indicators.
- 3.16 We note that, although the board approved a budget for the strategy in August 2008, the strategy was not published until February 2011. We are concerned that Transpower's board did not require more timely developing of *Transmission Tomorrow*.

Transmission Tomorrow

- 3.17 The *Transmission Tomorrow* strategy document and a supporting document, *Transmission Tomorrow – the enduring grid*, were based on an analysis of the development requirements of the grid under a range of scenarios. The analysis established that the grid backbone would continue to be required under all scenarios, although the timing of the required upgrades was less certain. Transpower's strategy for developing the grid is now focused on increasing the use of the existing grid using, where appropriate, new transmission technologies.
- 3.18 *Transmission Tomorrow* describes Transpower's three main strategies (to improve how the grid performs, improve system performance, and improve reliability and resilience) that it will use to supply the increasing services the grid must provide. It outlines the need for four platforms that cover the network, asset information, people, and the corridors along which transmission lines and undersea cables pass.
- 3.19 *Transmission Tomorrow* includes committed initiatives to be completed within the next five years, potential outcomes within the next 10 to 20 years, and possible outcomes within the next 20 and more years.

How Transpower identified what major investment was needed

Early discussion papers

- 3.20 Transpower staff told us that the strategy set out in the 2004 discussion paper and the annual planning reports formed the strategy that Transpower adopted up to the publication of *Transmission Tomorrow* in February 2011. This appears to be the case in that the discussion papers identified the need for the main projects that were approved and are under way.

Annual planning reports

- 3.21 Since 2006, annual planning reports have been used to identify grid investment projects.
- 3.22 The annual planning report's role is to signal proposed and possible transmission investments within a 10-year horizon, so that market participants have more information about Transpower's plans.
- 3.23 The annual planning report is based on a full assessment of forecast transmission issues, and represents Transpower's view of how the grid can be managed during the next 10 years to provide reliability of supply and a competitive electricity market.
- 3.24 The annual planning report includes:
- the forecast of demand and generation at each grid exit point and grid injection point during the next 10 years;
 - information about the existing transmission network;
 - system constraints and issues anticipated during the next 10 years;
 - a summary of potential transmission investment to alleviate the anticipated constraints on the system; and
 - information about other issues affecting transmission investment.
- 3.25 The report lists projects that have started, projects that have been committed to, and possible projects. However, as the report is not intended to be a risk-profiling or prioritising tool, it does not:
- prioritise the work that needs to be done;
 - identify interdependencies between projects; and
 - classify projects by "risk" (although it does refer to "need").

Transpower's investment approval process

- 3.26 The investment approval process is the decision-making framework for preparing investment proposals. The framework has five stages, which involve:
- identifying the need through the annual planning report process;
 - considering options to address the need – an initial options list is refined to a set of credible options, using specific criteria (cost, feasibility, and Good Electricity Industry Practice);¹⁰

¹⁰ Good Electricity Industry Practice principles require an electricity grid owner to act in a reasonable and prudent manner when managing its network, consistent with other electricity grid owners under comparable conditions, taking into account the size and age of the network and other associated safety and environmental factors.

- assessing the costs and benefits of each option and identifying a shortlist of options – the decision rule for the preferred option is based on the maximum net benefits or the least net cost (depending on the investment purpose);¹¹
- preparing a proposal to confirm the preferred investment option; and
- approved investments entering a detailed design (equipment and placement) stage.

3.27 Affected communities and stakeholders are consulted throughout the process.

3.28 The investment proposal is then presented to the Commerce for approval as part of a grid upgrade plan. A grid upgrade plan will usually cover several projects.

Transpower's investment programme

3.29 Transpower's tools to increase grid capacity mainly involve squeezing capacity out of existing assets,¹² replacing the existing aged assets with new and larger equipment, and building new infrastructure such as lines and substations.

3.30 Capital spending has increased significantly in the last four years. Between 1995/96 and 2004/05, capital spending averaged about \$100 million a year. Figure 3 shows the increased spending from 2006/07.

Figure 3
Transpower's capital spending from 2006/07 to 2010/11

Financial year ended 30 June	\$million
2007	284
2008	327
2009	331
2010	571
2011	733

Source: Transpower's annual reports.

3.31 During the next three years, Transpower's capital spending is expected to average about \$790 million a year, with a peak of \$844 million in 2012/13.

3.32 Since the end of 2007, more than \$2.7 billion of spending has been approved. Further investment is expected during the next decade. The Electricity Commission approved four grid upgrade plans, covering 20 grid upgrade projects

11 For core grid investments, the analysis needs to determine the option that meets the need at least market cost. For non-core grid reliability investments and economic investments, the analysis needs to determine the option that maximises net market benefits.

12 Capacity can be squeezed out of assets by: thermal upgrades (increasing the operating temperature of assets to allow more current to pass); reconductoring (replacing conductors with larger capacity conductors); duplexing (adding a conductor to each phase); or installing equipment that helps maintain voltage stability.

(in 2005, 2007, 2008, and 2009). Appendix 3 includes a list of the projects that the Electricity Commission approved as part of the plans to upgrade the grid.

- 3.33 Reliability needs have driven 15 of these projects;¹³ five were economic investments.¹⁴

How Transpower manages projects

- 3.34 We consider that the project approval process ensures that each project that is approved is cost-effective and worthwhile in its own right. We consider that the project governance structures and the processes for managing risks to projects are enough to identify, analyse, treat, and monitor project risks.

Skills, guidance, and tools

- 3.35 Because there was little investment during the glide path years, Transpower has not managed large projects. Therefore, its skill base in this area was lacking. Transpower recognised this and recruited qualified project managers and staff to improve its ability to carry out the large investment projects required.
- 3.36 Transpower's project management manual includes guidance on managing project risk. A risk register to record the intrinsic risk, controls, residual risks, and risk treatments is kept for each project. In addition, the Corporate Risk Register records risks to the timeliness and cost of projects, and any particular issues (such as land access).
- 3.37 The manual also deals with managing and reporting issues. (Issues are events that have occurred, while risks are events that might occur.) Issues are logged and tracked in an issues register.
- 3.38 The manual has electronic links to more detailed policies, procedures, and guidelines. For example, the project risk management section has an electronic link to Transpower's risk management policy, insurance policy, and seismic policy.
- 3.39 An online information management tool and data repository – Microsoft Project Server – supports project and programme managers. This tool allows the user to store project and programme-related information, such as schedules, management plans, and registers, within a specific workspace for the project or programme.

¹³ Reliability projects are grid enhancement projects (previously regulated by the Electricity Commission and now by the Commerce Commission) whose primary purpose is to reduce expected unserved energy (power not being transmitted on the grid).

¹⁴ Economic projects are grid enhancement projects (previously regulated by the Electricity Commission and now by the Commerce Commission) that are not aimed primarily at reducing expected unserved energy and that have market benefits that exceed market costs.

Project governance

- 3.40 The governance structure depends on the size and complexity of the project or programme.
- 3.41 Transpower's project governance structure includes a project owner, a project manager, and a reviewer. The project owner is often supported by a project advisory team whose role is to:
- be accountable for the project outcomes and ultimately hold the final decision-making authority;
 - provide direction to the project;
 - ensure that the correct resources are committed;
 - be an advocate for the project manager; and
 - balance the interests of the project with those of the main stakeholders.
- 3.42 We reviewed the Project Management Plan of the Pole 3 Project. This project involves building and installing converter equipment at Benmore (in the South Island) and Haywards (in the North Island) to increase the capacity of the HVDC inter-island link. The equipment will replace the 45-year-old Pole 1 equipment at both substations.
- 3.43 Transpower has put in place robust project, technical, and commercial governance to cover the Pole 3 Project's complexity.

The risk that Transpower might adopt an inadequate or excessive investment strategy

- 3.44 The major investment decisions taken so far have been obvious priorities.
- 3.45 However, we cannot be sure that Transpower has the most cost-effective investment strategy until it completes implementing:
- an integrated system for managing assets that provides one consistent source of asset information so that Transpower can make efficient decisions about whole-of-life managing of assets;
 - a comprehensive, quantitative, risk-based approach to managing assets that allows for risk to be traded off against the costs of mitigating the risk – essential for prioritising investments; and
 - long-term targets for what it considers to be the appropriate level of risk at a network level, and the associated network performance and quality measures.

- 3.46 In its draft decision on Transpower's operating and minor capital expenditure for the 2012 to 2015 period, the Commerce Commission notes that:

Many of Transpower's asset management practices are lagging behind international current practice. Furthermore, Transpower does not appear to use a robust and quantifiable approach to measuring and prioritising expenditure based on an assessment of risk ... Transpower's current outdated practices raise concerns about the robustness of Transpower's forecasts. The Commission is also concerned that the use of outdated practices may negatively affect the effectiveness of the actual investment undertaken by Transpower.

Without a risk-based approach to asset management (supported by appropriate tools and systems) and a longer term view of the acceptable level of risk and associated network performance (including quality measures) there is a possibility that:

- a. Transpower's actual investment projects will not target the right areas (i.e. as determined by a risk-based approach) and, therefore, will be suboptimal in terms of maximising the benefit delivered for a given level of expenditure; and*
- b. the overall level of investment is greater or less than that required to maintain risk at acceptable levels of performance demanded by current and future users. This may also result in higher-than-optimal whole life costs.¹⁵*

A key conclusion from the Commission's review is that it is critical that Transpower makes significant improvements in its asset management capability, in terms of both systems and implementation of a risk-based approach consistent with current international industry practice. This will help ensure that the level of investment being undertaken is both efficient and sustainable, and also delivers the levels of service required by users of the grid both now and in the future.¹⁶

- 3.47 The Commerce Commission intends to monitor and assess how Transpower performs. Every year, Transpower will be required to report its progress on quality performance and in implementing its main business improvement initiatives.

Recommendation 1

We recommend that the board of Transpower New Zealand Limited actively monitor Transpower's progress against *Transmission Tomorrow* and the prioritised work programme.

¹⁵ It is possible that the lack of a risk-based approach could result in over-investment. However, given the condition of the network and historical levels of investment, the Commerce Commission considers this highly unlikely in the medium term.

¹⁶ Commerce Commission (27 June 2011), *Draft Decision: Minor Capital Expenditure and Operating Expenditure Allowances, and Quality Standards to apply to Transpower for the Remainder Period of Regulatory Control Period 1*.

Part 4

Making the grid more reliable

- 4.1 In this Part, we discuss how well Transpower manages the risks to an aged grid to make it more reliable. We cover:
- reliability and performance concerns;
 - Transpower’s programme to improve how it manages assets; and
 - what still needs to be done.

Our conclusions

- 4.2 We expected that Transpower would have assessed the risks that old grid assets posed when the infrastructure audit that the Ministry of Economic Development commissioned in 2004 raised concerns about the age of the assets.
- 4.3 We found that Transpower knew that the grid was becoming less reliable and performing worse. While it was still building staff capability, Transpower could not focus on both grid reliability and capacity, so it made the strategic decision in 2003 and 2004 to focus on addressing the grid’s capacity issues. The issues of age and necessary replacing and refurbishing of grid assets were given a lower priority.
- 4.4 Noting Transpower’s lack of long-term performance goals, the Commerce Commission considers that such goals are essential to any strategic effort to improve performance.¹⁷ We agree that performance goals help keep spending strategic and targeted and help measure effectiveness and performance.
- 4.5 We found that Transpower had asset strategies covering specific groups of assets and management plans to support those strategies. The risk analysis in the asset management plans varies but is high-level only. We note that there is no prioritising or assessing of comparative risks to assets in different management plans. With limited capacity in the grid, it is not possible to establish where the highest risk (in terms of probability and consequence) is, and which assets in which asset management plan should be targeted first. This is especially important given how much replacing and refurbishing work is needed.
- 4.6 Transpower has begun a five-year programme to improve how it manages its assets. Its asset management system is an integrated and co-ordinated set of policies, strategies, objectives, plans, and processes. Transpower has prepared the foundation for this system. Transpower must improve its long-term targeting, works planning, resource forecasting, and systems for estimating costs and procurement.
- 4.7 We have reviewed what Transpower intends to do and consider that it will resolve the major issues. Transpower should implement its plans and processes with urgency.

¹⁷ Commerce Commission (27 June 2011), *Draft Decision: Minor Capital Expenditure and Operating Expenditure Allowances, and Quality Standards to apply to Transpower for the Remainder Period of Regulatory Control Period 1*.

Concerns about reliability and performance

- 4.8 Transpower knew that the grid was becoming less reliable and performing worse.
- 4.9 Transpower's benchmarking results in ITOMS in the years 2003, 2005, and 2007 showed a worsening performance and an increasing cost when compared with the study's other participants. By 2009, Transpower's overall asset performance was weak compared to most of the other transmission companies that participated in the benchmarking study.
- 4.10 Between 2008 and 2010, the grid's performance was variable. Transpower did not meet some of its performance measures. The 2011 results show improvements. In 2011, Transpower met some of its targets for grid performance. There has been less loss of supply to consumers. If the effects of the Christchurch earthquake are removed, the 2011 results look much better than previous years. Transpower's challenge is to consistently meet its performance targets.
- 4.11 In June 2008, Transpower commissioned an independent review of its maintenance practices and spending. This report concluded:
- Discussions with staff from both Transpower and the contractors revealed a workforce that has an innovative approach to solving problems. This has been driven mainly by a need to keep operational an aged asset base as little asset replacement has been undertaken on a broad basis in the last decade. Some 39% of the switch gear assets are of old technology with an average age of around 37 years. Transformers have an even higher average age of around 40 years with approximately 40 per cent of the in-service power transformers ranging from 40 to over 70 years old. Many assets are rapidly approaching end of life and need to be replaced if a satisfactory level of performance and reliability is to be maintained. Even with good care and innovative solutions it is not realistic to expect such assets to continue to be fit for purpose and perform adequately with increasing age. Eventually there comes a point when their reliability needs to be questioned. Best practice shows that initiating a replacement programme early will help to deliver a timely replacement programme of aging assets, and ensure a secure transmission system. Transpower should start immediately to develop an assertive plan to replace aging assets before system integrity is compromised and asset replacement will be difficult to manage proactively.¹⁸*
- 4.12 Transpower identified a strategic response to the DuPont report's findings. This response included:
- changing its business model;
 - developing a strategy for managing assets; and
 - improving how it maintains assets.

¹⁸ DuPont Operational Excellence: Review of Maintenance Practices & Expenditures Report, page 3.

- 4.13 We note that Transpower has made some progress in addressing the issues noted in 4.11. This progress is largely centred on developing strategies for major groups of assets and identifying replacement programmes at an asset group level (see paragraphs 4.27, 4.28, 4.36, and 4.37). Transpower has done much work to address the risk of not having enough strategic spares, especially spare transformers.

Strategic spares

- 4.14 The DuPont report noted a severe lack of strategic spares in all the main asset areas. It noted that:
- This is a significant problem that could severely compromise Transpower's ability to operate a reliable system if not addressed.*
- 4.15 The report pointed out that, given the country's location and manufacturer lead times of about two years, it was essential that the issue of strategic spares be addressed. The report noted that the lack of spare transformers was particularly concerning.
- 4.16 The report recommended that Transpower:
- ... critically review the required level of strategic spares in asset categories of transformers and circuit breakers.*
- 4.17 Transpower knew that strategic spares were needed and had identified the need to address this before the release of the DuPont report. In early 2008, Transpower carried out with urgency a programme to buy additional transformers and other equipment as strategic spares.
- 4.18 Transpower has spare power transformer units to be used in case a transformer fails. Before 1977, most transformers were installed in groups of three single-phase units (referred to as a bank of transformers), which were usually installed with a spare unit onsite. Since 1977, the practice has been to install three-phase transformer banks that have no onsite spare. Therefore, strategically placed spare transformers are needed.
- 4.19 It will be possible to install the spare transformers within one month of a serious transformer failure. They will provide coverage for 98% of Transpower's three-phase transformers.

More spending on renewing and refurbishing assets

- 4.20 Transpower has increased its capital spending on renewing and refurbishing assets from \$52.74 million in 2007/08 to \$141.68 million in 2009/10.

Transpower's programme to improve how it manages assets

- 4.21 Transpower has started a five-year programme to improve its asset management system.
- 4.22 Transpower has adopted the requirements of PAS 55 as its guide to good asset management practice and plans to get external certification of its asset management system by March 2013.
- 4.23 Figure 4 shows the proposed asset management system. The system is an integrated and co-ordinated set of policies, strategies, objectives, plans, and processes which support and help deliver Transpower's organisational strategic plan.

How far has Transpower got through this programme?

- 4.24 Transpower has prepared the foundation for the asset management system. The progress that Transpower has made is discussed in paragraphs 4.26 to 4.46.
- 4.25 In addition to the plans and strategies that make up its framework for managing assets, Transpower issued a Corporate Business Capability Plan in February 2011. This plan describes the long-term approach for improving business capability for services throughout Transpower's corporate business systems. The budgeted cost of these improvements is \$19.2 million spread over the next five years.

Asset Management Policy

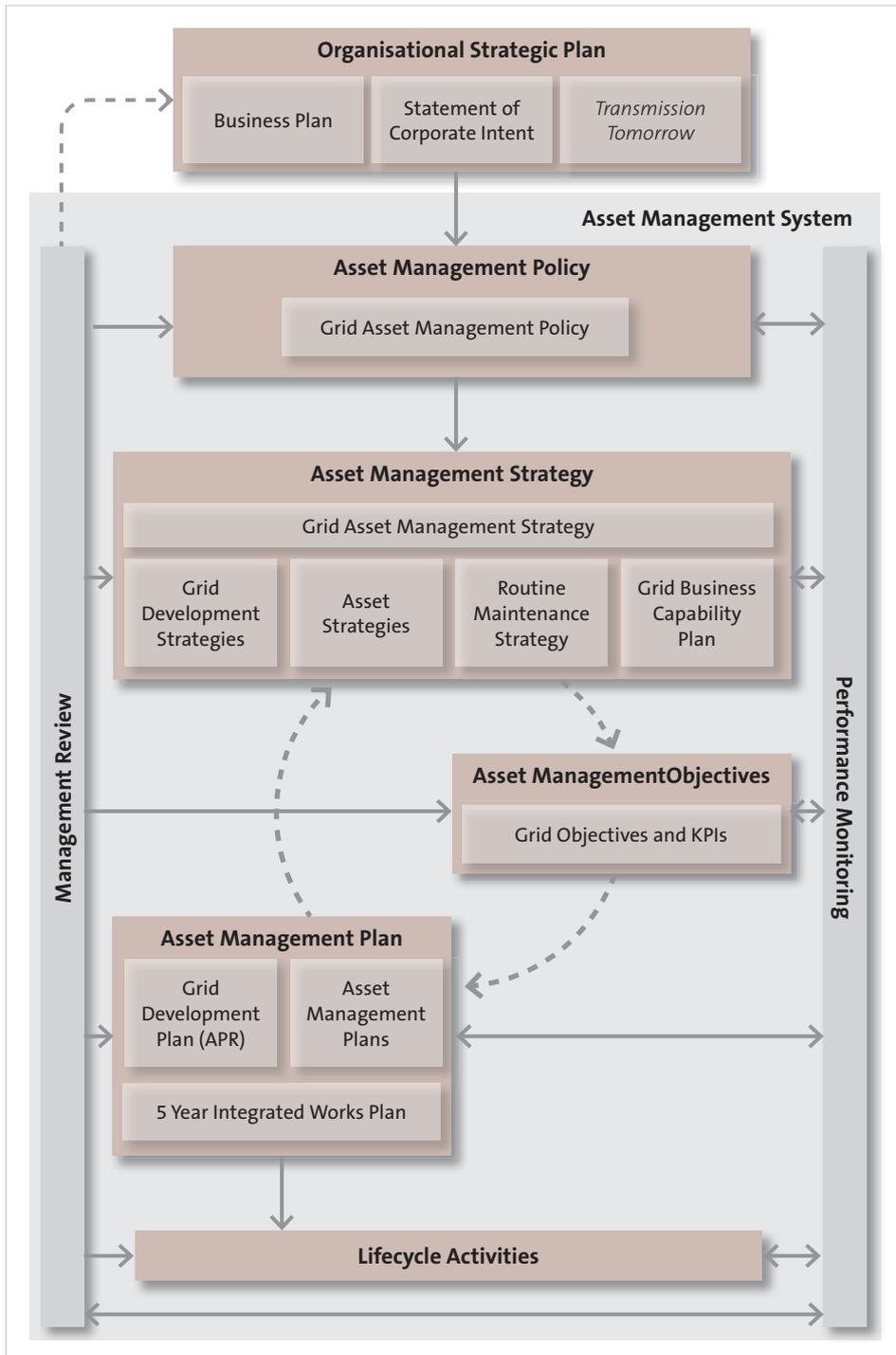
- 4.26 In February 2011, a Grid Asset Management Policy was issued. The strategy is being implemented.

Grid Asset Management Strategy

- 4.27 Between May 2010 and February 2011, Transpower approved asset strategies covering specific groups of assets.¹⁹ These strategies provide a medium to long-term guide for asset management decisions for groups of assets. The strategies include:
- asset performance targets;
 - criteria to help decide when to replace assets;
 - standardised procuring of new equipment;
 - replacing existing equipment;
 - monitoring and management regimes; and
 - reviewing preparedness for emergencies.

¹⁹ An asset strategy was developed for each of the following groups of assets: transmission lines, tower painting, substation management systems, secondary assets, outdoor 33kV switchyards, high-voltage outdoor circuit breakers – 66kV and above, power transformers, and synchronous condensers.

Figure 4
Transpower's proposed framework for managing its assets



Source: Transpower's Grid Asset Management Policy.

- 4.28 In February 2011, a Routine Maintenance Strategy was issued. This strategy is meant to improve how Transpower performs in the ITOMS international benchmarking by putting in place many initiatives, including improvements in standardised work practices and workforce training, as discussed in paragraphs 2.44 to 2.45. Initiatives such as the review of outage planning and a transformer online monitoring programme have just begun.
- 4.29 Transpower has prepared a grid business capability plan for the period from 2010/11 to 2014/15. This plan describes Transpower's long-term approach to developing the grid systems during the next five years. The plan identifies seven programmes of change with a budget cost of \$98.4 million.

Grid Asset Management Objectives

- 4.30 Transpower's Business Plan includes grid objectives and key performance indicators.
- 4.31 Transpower must improve its long-term targets for what it considers to be the appropriate level of risk at a network level, and the associated network performance and quality measures. The report by Geoff Brown & Associates and the Commerce Commission's draft decision highlight the need for Transpower to improve its performance goals.
- 4.32 Geoff Brown & Associates Limited noted that all but one of Transpower's priorities in its business plan focus on the quality of inputs, not outcomes. Their report says that the one exception to this input focus – developing the grid to meet “agreed reliability standards” – cannot be used to measure improvement. This is because Transpower has been unable to quantify any “agreed standards”, other than reliability targets in its Statement of Corporate Intent.²⁰
- 4.33 This view is supported by the Commerce Commission, which reported in its draft decision that:

The Commission considers that long-term performance goals are essential to any strategic effort to improve performance. Performance goals provide a means of undertaking expenditure in a strategic and targeted manner, and allow the measurement of effectiveness and performance ...

The Commission does not consider the current targets to be an appropriate long-term level of performance.²¹

20 Geoff Brown & Associates Limited (15 June 2011), *Review of Transpower's Forecast Operating and Capital Expenditure for 2012-15*, prepared for Commerce Commission.

21 Commerce Commission (27 June 2011), *Draft Decision Minor Capital Expenditure and Operating Expenditure Allowances, and Quality Standards to apply to Transpower for the Remainder period of Regulatory Control Period 1*.

Grid Asset Management Plan

4.34 Asset management plans have been developed to support the asset strategies.²² The management plans outline how particular assets will be managed over their life cycle. Transpower has advised us that the details in the asset management plans have been entered into the asset management database. This database can then be sorted by site, programme, or portfolio.

4.35 Our analysis of the asset management plans found that:

- Some asset management plans²³ include asset replacement plans. The detail and extent to which the replacing of individual assets is prioritised differs between the plans.
- Some asset management plans analyse risk in terms of the probability of a particular group of assets failing and the consequences of a failure.²⁴ However, in some cases, this analysis is superficial. For example, the asset management plan for some outdoor components does not include an analysis of the important site(s) or circuit(s) and the age and wear of the components at these sites. Only two asset management plans included action that was put in place to mitigate the risks of asset failure.
- There is no prioritising or assessing of risk between the asset management plans. With limited capacity in the grid it is not possible to establish where the highest risk (in terms of probability and consequence) is, and which assets in which asset management plan should be prioritised. This is especially important given how much replacing and refurbishing work must be done.

4.36 Geoff Brown & Associates Limited raised concerns about Transpower's inability to prioritise asset renewal and refurbishment in their report. They noted that:

... Transpower lacks a tool that can prioritise asset renewal and refurbishment programmes across a range of different asset types in a consistent and structured manner ...

What is required is an approach that can evaluate maintenance related capex alternatives on a common basis ... the industry standard prioritisation tool is condition based risk management (CBRM) ...

Under the CBRM approach, the maintenance and renewal requirements of individual assets within a specific asset class are not prioritised in isolation from

22 The asset management plans cover the following groups of assets: transmission line towers, Outdoor 33kV switchyards, gas insulated switchgear, indoor switchgear, power transformers, freestanding instrument transformers, tower foundations, outdoor buswork and supporting structures, outdoor disconnectors and earth switches, capacitors and reactors, outdoor circuit breakers, buildings, and grounds.

23 Outdoor 33kV switchyards, indoor switchgear, single phase transformer banks, and free-standing instrument transformers.

24 The following asset management plans included a risk section: Transmission line towers, indoor switch gear, free-standing instrument transformers, tower foundations, outdoor buswork and supporting structures, outdoor circuit breakers, outdoor disconnectors, and earth switches.

other asset classes. Instead the health of all assets on the grid is assessed against a consistent set of criteria, which typically include the condition of the asset, the probability of failure or probable rate of deterioration and the consequences of asset failure. This allows the health of each individual asset to be quantified in a way that makes it possible to compare asset health directly across different asset classes and to prioritise asset replacement and refurbishment expenditure accordingly.²⁵

- 4.37 Transpower has an Integrated Works Programme that addresses the needs identified in the Annual Planning Report and asset management plans in a five-year work plan. A resource forecasting model is then used to test the plan's overall deliverability.
- 4.38 Transpower uses integrated work planning to manage its grid capital and major maintenance works plans, with work grouped into co-ordinated delivery programmes. This helps to minimise the:
- times that a particular asset or site needs to be “visited”;
 - number of outages required; and
 - overall resources required.
- 4.39 This is intended to lower the overall risk to the system and safety and the overall life-cycle costs.
- 4.40 We consider that for the Integrated Works Planning process to be effective, Transpower must ensure that the work in the Annual Planning Report is prioritised according to risk.
- 4.41 BW Consulting's December 2010 independent review notes that:
- The plans and strategies contain a considerable amount of information with respect to asset condition but there is little evidence of detailed overhaul plans for asset replacement or refurbishment. Each of the asset groups presents a case for considerable spend in replacement and refurbishment but there are no defined schedules of replacement and refurbishment candidates indicating when the work should be done and at what anticipated cost. Because of the lack of past investment the scale of the replacement and refurbishment requirements is massive particularly if all the strategies were to be implemented.²⁶*
- 4.42 The review says that it would be advantageous if Transpower prioritised all of the strategies and scoped a replacement and refurbishment plan based on safety (to both the public and staff), risk (to third parties and the system), system needs and cost, given time frames, and budget.

²⁵ Geoff Brown & Associates Limited (15 June 2011), *Review of Transpower's Forecast Operating and Capital Expenditure for 2012-15* prepared for Commerce Commission, pages 53-55.

²⁶ BW Consulting (2010), *Transpower's asset management strategies and plans*, page 38.

- 4.43 Transpower has reviewed how it estimates costs and has begun a two-year programme to identify and implement changes needed to get a more accurate, auditable, transparent, and robust cost-estimating system for all grid capital works.
- 4.44 The main objectives of the programme are to:
- develop an improved and independent estimating tool as Transpower's primary source of information, against which quotes and estimates can be assessed; and
 - gain confidence that Transpower is paying equitable and market competitive rates for all work.

Recommendation 2

We recommend that Transpower New Zealand Limited complete its programme for improving how it manages assets and risk; in particular, Transpower must implement:

- an integrated system for managing assets that provides one consistent source of information about assets so that it can make good decisions about how it manages its assets;
 - a comprehensive, quantitative, risk-based approach to managing assets that allows for risk to be traded off against the costs of mitigating the risk – essential for prioritising investments; and
 - long-term targets for what Transpower considers to be the appropriate level of risk at a network level, and the associated network performance and quality measures.
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Appendix 1

The regulatory framework

In November 2010, the Electricity Industry Act 2010 (the Act) took effect. The Act repealed and replaced significant sections of the Electricity Act 1992. The new Act provides a new framework for regulation of the electricity industry.

Under the Electricity Act 1992, the Electricity Commission was responsible for regulating the operation of the electricity industry in accordance with the Act, Electricity Governance Regulations, the Electricity Governance Rules (the rules), and the Government Policy Statement. The Commerce Commission was (and continues to be) responsible for regulating Transpower's revenue.

The 2010 Act disestablished the Electricity Commission and replaced it with the Electricity Authority (the authority). The authority is required to make and administer the Electricity Industry Participation Code (the code) and monitor compliance with the Act.

On 1 November 2010, the code came into force. It incorporated large parts of the 2003 Electricity Governance Regulations and rules that it replaced.

The 2010 Act also established sections 54R and 54S of the Commerce Act 1986. These sections transferred the Electricity Commission's role in requesting and approving grid upgrade plans to the Commerce Commission. The 2010 Act also gave the Commerce Commission the power to determine input methods for Transpower's capital spending policies.

Under the terms of the 2008 administrative settlement between the Commerce Commission and Transpower, the Commerce Commission was required to set a non-part F capital expenditure threshold. The threshold sets the process and constraints by which an annual level of capital spending will be approved in advance. Spending on existing asset replacement, asset refurbishment, asset enhancement and development, and operational network information technology services were considered non-Part F capital expenditure. The non-part F capital expenditure threshold was set each year.

In December 2010, the Commerce Commission finalised a new regulatory regime that required Transpower to submit quality performance targets, and plans for operating expenditure and minor capital expenditure for a three-year period from 1 July 2012 to 30 June 2015. This is a change from the previous annual approval process.

At the time of our audit, the Commerce Commission had considered the three-year proposal and produced a draft decision.

Grid upgrade plans

Section 54E of the Commerce Act declares electricity lines services to be regulated under Part 4 of the Act. Transpower is further subject to individual price-quality path regulation under section 53ZC of the Commerce Act 1986. Transpower is required to get Commerce Commission approval for investment in the grid. This was previously the role of the Electricity Commission. Transpower is required to prepare and submit grid upgrade plans (the plans) to the Commission.

Part F, section 3, of the rules required the plans submitted to the Electricity Commission to contain, among other things:

- a comprehensive plan for managing assets and operating the grid;
- information on investment contracts (contracts for grid investments that are agreed between Transpower and one of its customers); and
- different treatment of economic and reliability investments.

Section 54S of the Commerce Act 1986 requires the Commerce Commission to prepare an input methodology for capital expenditure projects. It has until 1 November 2011 to do so. The Minister can extend this deadline for a further three months. Until the new input methodology is completed, section 54R of the Commerce Act 1986 requires Transpower to comply with Part F of the Electricity Governance Rules (the rules) when considering grid upgrade plan proposals.

Section 54S states that the new input methodology prepared by the Commerce Commission must include requirements that Transpower must meet, including the scope and specificity of information required, the extent of independent verification and audit, and the extent of consultation and agreement with consumers.

Grid investment test

Until the Commerce Commission determines the capital spending input methodology, the grid investment test in Part F of the Electricity Governance Rules continues to be applied to Transpower's investments.

Under Part F of the rules, the Electricity Commission and subsequently the Commerce Commission checked that Transpower's investment proposals met the grid investment test. The grid investment test is essentially a net benefits test. A proposed grid investment satisfies the test if it is determined to maximise net market benefits (or minimise net costs) relative to alternatives.

The objectives of the grid investment test include achieving economic efficiency, looking after the interests of end users, balancing costs of various levels of reliability against expected value of unused energy and selecting transmission options that maximise net benefits to producers, distributors, and customers.

Under the code there is no requirement for a grid investment test, but section 54S of the Commerce Act does require the Commerce Commission to determine an input methodology for Transpower's capital expenditure, which will; replace the grid investment test. The Commerce Act (Transpower Input Methodologies) (Capital Expenditure) Determination 2011, produced by the Commerce Commission contains a similar net electricity market benefit test for major capital expenditure.

Grid reliability standards

The rules required investments to be justified against the grid reliability standards (the standards). The standards set by the Electricity Commission consisted of:

- an economic (probabilistic) standard for the whole grid and the associated assessment of the costs and benefits for reliability; and
- a "safety net" minimum reliability standard of N-1 of the core grid. N-1 security means that at any particular point location in the core grid, the loss of one system component can be tolerated without loss of service. This means that if an equipment loss occurs, the system has enough back up capacity to keep transmitting. It also means that maintenance can often be done on one component without the need to restrict supply.

The standards required Transpower to enter a process to upgrade the assets or amend the transmission agreement or service levels when it reasonably expected the existing connection or interconnection assets to be unlikely to continue to meet the standards at the relevant grid exit point over the next five years. This requirement is contained in the new code and is discussed below.

With the change in legislation, new standards were included in Schedule 12.2 of the code. The standards are set by the Electricity Authority. The purpose of the standards is to provide a basis for Transpower and other parties to appraise opportunities for transmission investments and alternatives.

The grid satisfies the standards if:

- the power system is reasonably expected to achieve a level of reliability at or above the level that would be achieved if all economic reliability investments were to be implemented; and
- with all assets that are reasonably expected to be in service, the power system would remain in a satisfactory state during and after a single credible contingency event occurring on the core grid.

A single credible contingency event means an event comprising any of the following:

- a single transmission circuit interruption;
- the failure or removal from operational service of a single generating unit;
- an HVDC link single pole interruption;
- the failure or removal from service of a single bus section;
- a single interconnecting transformer interruption; or
- the failure or removal from service of a single shunt connected reactive component.

The Commerce Commission's Commerce Act (Transpower input Methodologies) (Capital expenditure) Determination 2011, requires Transpower to assess how well the grid meets the grid reliability standards for investments.

Grid reliability reporting

Under the rules, Transpower was required to publish a grid reliability report within six months of the statement of opportunities being published.²⁷

The report was required to set out:

- a forecast of demand at each grid exit point during the next 10 years;
- a forecast of supply at each grid injection point during the next 10 years;
- whether the power system is reasonably expected to meet the N-1 criterion, including in particular whether the power system would be in a secure state at each grid exit point, at all times over the next 10 years, having regard to the possible future scenarios set out in the statement of opportunities; and
- planning proposals for addressing any matters identified in the previous item.

The forecasts of demand at each grid exit point and the supply at any grid exit point supply included in the report had to be consistent with the forecasts of demand and supply set out in the statement of opportunities.

When there was a material change in the forecast demand at any grid exit point or in the forecast supply at any grid injection point, Transpower was required to publish a revised report as soon as reasonably practicable.

²⁷ The statement of opportunities was required under the rules. The Electricity Commission was required to publish the statement to enable identification of potential opportunities for efficient management of the grid, including investment in upgrades and investment in transmission alternatives. The Government Policy Statement required that the statement of opportunities be prepared every two years. The statement of opportunities was not included in the code. There is provision for the Electricity Authority to carry out a core grid determination to provide a basis for the Authority to determine the grid reliability standards, and for Transpower and other parties to appraise opportunities for transmission investment and transmission alternatives. Interested parties may request a core grid determination.

The code requires Transpower to publish a grid reliability report. The requirements for the content of the report have been carried over from the rules and included in Part 12 of the code. A change has occurred to the timing of the publication of the report. Transpower must now publish the report no later than two years after the date on which it published the previous report, or as determined by the Electricity Authority. The requirement remains for the report to be revised and published if there is a change in forecast demand at a grid exit point or change in forecast supply at a grid injection point.

If the report identifies that the power system is not reasonably expected to meet the N-1 criterion at the grid exit point at all times during the five years after the publishing date of the report, and that this is because of an interconnection asset, the code requires Transpower to act. Transpower must investigate whether the interconnection asset meets the grid reliability standards. If the asset does not meet the standard, Transpower must consider its options with respect to the standards. Transpower must submit an investment proposal to the Commerce Commission if it considers that one or more investments are required in respect of that interconnection asset to meet the standards.

Appendix 2

Transpower's framework for managing risk

Risk management policy

Transpower has a Risk Management Policy (the Policy) that documents:

- the framework within which Transpower's risks (including those related to projects) can be identified, assessed, managed, and reported;
- the principles that will be applied;
- the risk assessment criteria;
- risk reporting; and
- risk management governance and responsibilities.

The Policy includes the Corporate Risk Assessment Matrix. The Matrix provides guidance on the likelihood (the probability that an event is likely to occur during a particular time) and consequences (outcome or effect) of an event so that risks can be assessed and quantified. This is aimed at ensuring consistent measuring of risks.

Risk management governance structure and responsibilities

The Policy also sets out a risk management governance structure and the responsibilities of the groups within the structure. This structure is shown in Figure 2.

Board responsibilities

The board is responsible for approving the Risk Management Policy and evaluating its effectiveness. The board is also responsible for considering the major risks and how well the risks are being managed. This includes considering whether the necessary timely actions are taken to remedy any identified significant failings or weaknesses.

The Audit and Finance Committee is responsible for reviewing the Annual Internal Audit Plan to check that it reflects Transpower's risk profile and for recommending that the board approve the plan. The Audit and Finance Committee is also responsible for overseeing how non-technical risks are managed.

The board appoints a Network Risk Committee. The Network Risk Committee's terms of reference require the committee to consider, assess, and review asset and network risks and their controls. These risks include building, capacity, reliability, maintenance, and general adequacy of Transpower's grid assets and operations to meet the needs of the electricity industry and achieve the company's objectives set out in its business plan and Statement of Corporate Intent. The Network Risk Committee is also responsible for reviewing policies and procedures.

Management responsibilities

The chief executive has overall responsibility for ensuring that all risks are identified, assessed, managed, and reported in a transparent, structured, and consistent way.

The chief executive, general managers, and chief engineer are accountable for ensuring and monitoring compliance with the Policy.

General managers are responsible for identifying, assessing, recording (in the Company Risk Register), and managing all risks for which their functional group is accountable. This includes:

- ensuring that changes to risks or new risks are identified and reported as they arise; and
- designating risk owners within their divisions to establish accountabilities and ensure that these accountabilities are met.

In keeping with the Policy and terms of reference, managers set up a Management Risk Committee to provide a multidisciplinary forum where divisions could “explore and discuss” risks. This committee, responsible for monitoring Transpower’s main risks, comprises the chief executive, one person from each division, and the risk and audit manager. It meets monthly and is meant to focus on high-impact risks that may affect or involve more than one part of the business.

Programme and project managers are responsible for identifying, assessing, recording (in the company risk register), and managing all risks to their programme or project. This includes ensuring that details of any changes to programme or project risks, or new risks, are reported as they arise.

Risk registers

All identified risks are recorded in a corporate risk register. Project risks are included in their own project risk registers.

Appendix 3

Grid Upgrade Plan approvals

This table uses data from Transpower's Grid Upgrade Plans 2005-2007.

Project	Type of investment	Status	Cost \$million
2005 Grid Upgrade Plan			
North Island grid upgrade project	Reliability	approved July 2007 (amendment was submitted in October 2006)	824.0
Otahuhu Substation Diversity Proposal	Reliability	approved August 2007	99.0
Central North Island Upgrades	Economic	approved April 2008	18.0
HVDC Pole 1 Replacement Proposal	Reliability	revised HVDC proposal submitted in May 2008	N/A
2007 Grid Upgrade Plan			
West Coast project	Reliability	approved July 2008 (revised proposal submitted in March 2008)	19.0
HVDC Proposal	Economic	approved September 2008	672.0
North Auckland and Northland Investment Proposal 1	Reliability	approved March 2009	473.0
North Auckland and Northland Investment Proposal 2	Reliability	withdrawn April 2009	N/A
2008 Grid Upgrade Plan			
Wairakei Ring	Economic	approved February 2009	141.0
Maungatapere Bus Security	Reliability	approved February 2009	4.1
Wellington 110kV interconnection	Reliability	approved March 2009	9.6
Woodville-Mangamaire-Masterton transmission	Reliability	approved March 2009	17.4
Redclyffe Bus Security	Reliability	approved May 2009	1.9
Marsden substation	Reliability	approved July 2009	6.4
Bombay 110kV Bus Security	Reliability	approved August 2009 (withdrawn in May 2009 and resubmitted in June 2009)	4.7
Redclyffe 220 110kV interconnection	Reliability	deferred in February 2010 – trial to be conducted	N/A
2009 Grid Upgrade Plan			
Wanganui-Stratford transmission	Reliability	approved November 2009	44.1

Project	Type of investment	Status	Cost \$million
Bay of Plenty interconnection capacity	Reliability	approved December 2009	21.5
Lower South Island renewables	Economic	approved August 2010	197.0
Auto synchronisation points	Reliability	approved March 2010	9.5
Upper North Island Dynamic reactive support	Reliability	approved July 2010	110.2
Lower South Island reliability	Reliability	approved September 2010	62.4
Bunnythorpe-Haywards thermal upgrade	Economic	approved September 2010	3.5
Total approved by the Electricity Commission			2,738.3