UnitedNetworks

ELECTRICAL ASSET MANAGEMENT PLAN

30 JUNE 2002

Contents

Simply click on a section to link directly to the information required

		PAGE
	Foreword	1
	Executive Summary	2-5
1	Introduction	6-27
2	Levels of Service	28-38
3	Asset Utilisation and Future Demand	39-46
4	Maintenance	47-61
5	Development	62-82
6	Financial Summary	83-87
7	Asset Management Practices	88-91
8	Risk Management	92-102
9	Plan Improvement and Monitoring	103-106
	Directory	107

for further information about UnitedNetworks visit:
www.unitednetworks.co.nz

Fast facts about UnitedNetworks

- UnitedNetworks is a network infrastructure company that owns and manages electricity, gas and fibre optic networks
- New Zealand's 11th largest company by market capitalisation
- Net assets valued at NZ$2.28 billion
- Annual capital expenditure around $80 million
- Owns 30,022 kilometres of electricity lines, 7,098 kilometres of gas lines and 100 kilometres of fibre optic cable
- Owns "state of the art" broadband communication networks in the Auckland and Wellington central business districts
- Distributes electricity to around 30% of New Zealand's electricity consumers and distributes gas to around 50% of the country's gas consumers

Electricity & Gas Consumers:

Northern Region	
Electricity:	185,221[2]
Gas:	64,557[1]
Eastern Region	
Electricity:	167,617[2]
Gas:	–
Central Region	
Electricity:	152,219[2]
Gas:	57,992[1]
Total electricity consumers:	505,057[2]
Total gas consumers:	122,549[1]

Shareholders

UtiliCorp N.Z. Limited	70.2%
UnitedNetworks Shareholders' Society Inc.	10.7%
Other shareholders	19.1%

[1] As at 31st December 2001

[2] As at 31st March 2002

Foreword

UnitedNetworks is pleased to present its 2002 Electrical Asset Management Plan. The Plan summarises an extensive set of internal policies, standards, performance measures and action plans, which ensure that the company's electrical network is in sound condition to meet the expectations of our customers.

Our Asset Management Team has a critical function within UnitedNetworks. They must balance risk, cost, technology, and customer service for an asset having a long life cycle and for which planning must anticipate well in advance future service trends. While this is a very difficult task, I am extremely confident that the team has demonstrated the correct balance in this Asset Management Plan.

It is essential for the improvement of New Zealand's infrastructure that companies are able to innovate to enhance networks. The light-handed regulatory regime that has historically existed in New Zealand has promoted innovation. It allows companies like UnitedNetworks to explore and utilise new technologies and systems to reduce its asset costs while improving the integrity of the network and sharing those benefits with shareholders and customers. The Commerce Commission is currently consulting on a revised regulatory regime. UnitedNetworks is actively involved in this process to ensure that the outcome is well-considered, durable and designed with the long-term interests of consumers in mind.

UnitedNetworks welcomes comments from its stakeholders about the Plan.

Dan Warnock
Chief Executive Officer

RETURN TO MAIN CONTENTS PAGE

EXECUTIVE SUMMARY

The Electricity (Disclosure Information) Regulations 1999 require every electrical lines business owner to disclose an Asset Management Plan in relation to their works, and specifically to provide that information set out under Schedule 2 of Regulation 25 under the following categories:

- Summary
- Background and objectives
- Assets covered
- Service levels
- Life-cycle management, including development and maintenance
- Risk management, including policies, assessment and mitigation
- Measurement, evaluation and improvement

For ease of understanding UnitedNetworks has attempted, as much as possible, to structure this document around these categories.

THE PURPOSE OF THE PLAN

The main purpose of this Asset Management Plan is to outline the asset management programmes and practices established by UnitedNetworks to ensure that service levels meet customer and consumer expectations, and to achieve compliance with regulatory requirements. UnitedNetworks maintains an extensive matrix of internal asset related documents that collectively translate the company's understanding of its stakeholder requirements into action plans and deliverables. These are updated annually or more frequently as required to reflect changing stakeholder requirements or other externalities.

This Asset Management Plan summarises these into a simple coherent document that demonstrates a linkage between stakeholder requirements, business imperatives and the management of network assets.

Specifically the Plan is designed to demonstrate the suitability of network assets for future and current service requirements and provides assurance that prudent risk management practices are being exercised by the company.

UnitedNetworks electrical asset strategy is to provide a safe, reliable network operated and maintained on a cost-effective basis. This means maximising asset utilisation and minimising life-cycle cost through well managed maintenance and capital investment programmes. It also requires optimising returns on assets as well as safety and regulatory compliance.

GENERAL HISTORY

The UnitedNetworks electrical asset is the result of the merger/acquisition of eight independently owned electrical network assets, historically referred to as 'power boards'. During the early to mid 1990's government initiatives resulted in these eight power boards being reconstituted, as three privately owned integrated electrical lines/supply companies (Power New Zealand, TrustPower and TransAlta).

Subsequently the 1998 Electricity Industry Reform Act required the separation of electrical lines and supply businesses. This resulted in Power New Zealand purchasing the lines businesses of TrustPower and TransAlta, selling its supply business (and name), and re-branding itself as UnitedNetworks. Each of the predecessor organisations that now constitute the UnitedNetworks electrical lines business had their own asset management practices and systems. Significant effort has been expended by UnitedNetworks in an attempt to align these.

DATES AND PLANNING PERIODS

This Asset Management Plan documents the likely development, maintenance and replacement requirements of the UnitedNetworks electrical lines business over the next 10 years, from 1 January 2002 to 31 December 2011, with particular focus on specific projects that have been identified in the first three to five years. Projects identified in the latter half of the planning period can be considered as indicative only, and are more likely to be subject to changing network/market conditions and trends in consumer demand.

ELECTRICAL ASSET DESCRIPTION

UnitedNetworks owns and manages three non-contiguous electrical networks in the Auckland, Thames Valley/Bay of Plenty and Wellington regions which supply 28% of New Zealand's electricity consumers. UnitedNetworks is the largest electrical distribution service provider in New Zealand in terms of both assets managed and consumers served.

The Northern and Eastern Regions are characterised as mixed urban/rural networks. Both are predominantly overhead distribution networks exposed to tree, animal, storm and third party damage. The Central Region is characterised by high consumer density and significant underground network in the Wellington City area.

UnitedNetworks electricity subtransmission and distribution systems contain a large number of many types of asset. Subtransmission lines and cables convey power from the Transpower grid exit points to zone substations mostly at 33kV (although there are 66kV subtransmission lines in the Coromandel, and 110kV lines between Albany and Wairau).

Zone substations transform subtransmission voltages down to 11kV for power distribution over a network of cables and overhead lines. A large number of distribution substations are installed in commercial buildings, industrial sites, berm-site kiosks and on overhead poles. The distribution substations transform distribution voltages to 400V. 400V lines and cables are used to supply the majority of residential, farming and business consumers. The asset base also includes large quantities of auxiliary systems including protection, control and communication systems.

LEVELS OF SERVICE

The voice of UnitedNetworks customers and the market are addressed through a strong focus on reliability and customer/consumer satisfaction, with financial targets reflecting the interests of shareholders and safety targets addressing the interest of both internal and external service providers.

RELIABILITY

UnitedNetworks recognises reliability of supply as a key determinant of the quality of its service and has adopted the industry-recognised measures of SAIDI, SAIFI and CAIDI[1] within its company-wide key performance indicators. Reliability, its measurement, analysis and continuous improvement are embraced within the company as an integral part of "what we do around here".

LIFE-CYCLE ASSET MANAGEMENT

Prudent asset management requires that the full life-cycle costs of asset purchase, operation, maintenance and disposal are taken into account in asset investment decision making. UnitedNetworks adopts a long-term planning approach that emphasises the achievement of dynamic efficiency and optimises expenditure over the long lives of electricity infrastructure assets.

Development and maintenance strategy is closely integrated to ensure that the least cost life-cycle alternatives can be identified and to ensure that any proposed investments form part of a coherent

1. SAIDI - system average interruption duration index
SAIFI - system average interruption frequency index
CAIDI - customer average interruption duration index

and sustainable network development path. All investment decisions, whether associated with asset replacement, maintenance or new development, are made on the basis of assessments of financial and economic return and risk over the long-term.

Network development planning is undertaken to identify asset enhancement, and development programmes required to meet target levels of service. Specific development plans are prepared based on the systematic analysis of a wide range of factors, including maximum demands, network power flows, customer/consumer requests and demographic estimates.

Network maintenance plans build on the historical practices and standards that have been used to manage the assets of the predecessor organisations which have been amalgamated to form UnitedNetworks.

UnitedNetworks places emphasis on the application of risk based management techniques to maintenance planning and policy. The optimum mix of reactive, condition monitoring, scheduled restoration, scheduled discard/replacement and failure finding tasks are determined using reliability centred and maintenance performance methods.

Over the planning period the following changes are expected to deliver significant benefit to the asset management process:

- Externally sourced labour forces, managed through a contractual process
  During 2001 UnitedNetworks sold its contracting business unit to Siemens Energy Services
- A consistent 'centralised view' regarding risk assessment, maintenance management and asset utilisation
- The continual improvement of the UnitedNetworks information systems

FUTURE DEMAND

On average UnitedNetworks total electrical demand over the ten year planning period is projected to increase at a rate of 1.6% per annum, with localised growth in demand in developing regions occurring at rates exceeding 10% per annum.

ASSET MANAGEMENT PRACTICES

The effective management of the considerable asset that UnitedNetworks owns necessitates the use of sophisticated modelling tools and access to detailed asset data.

UnitedNetworks' information systems are presently partly integrated and partly regionally based. The vision for UnitedNetworks' network information systems is to establish enterprise-wide application integration (EAI). This will require a co-operative and open development environment to avoid duplication of information and functionality as systems exchange data.

RISK ASSESSMENT

UnitedNetworks has a low tolerance to risk exposure due to the nature of the essential service it provides, the safety aspects of conveying electricity and the need to protect both company image and cashflows. UnitedNetworks has adopted a systematic and rigorous approach to risk identification and control in compliance with the risk management standard NZAS4360.

Management of network (or asset related) risks is undertaken under the direction of the Electrical Business Line Risk Management Committee. The committee directs the systematic identification, analysis, assessment, treatment, monitoring and communication of all credible risks associated with the conveyance of electricity across the distribution network as well as regulatory compliance risks and construction and maintenance risks.

All credible risks are captured in a software database (Risk Assessor – Methodware) from which risks are mitigated, controlled or treated.

Risks are categorized into six categories; namely – transaction, external, governance, financial, operations and information.

"Security of supply" underpins both the quality of service delivery to the consumer, in terms of availability, and the extent to which the network is exposed to sustained power failures such as that experienced during the 1998 Auckland CBD power crisis. UnitedNetworks adopts a probabilistic approach to security planning, driven by the need to more comprehensively assess investment proposals and business risks than is possible using solely deterministic models.

Since external events may impact on whole substations or extended areas of the network, conveyance risk management also extends to consideration of catastrophic risk events (earthquake, landslide, volcanic action, tsunami, floods, wind storms, fire or malicious damage) and Transpower grid risks.

Investment based solutions to conveyance and other risks are not the only alternative considered. Non asset based factors such as speed of response to faults and communication with customers/consumers may be preferable to expensive capital solutions.

MONITORING AND IMPROVEMENT PROGRAMME

UnitedNetworks has established a dedicated corporate performance team to identify, monitor and report on a set of relevant performance measures. These Key Performance Indicators (KPI) are reviewed monthly by all senior management and all significant gaps between actual performance and target performance are analysed objectively so that alternative strategies and improvement plans can be identified.

The improvement of asset management practices at UnitedNetworks is addressed through an ongoing improvement process including commitment to external audits and comprehensive gap analysis of all facets of asset management activity. An external review of UnitedNetworks electrical related asset management practices/systems during 2002 yielded a Total Asset Management Plan (TAMP) index of 85%. The review indicated the need for UnitedNetworks to focus on maintenance and costing data/systems.

INTRODUCTION

1.1	Background	7
1.1.1	General history	7
1.1.2	Purpose of the Plan	7
1.1.3	Scope of Plan	8
1.1.4	Planning periods adopted	8
1.1.5	Infrastructure assets included in the Plan	8
1.1.6	Key stakeholders in the Plan	10
1.1.7	Relationship with other planning documents	10
1.1.8	Accountabilities and responsibilities for asset management	11
1.1.9	Target audience	12
1.1.10	Organisation structure	12
1.2	Goals and objectives of asset ownership	13
1.2.1	Reasons and justifications for asset ownership	13
1.2.2	Organisation objectives	14
1.3	Plan framework	16
1.4	Asset description	18

RETURN TO MAIN CONTENTS PAGE

1. INTRODUCTION

1.1 BACKGROUND

1.1.1 General history

UnitedNetworks electrical asset is the result of the merger/acquisition of eight independently owned network assets, historically referred to as 'power boards'. During the early to mid 1990's government initiatives resulted in these eight power boards being reconstituted as three privately owned integrated electrical lines/supply companies (Power New Zealand, TrustPower and TransAlta). Subsequently the 1998 Electricity Industry Reform, which required the separation of lines and supply businesses, resulted in Power New Zealand purchasing the lines businesses of TrustPower and TransAlta, selling its supply business (and name), and re-branding itself as UnitedNetworks.

Each of the predecessor organisations which now constitute the UnitedNetworks electrical lines business had its own approach to:

- Asset management/strategy
- Asset class breakdown
- Asset identification
- Investment modelling
- Security modelling
- Risk assessment
- Design standards
- Material standards
- Maintenance standards
- Asset replacement guidelines
- Asset inspection or condition survey information
- Asset condition survey techniques

To add complexity, these organisations also had their own approach to record keeping, asset databases and information management.

While the most common element between all of these systems and approaches was the electrical assets themselves, even these vary in specification, design and deployment.

The alignment of systems, standards and practices is a time consuming process and while significant progress has been achieved to date this work will continue during 2002.

1.1.2 Purpose of the Plan

The main purpose of this Asset Management Plan is to outline the asset management programmes and strategies that have been established by UnitedNetworks to ensure that service levels meet customer expectations, and regulatory compliance is achieved.

The information contained in the Asset Management Plan is based on the present understanding of consumers' requirements and asset condition, and is intended to demonstrate to all stakeholders that UnitedNetworks manages its assets responsibly.

Protection of stakeholder interests is achieved through the application of business management and risk management processes. In particular the Plan seeks to ensure that:

- The organisation understands the assets and any asset related strategies
- Asset strategies reflect the voices of stakeholders, customers and the market place

- Legal and regulatory requirements are an integral part of the business
- Ethical behaviour is practised in all stakeholder interactions
- Asset strategies support revenues that deliver a level of company profit which is in keeping with both shareholder expectations and regulatory requirements
- Acceptable performance is achieved in direct and indirect operating and maintenance costs
- Growth development capital is matched by growth in revenue
- Network replacement is undertaken “just in time”
- An optimal life-cycle approach is taken to managing network assets
- Annual budgets and workplan development is undertaken with a long-term view of the asset base
- There is a link between corporate strategy and the management of network assets
- Capital provision for network security passes tests for prudent operation and represents value to customers and consumers
- Unplanned losses are controlled or the risks are transferred through insurance contracts
- Intangibles are controlled including intellectual property, access rights and company brand

1.1.3 Scope of Plan

The Asset Management Plan covers all UnitedNetworks subtransmission assets, distribution assets and associated systems which transport power delivered at Transpower points of supply to consumers within the Northern, Eastern and Central Region service areas.

In addition to UnitedNetworks owned subtransmission and distribution network assets, the Asset Management Plan also takes into account assets owned by Transpower where transmission system development impacts on service level objectives.

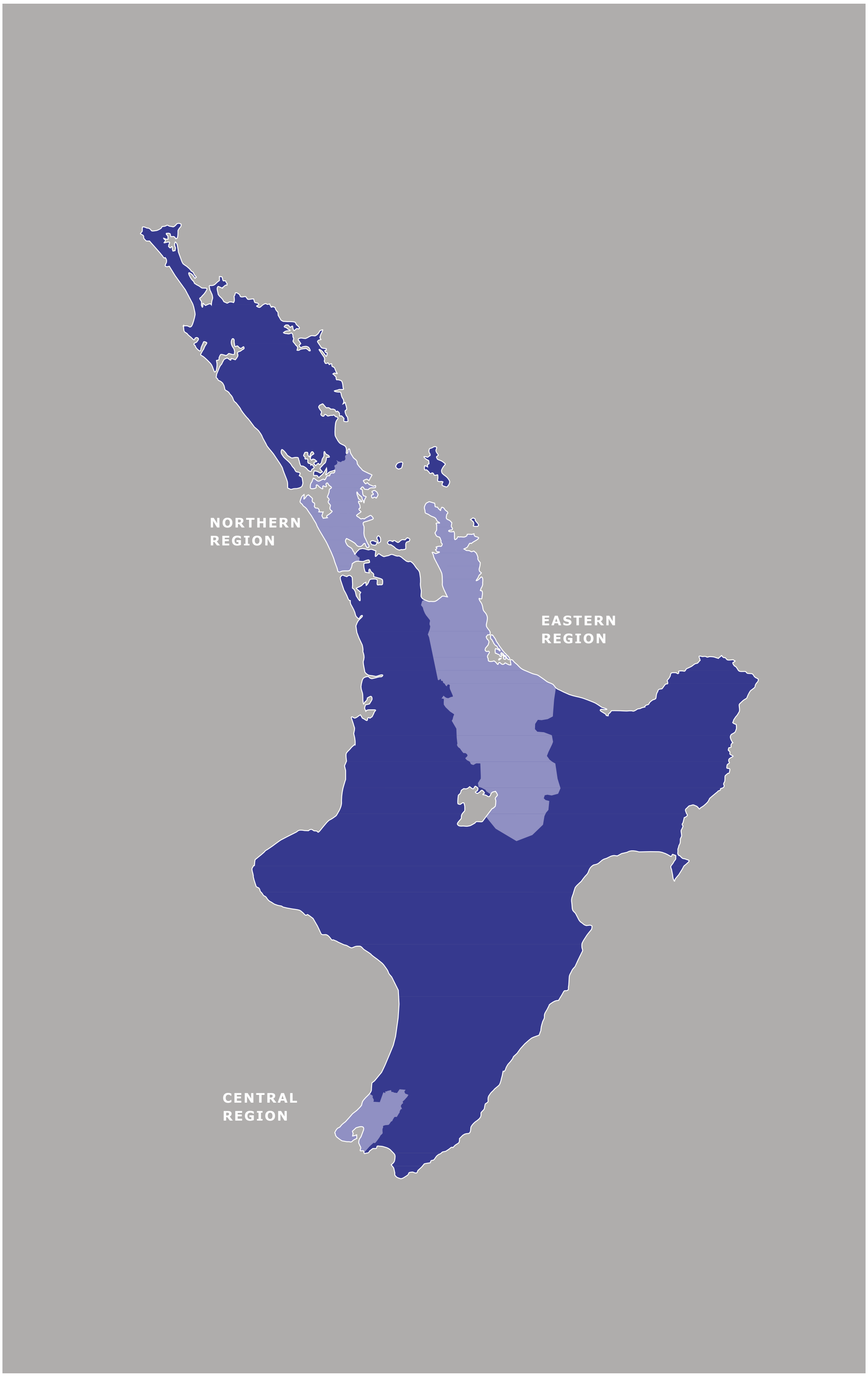
The Asset Management Plan is not, in itself, an approved programme for specific work, but summarises the general programmes and specific projects that UnitedNetworks believes will be required. Inevitably actual projects and programmes will differ from this Plan, particularly where they are driven by specific customer requirements. The Asset Management Plan does not represent an authorisation to commit expenditure, nor does it represent a commitment to proceed with any of the specific projects or programmes. Authorisation will result from approval of the annual budget by the board and from specific project approvals.

1.1.4 Planning periods adopted

The Asset Management Plan documents likely development, maintenance and replacement requirements of the network assets over the next 10 years, from 1 January 2002 to 31 December 2011, with a focus on specific projects that have been identified in the next three to five years. Developments identified in the latter half of the planning period can be considered indicative only, and are more likely to be subject to changing network and market conditions and trends in customer demand.

1.1.5 Infrastructure assets included in the Plan

UnitedNetworks owns and manages three non-contiguous networks in the Auckland, Thames Valley/Bay of Plenty and Wellington regions which supply 28% of New Zealand’s electricity consumers. The customer base is characterised by significant diversity.


NORTHERN
REGION
EASTERN
REGION
CENTRAL
REGION

The key features of the three regional networks are presented below (as at 31 March 2002):

	Northern Region	Eastern Region	Central Region	All Regions
Customer connection numbers	185,221	167,617	152,219	505,057
Total circuit length (km)	10,249	13,961	5,812	30,022
11kV Feeder length (km)	3,875	7,509	1,649	13,034
Customer Density (customer/cct-km)	48	22	92	39
Distribution Transformer Capacity (MVA)	1,111	1,441	1,178	3,730
11kV Feeder Maximum Demand (MW)	670	578	668	1,916
Feeder Utilisation	60%	40%	57%	51%
After Diversity Maximum Demand (MW)	489	478	477	1,424
Energy supplied (GWh pa)	2,112.4	2,501.1	2,192.5	6,806.0
Load Factor	47%	65%	51%	55%

The regional networks are described in more detail in Section 1.4 below.

UnitedNetworks also owns and operates:

- A gas network located in the greater Auckland, Wellington, Napier, Hastings and Palmerston North areas
- A broadband communication networks located within the central business districts of Wellington and Auckland

1.1.6 Key stakeholders in the Plan

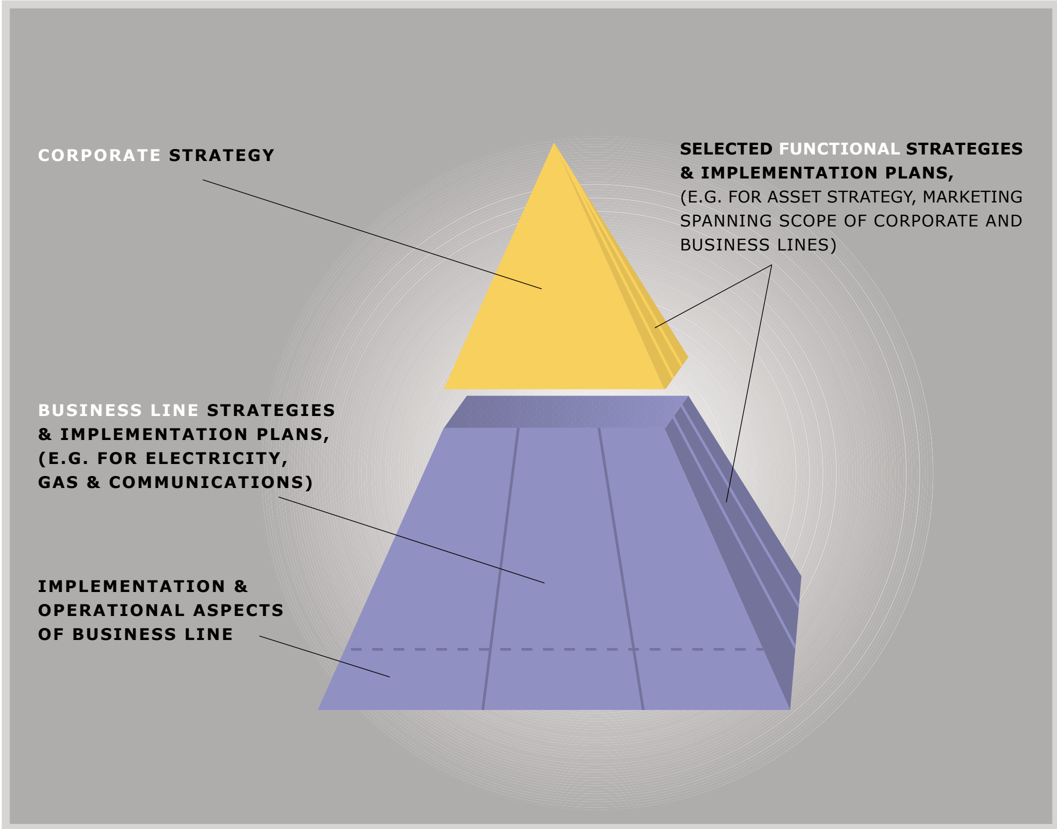
UnitedNetworks interacts with many stakeholders, each with a different interest. These include:

STAKEHOLDER	MAIN INTERESTS
Shareholders	Dividend & share price
Retailers	Comparative cost & supply reliability
Retailer's customers	Price, supply reliability & safety
Suppliers	Security of revenue
Government	Supply reliability & safety
Regulator	Comparative cost, rate of return & reliability
Bankers	Security of revenue
Insurers	Exposure to material damage & business interruption
Public and Media	Safety, environment, access & corporate citizenship
Staff	Safety, profitability & reputation

1.1.7 Relationship with other planning documents

The Asset Management Plan is a key high level document which is supported by a large number of detailed internal documents covering all asset management activities, specific projects and planning, design, construction, maintenance and operation standards.

The link between corporate strategy and the Asset Management Plan is demonstrated in the following diagram. Effectively the Electrical Asset Management Plan is an asset related implementation plan which contains asset strategies and is owned by UnitedNetworks 'electrical lines business'.



1.1.8 Accountabilities and responsibilities for asset management

The current organisational structure was formulated with the objective of managing multiple utilities and is arranged in functional areas that seek to improve customer service and achieve performance excellence. The electricity business line is managed by a cross functional team that has representation from the functional areas.

“Asset Strategy” is responsible for optimised network performance and investment through the provision of strategic planning, and investment and network modelling. Key accountabilities include the development of the Asset Management Plan for network performance, technical standards, maintenance and capital investment optimisation. The asset management information systems are jointly managed with the company’s Information Systems (IS) group.

“Group Operations” is responsible for the implementation of asset strategies and policies to achieve operational excellence. Key accountabilities include the development and implementation of the capital and maintenance workplans, field based operations and customer service, engineering and operating standards and procedures, technical training and auditing, and the day-to-day management and operation of the network.

The prime aim of the asset strategy team is to provide a link between the strategic asset objectives and the pragmatic actions necessary to ensure that the electrical network continues to satisfy customer requirements.

A further aim of the team is to ensure that a consistent approach to asset strategy is deployed across all of UnitedNetworks operating regions. This requires a ‘nationally directed’ but ‘regionally deployed’ approach to network development, maintenance and replacement planning, with issues being resolved using the same process in all regions.

To support this requirement and ensure its success, a common understanding of the discrete elements of development, maintenance and replacement planning is necessary.

1.1.9 Target audience

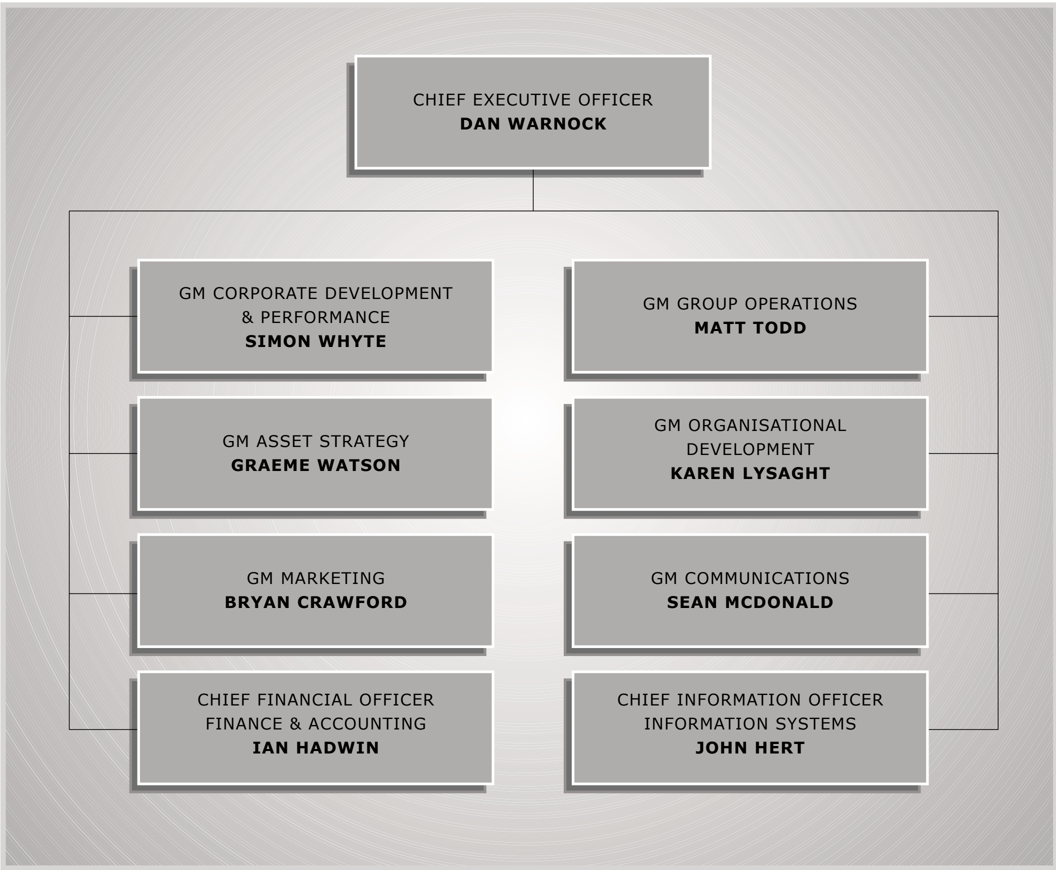
The target audience of this Plan are all of UnitedNetworks stakeholders (refer to section 1.1.6) and include:

- Contractual service providers directly involved in the provision of maintenance services on UnitedNetworks electrical sub-transmission and distribution assets
- The New Zealand Government. The Electricity (Information Disclosure) Regulations 1999 require UnitedNetworks to disclose its Asset Management Plan within three months of the beginning of the financial year (i.e. 30 June 2002)

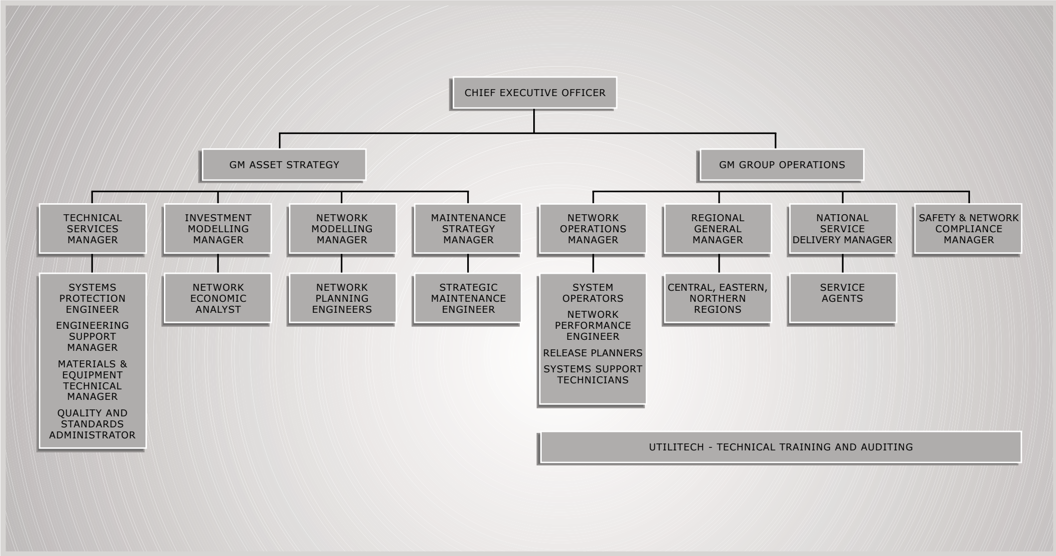
1.1.10 Organisational structure

UnitedNetworks has an organisational structure that aligns the business and operational processes with customer and stakeholder needs as defined in the company's strategic plan. A balanced scorecard approach to business management has been adopted to ensure that customer, employee, shareholder and community needs are addressed. The following charts show UnitedNetworks organisational structure at 31 March 2002.

UNITEDNETWORKS ORGANISATIONAL STRUCTURE



ASSET MANAGEMENT REPORTING STRUCTURE



1.2 GOALS AND OBJECTIVES OF ASSET OWNERSHIP

1.2.1 Reasons and justifications for asset ownership

General

The assets employed by UnitedNetworks are required to conduct electricity from generating sources or transmission grid exit points to the end consumers. The assets range from major high voltage transmission assets through to low voltage reticulation located within subdivisions or on private property. Section 1.4 outlines the general characteristics and location of the assets employed by UnitedNetworks.

Subtransmission assets

UnitedNetworks subtransmission assets are operated at 110kV, 66kV and 33kV. In general the selection of these voltage levels was made in historical times and was justified on an economic basis (consideration of electricity volumes, transmittal distances, electrical losses etc.) In some cases multiple lines have been installed to provide higher levels of security to zone substations (and thus to consumers). Section 5.1 outlines how UnitedNetworks justifies the installation of multiple lines via the use of probabilistic security criteria.

Zone substation assets

The zone substations convert the high voltages associated with high volume lines (110kV, 66kV, 33kV) down to a more economical voltage level (11kV) which can be used to distribute electricity to consumers or groups of consumers.

Generally zone substations convert a significant amount of electricity from one voltage to another and supply a significant number of consumers. This means that duplicate assets are often provided in order to deliver a reasonable level of redundancy. This also enables maintenance to take place without the loss of supply to consumers.

11kV distribution assets

The 11kV voltage level is particularly economic for distributing electricity to consumers. A large portion of the total asset line length is that of 11kV lines because they are needed to transmit electricity from the relatively few zone substations to within a couple of hundred metres of a significant customer base. There are a significant number of interconnections between 11kV lines which deliver a satisfactory level of network redundancy and thus consumer reliability.

400V distribution assets

Distribution substations convert the 11kV voltage down to a lower voltage (230V/400V) (Low Voltage, LV) which can be used safely by consumers. Historically the use of 230V has been shown to be a suitable voltage for consumer use in New Zealand.

SCADA and communication assets

The SCADA and communication assets that UnitedNetworks owns are operational tools which enable the network to be operated and protected in a cost effective manner. These systems are used to ensure that the assets are not operated over and above their manufactured ratings and to enable automatic switching of the network so that network reliability levels are maintained.

1.2.2 Organisation objectives

Vision

UnitedNetworks vision is "to be New Zealand's most dynamic company, continually exploring the frontiers of the use of networks to unlock and deliver value".

Mission

UnitedNetworks mission statement is "We create and capture lasting value for our customers, stakeholders and the communities we operate in by enabling connectivity to network delivered products and services".

Values

UnitedNetworks have adopted a set of values, which are the fundamental set of beliefs held by the organisation. The values establish a basis for acceptable business and personal behaviour. These values are monitored as part of UnitedNetworks performance management process with each staff member being measured on business objectives and their adherence to the value behaviours. The values adopted are:

- Involved
  Human, professional, engaged and responsive. Good corporate and community citizen.
- Go Get Em
  Results focussed, always seeking to fit our depth of expertise to new areas of opportunity.
- Audacious
  Flexible, courageous, resolute, bold imaginative.
- Restless
  Never still. Always looking to redefine the possible. Continuous innovation and improvement.
- Rigorous
  Grounded, functional, logical and pragmatic. Always asking 'does it work?'

Goals and objectives

The corporate goals are based upon the needs of UnitedNetworks key stakeholders, namely consumers, customers, employees, shareholders and community. The goals are defined in terms of network reliability [SAIDI, SAIFI], net profit and other customised business line and regional goals including community programmes such as Project K and NZSO sponsorship.

The functional unit plans and individual objectives are aligned with the corporate/business line goals, and performance incentive payments [fixed and variable] are made based upon the achievement of related KPIs.

The Asset Management Plan is an integral part of this process. Currently performance measures relating to company profit, network reliability, safety and customer satisfaction contribute towards a performance related incentive plan for employees. Company KPIs are monitored and reported monthly to foster one of the key company values, namely 'rigorous'. Gap and trend analysis is utilised to identify reliability and process improvement projects and initiatives to improve performance.

Health and safety

UnitedNetworks recognises that the effective management of health and safety is a fundamental responsibility of the company, and an essential factor in the ongoing success of the business. This is reflected in the company's commitment to best-practice health and safety management and is demonstrated by the steady improvement in safety performance over the past three years.

The divestment of the contracting division of the company to Siemens Energy Services in mid 2001 provided the opportunity for the company to implement a range of safety performance measures which have been instrumental in advancing the safety culture within the total organisation, and further reducing accidents. The company is continuing to work with its contract partners to identify innovative and effective ways of further improving the safety of its electrical networks operations.

1.3 PLAN FRAMEWORK

The structure of this document reflects the high-level asset management activities undertaken within UnitedNetworks, organised to comply with regulatory information disclosure requirements.

Each of the steps in the asset management cycle needs to be supported by plans, processes and a common understanding of requirements. In general terms UnitedNetworks follows the asset management cycle illustrated on the following page, but the level of activity in the different areas is variable and a function of data and resource. Supporting documentation and systems for the asset management cycle are outlined in section 7.

In summary, the main processes and steps currently undertaken by UnitedNetworks in asset management are:

Establish business needs (section 1)

Business needs are determined by UnitedNetworks operating environment and reflect corporate, community, environmental, financial, legislative, institutional and regulatory factors together with stakeholder expectations. Section 1.2 sets out the background and business needs that drive the Asset Management Plan.

Establish existing asset information (sections 1, 3 and 4)

Existing information on the performance, utilisation, condition, age and capability of existing assets is needed to support requirements analysis. Information on the existing assets and network configuration is set out in section 1.4.

The asset register, Geographic Information System (GIS) and associated databases, store cost information and technical characteristics for all assets including their location, history and performance. The way in which information systems support asset management processes is described in section 7.

Define levels of service (section 2)

The asset management process begins with the identification of appropriate levels of service to meet business needs. Section 2 discusses levels of service and their identification.

Forecast demand (section 3)

Future network demand is forecast as an input to the determination of network development and capital investment requirements. Section 3 discusses and presents demand forecasts.

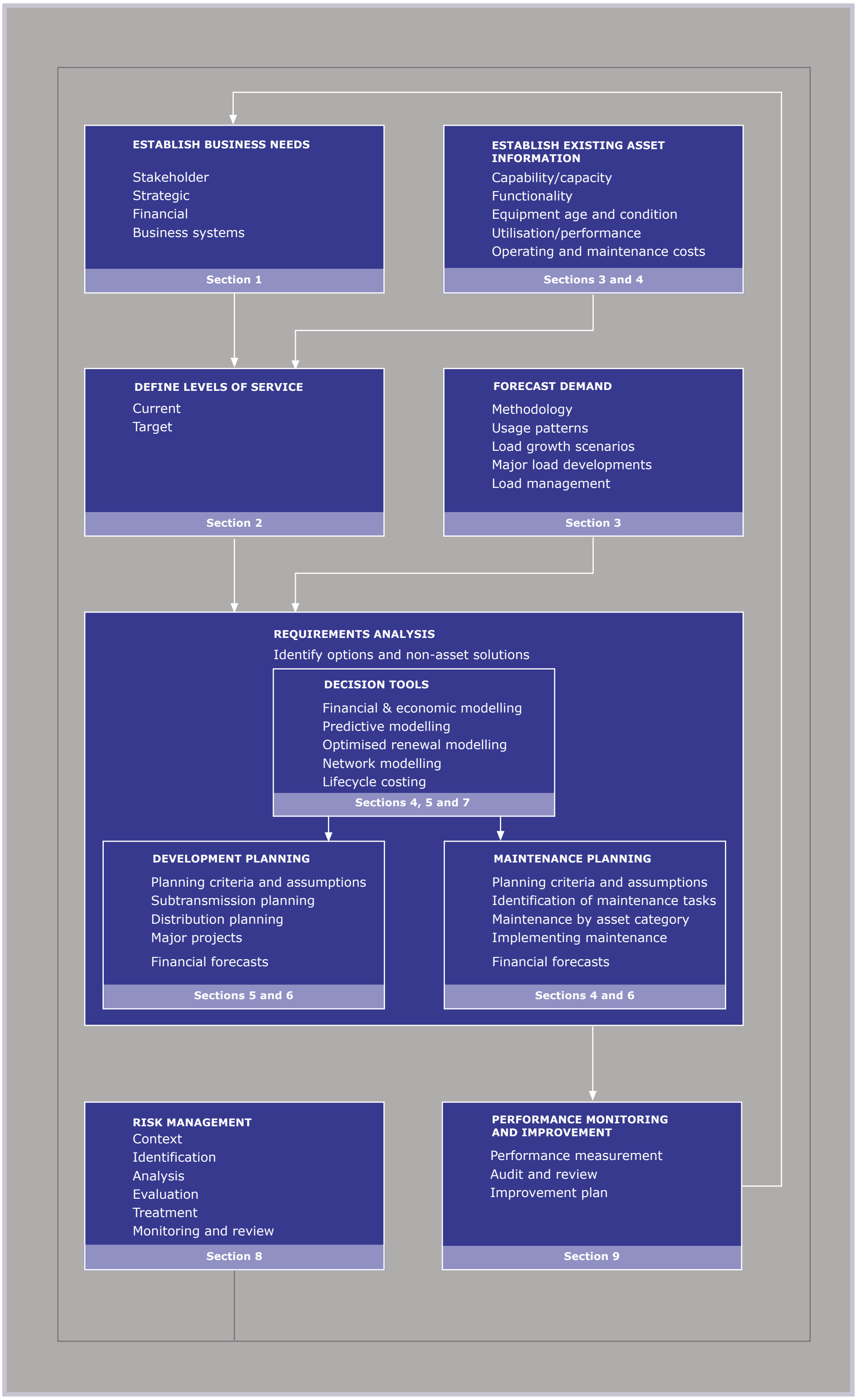
Requirements analysis (sections 4, 5 and 7)

Requirements analysis explores the options for achieving the target level of service or specific network need in sufficient detail to identify potential asset or non-asset solutions.

Decision tools and systems used to support requirements analysis include loadflow analysis, effective capital budgeting techniques, optimised renewal modelling, life-cycle costing, risk assessments and geographic information.

Planning criteria, together with the options and programmes for maintaining and renewing existing assets or establishing new assets, are set out in sections 4 and 5.

ASSET MANAGEMENT PLAN STRUCTURE



Development planning (sections 5 and 6)

Network development planning is undertaken to identify asset enhancement and development programmes required to meet target levels of service, and is based on systematic analysis of maximum demands, network power flows, customer requests and demographic estimates.

Development planning activity includes all those processes leading up to commencement of the operational and maintenance phase of the asset life-cycle. Optimising life-cycle costs (during planning and design) is a major objective of this step. UnitedNetworks approach to development planning, and major development projects in each region are set out in section 5.

Maintenance planning (sections 4 and 6)

Maintenance planning is undertaken to determine asset maintenance requirements and to manage the resources required to support the asset. Long, medium and short-term maintenance and other tasks associated with maintaining or renewing assets are formulated in asset maintenance policy. This includes consideration of skills, spares, support requirements and test equipment. UnitedNetworks approach to maintenance planning is set out in section 4.

Risk management (section 8)

Risk management, which underpins all asset management business processes, is discussed in section 8.

Performance monitoring and improvement (section 9)

Performance management commences with the ongoing monitoring of asset performance and condition, the consumption of resources and their associated costs, and the efficiency and effectiveness with which resources are utilised. Evaluation of actual performance against business and other targets and objectives drives the identification of improvement initiatives.

Performance improvement planning includes the formulation of plans for improvement in all aspects of asset management, whether the result of particular performance assessments or ongoing continuous improvement.

1.4 ASSET DESCRIPTION

Northern Region

The Northern Region covers those areas managed by the North Shore City, the Waitakere City and the Rodney District Councils, and consists of rural, urban, commercial and industrial developments.

Most commercial and industrial developments centre around the Takapuna, Albany Basin, Glenfield, Henderson and Te Atatu areas. There are no high density, high rise locations typical of major central business districts.

Areas north of the Whangaparaoa Peninsula and west of Henderson and Te Atatu are predominantly rural residential apart from scattered small townships. Zoning in these areas is largely for farming or conservation use.

The east and south-east areas in Waitakere City and North Shore City consist of medium density urban dwellings that are part of metropolitan Auckland.

The historical development of the electrical network has pivoted around coastal townships that have, in time, expanded with population growth. Significant expansion to the network occurred in the Takapuna area when the Harbour Bridge was commissioned in 1959. Given its rural heritage most of the distribution network was established using overhead construction, which has a significant impact on network reliability performance.

The network design is relatively consistent throughout the area as a result of 70 years of ownership and management by one organisation, namely the Waitemata Electricity Power Board (WEPB) since the 1920s. In 1991 the WEPB was privatised and renamed Power New Zealand (PNZ) and subsequently became UnitedNetworks in 1998.

The Northern Region takes bulk electrical supply at 33kV from the national grid operator Transpower at the following four points of supply:

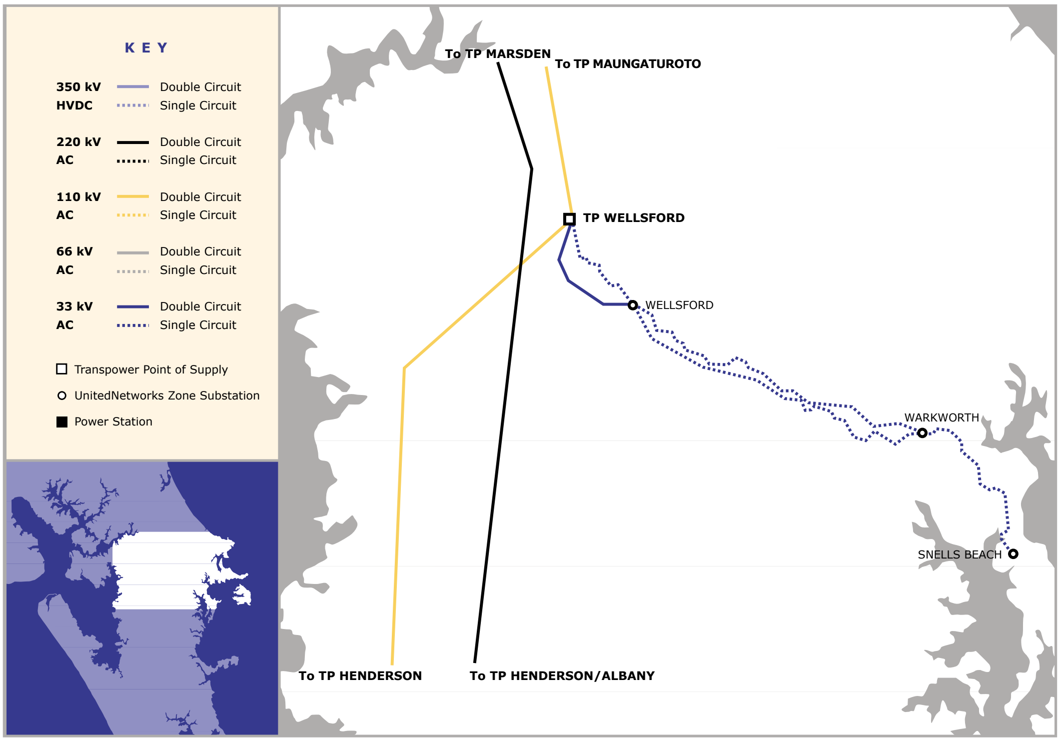
- Albany
- Henderson
- Wellsford
- Hepburn Road

Supply is also obtained from Albany at 110kV to supply UnitedNetworks Wairau Road substation via three 110kV transformer feeders where electricity is stepped down to 33kV.

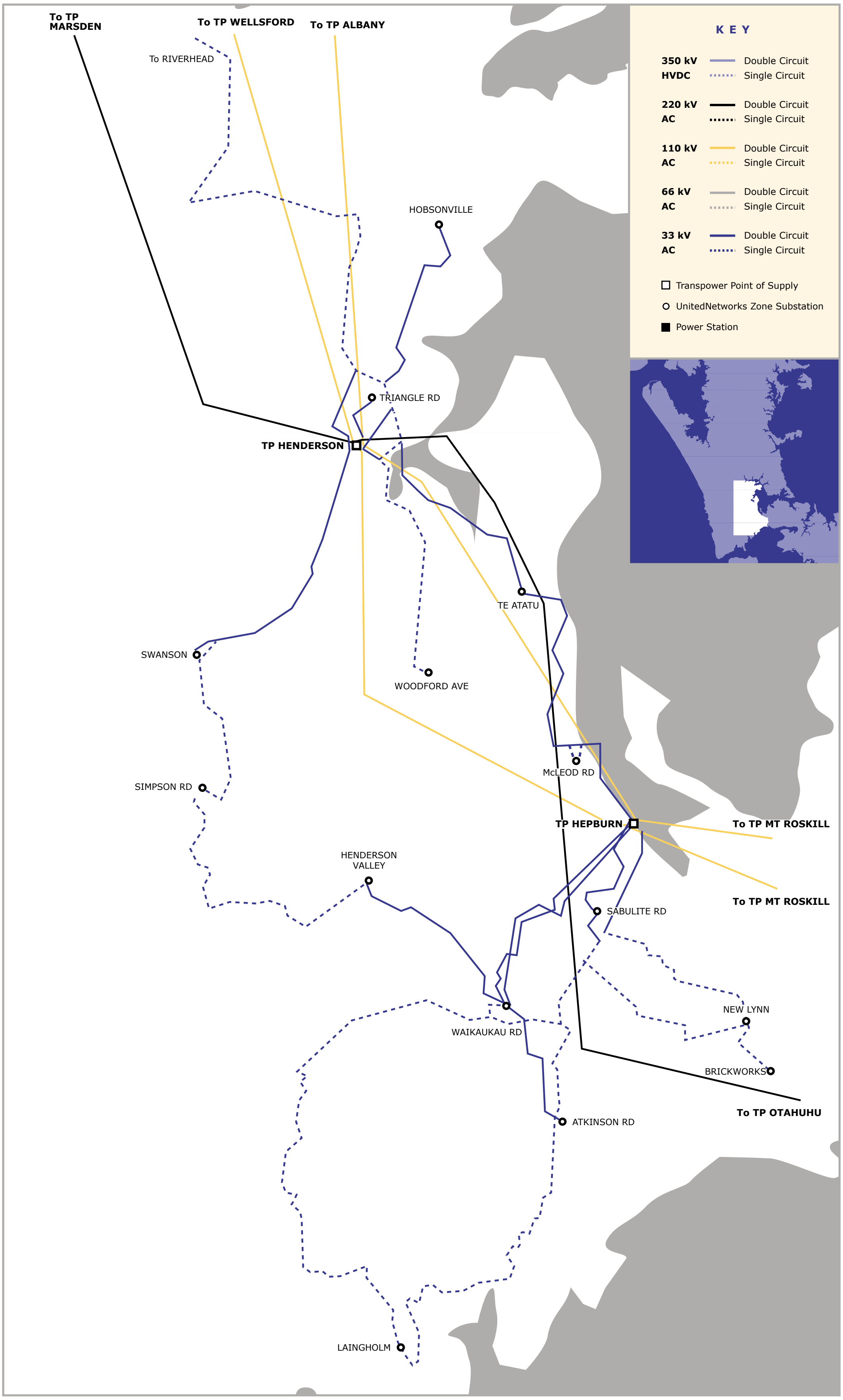
Electricity is transmitted to zone substations via the UnitedNetworks owned 33kV sub-transmission network. The 33kV sub-transmission is essentially a meshed network of overhead lines and cables emanating from the points of supply. A number of zone substations are fed directly from these points of supply via the 33kV network. A limited amount of interconnections exist between the networks supplied from different points of supply. 33kV switchboards/switches are normally installed at zone substations to allow linking between zone substations and thus the formation of a meshed 33kV network.

The following diagrams show the transmission grid that supplies the region and the configuration of the sub-transmission network and the locations of UnitedNetworks zone substations.

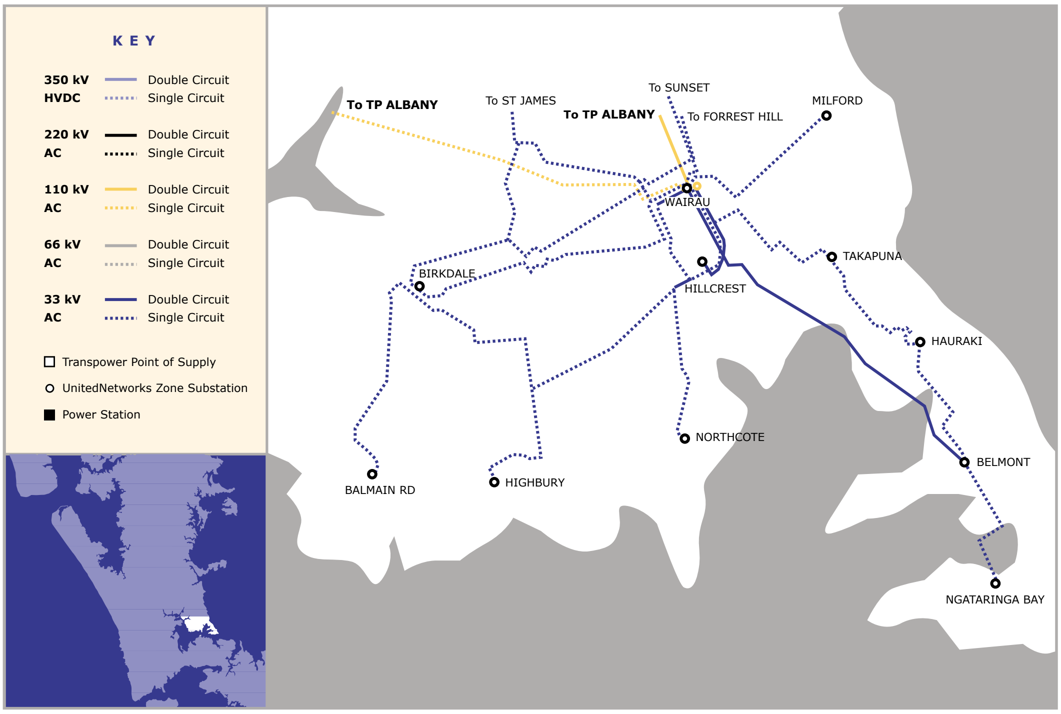
NORTHERN REGION – WELLSFORD



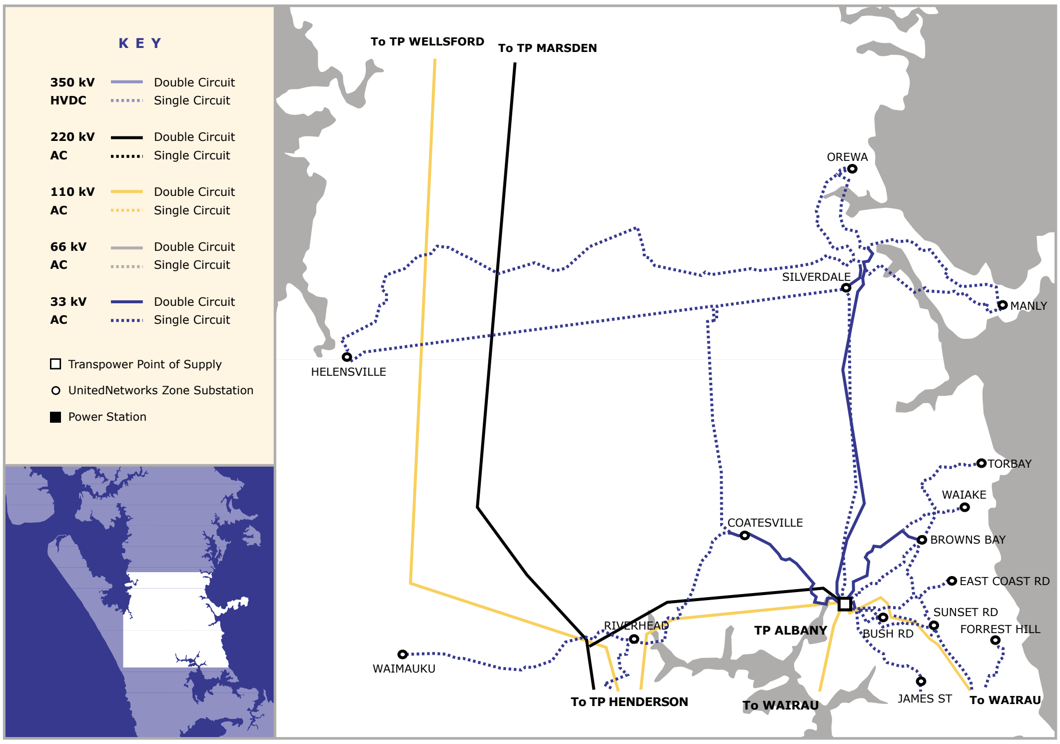
NORTHERN REGION – HENDERSON/HEPBURN RD



NORTHERN REGION – ALBANY 110 (WAIRUA VALLEY)



NORTHERN REGION – ALBANY 33



Electricity is transformed to 11kV for local distribution at zone substations. A network of 11kV cables and overhead lines distribute electricity to 11kV/400V transformers installed in commercial buildings, industrial sites, berm-side kiosks and on overhead line poles. In rural areas the 11kV lines are often equipped with auto-reclosers. The network is designed so that relatively few consumers are without supply for a significant amount of time should a fault occur. The radial nature of the rural circuits prevents alternative power supplies from being connected into the affected area resulting in a large area, but with few consumers, affected by an outage. These circuits are overhead ensuring rapid supply restoration once the fault is located. 400V cables and overhead lines are used to supply the majority of the residential, farming and business consumers.

The predominantly overhead distribution network is exposed to tree, animal, storm and third party damage. A programme of overhead to underground conversion continues in urban areas which is funded by the UnitedNetworks Shareholders' Society (UNSS) and which is principally directed at improving amenity value.

Eastern Region

The Eastern Region network serves a relatively low density service area which contains a mixture of rural and urban developments. The area includes some large industrial sites (foundries, dairy factories, saw mills, etc) scattered around the Thames and Waikato areas. Tauranga also accommodates one of the busiest ports in New Zealand. Resort developments centre around Rotorua, Taupo, and the coastal areas of the Coromandel Peninsula.

In many cases the network loads are seasonal and linked to industrial or tourist activities.
A number of major industrial consumers exist, the most significant of which are in the dairy and forestry sectors.

The diverse design practise and equipment specifications that resulted in different network configurations in the different parts of the region can be traced back to the fact that the region consists of the amalgamation of the following six historical supply authorities:

- Thames Coromandel Power Board which supplied the northern sections of the Coromandel Peninsula
- Thames Valley Electricity Power Board which supplied the north-western section of the network stretching from the Coromandel Peninsula to Tokoroa in the south
- Rotorua Electric Power Board which supplied the area around Rotorua
- Tauranga Electric Power Board which supplied Tauranga, Mt Maunganui, Te Puke and the surrounding areas but excluding the Tauranga central business district
- Tauranga Municipal Electricity Department (MED) which supplied the Tauranga central business district
- Taupo Municipal Electricity Department (MED) which supplied the areas around Taupo

As a result of the different historical ownership of these networks very different network design and construction philosophies have been applied with a variety of equipment installed. In particular this has resulted in transformers having different vector groups being installed and difficulties in operating different parts of the distribution network in parallel.

UnitedNetworks takes supply from the following ten Transpower points of supply at 11kV, 33kV and 66kV:

- Kopu (66kV)
- Waikino (33kV)
- Kinleith (33kV)
- Mt Maunganui (33kV)
- Rotorua (33kV)
- Waihou (33kV)
- Hinuera (33kV)
- Tauranga (33kV)
- Te Matai (33kV)
- Wairakei (33kV)

From these points of supply, electricity is transmitted to 46 zone substations via the 66kV and 33kV sub-transmission networks. The UnitedNetworks 33kV and 66kV sub-transmission is a mixture of mesh and radial network and predominantly of overhead construction. 33kV and 66kV switches/switchboards are installed to allow interconnection. The mesh arrangement adopted by Northern and Eastern Regions offer higher security levels, due to the diversification of circuit routes, and where necessary, supply by more than two circuits.

Supply is also taken from the following six Transpower points of supply at 11kV:

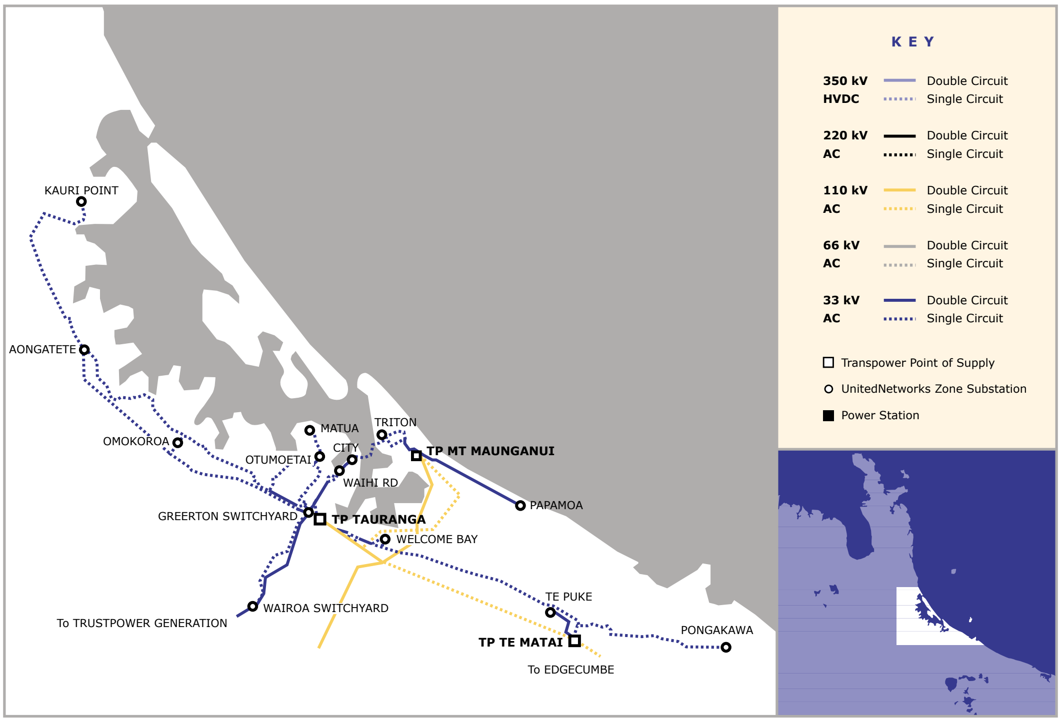
- Kinleith
- Mt Maunganui
- Ohaaki
- Tauranga
- Rotorua
- Owhata

A small section of UnitedNetworks 11kV network is supplied from the 11kV point of supply at Atiamuri generating station owned by Mighty River Power. Due to a phase shift this small pocket of 11kV network operates independently (island) of the remainder of the network.

A significant amount of embedded generation (38MVA) from the Kaimai generating station injects electricity into the UnitedNetworks 33kV network through the 33kV switchyard at Greerton (Tauranga). A lesser amount of generation capacity (6MVA) at Hinemaiaia is also connected to the 33kV switchyard at Centennial Drive (Taupo). The Rotokawa geothermal generation station (28MVA) is also connected to the 33kV switchyard at Centennial Drive. In some remote areas south of Taupo, a small group of consumers are served by 33kV/415V transformers connected to the Centennial Drive – Hinemaiaia 33kV line.

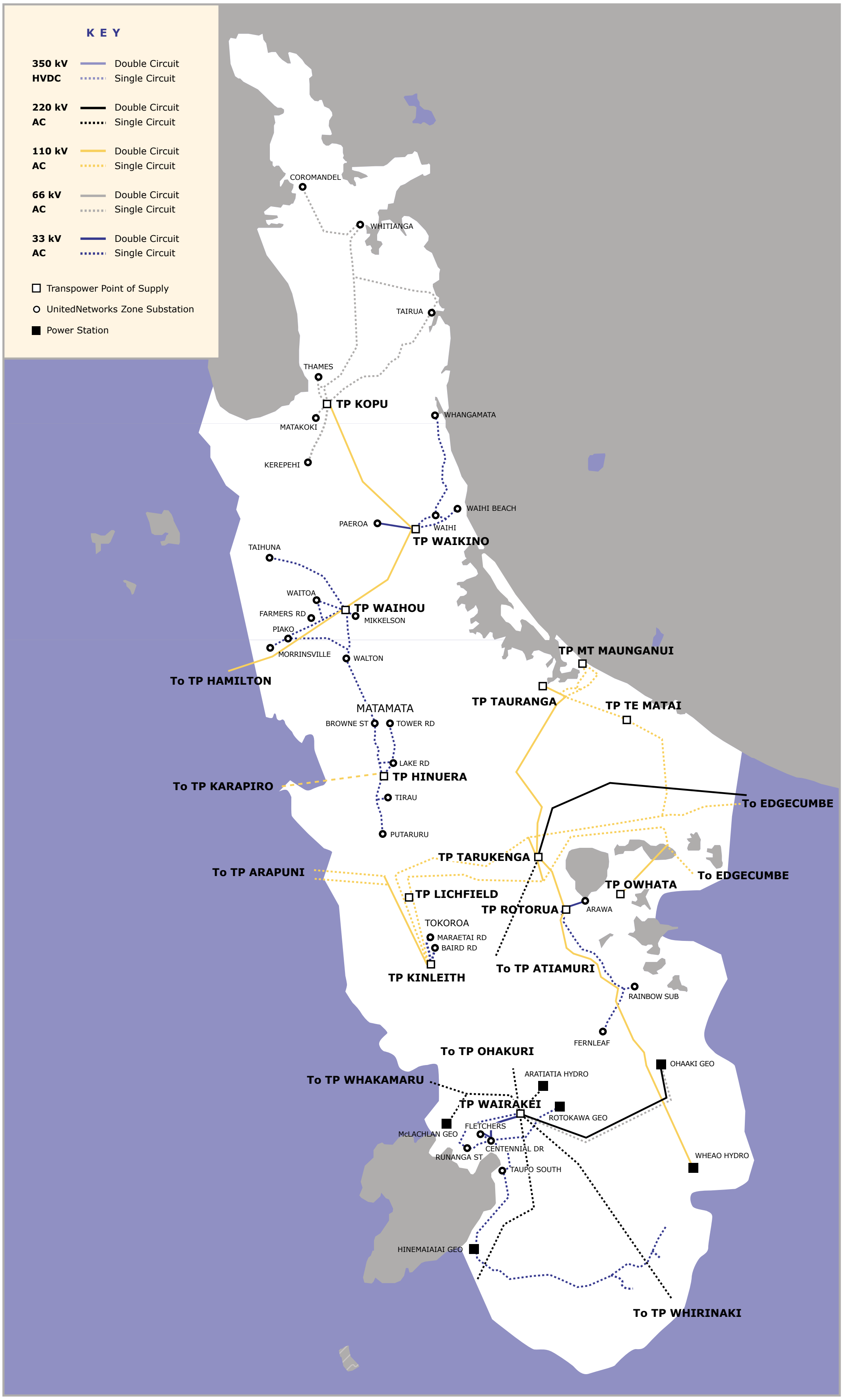
The following diagrams show the transmission grid that supplies the region and the configuration of the sub-transmission network and locations of UnitedNetworks zone substations.

EASTERN REGION – TAURANGA



A network of 11kV cables and overhead lines distributes electricity to 11kV/400V transformers installed in commercial buildings, industrial sites, berm-side kiosks and on overhead line poles. 400V cables and overhead lines are used to supply the majority of the residential, farming and business consumers. In some remote areas with low load density, single wire earth return (SWER) lines are installed. UnitedNetworks also owns the 11kV distribution network and distribution transformers within the Carter Holt Harvey Kinleith Pulp & Paper Mill site.

EASTERN REGION



Central Region

The Central Region is characterised by the high customer density and rugged terrain of the Wellington City area. Other business and retail centres are scattered around the region at Lower Hutt, Porirua, Upper Hutt, Seaview, Gracefield, Petone and Johnsonville. Small industries and warehouse developments centre on the Lower Hutt, Ngauranga Gorge, Petone and Naenae areas.

The high reliability performance of this network is achieved through a combination of high customer density, large numbers of underground cables and an ability to sectionalise faults through no-break switching.

The Central Region network was previously owned by the Wellington Municipal Electrical Department (in the Wellington City) and the Hutt Valley Energy Board (in the Lower Hutt, Upper Hutt and Porirua Cities). The design philosophies in these two areas are quite different. For example, all 11kV and 33kV circuits in Wellington are underground, whereas those in the Hutt and Porirua areas are a combination of overhead and underground configuration. Most of the 33kV cables used in Wellington are gas pressure cables (because of the terrain), whereas those in the Hutt and Porirua are oil filled. 11kV cables in the Wellington area are predominantly PILC with copper conductor whereas XLPE cables with aluminium conductors have been extensively used in the Hutt and Porirua areas.

UnitedNetworks takes supply at 33kV from the following eight Transpower points of supply:

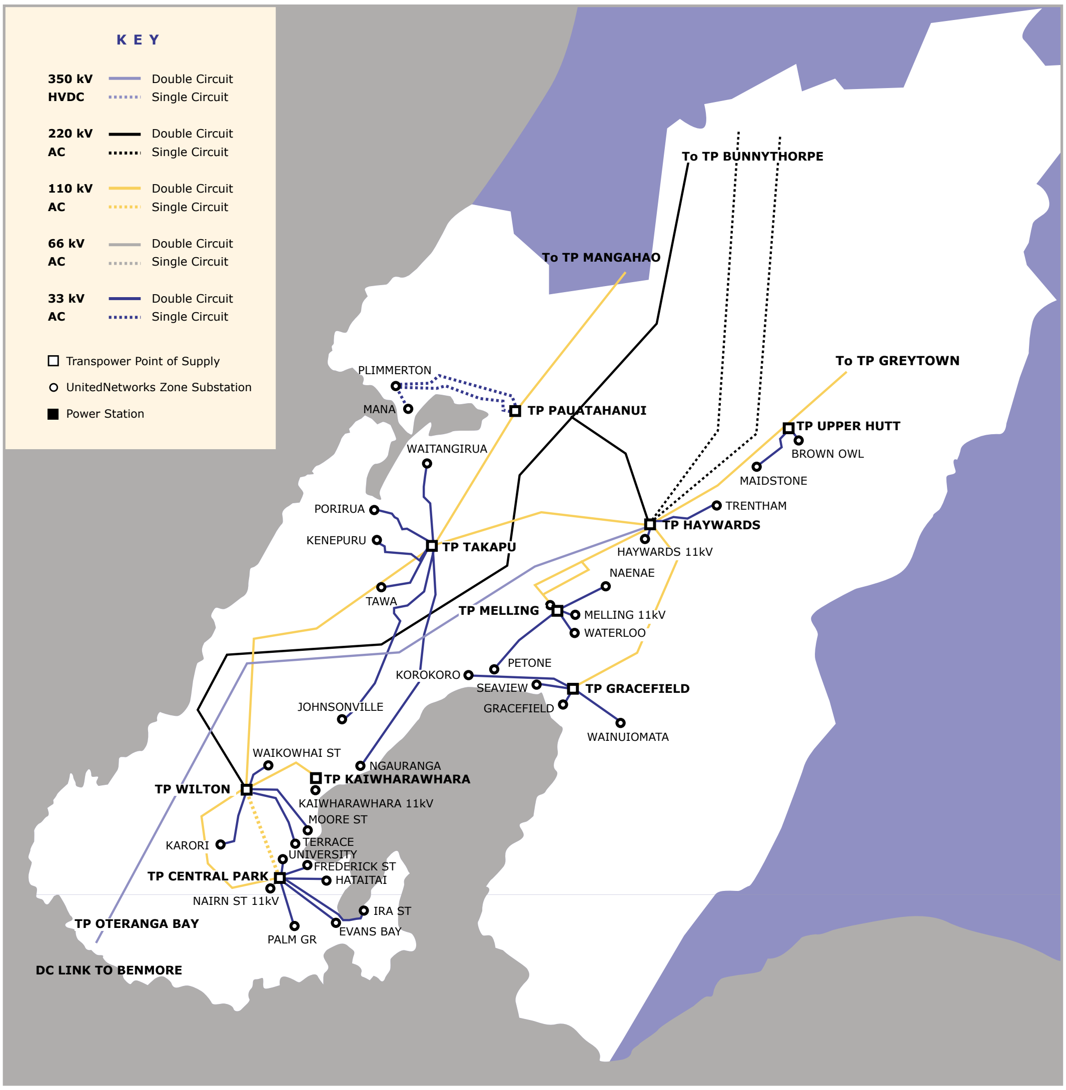
- Central Park
- Gracefield
- Upper Hutt
- Takapu Rd
- Wilton
- Melling
- Haywards
- Pauatahanui

Electricity is transmitted to 28 zone substations via the 33kV sub-transmission network. Each of these zone substations accommodates two 33/11kV transformers, except for Plimmerton and Mana substations. Only one transformer is installed at each of Plimmerton and Mana substations. All other zone substations are supplied by two radial 33kV feeders, with no 33kV switchboards installed at zone substations (often referred to as feeder fed transformers). Security for this dual radial feeder arrangement is not as high as the other regions for the same level of investment or utilisation/loading level. Consideration will be given to developing the Central Region sub-transmission network into a mesh arrangement over time.

Another feature of the Wellington network design is the traditional use of larger transformers with relatively low impedance. This practice and the presence of automatic circuit breakers in the distribution network (as a result of closed 11kV rings) generally preclude parallel operation of the two transformers in a zone substation. This results in the inability to use the diversity (for example, between residential and commercial load) between the two zones to reduce demand on the transformers.

The following diagram shows the transmission grid that supplies the region and the configuration of the sub-transmission network and locations of the UnitedNetworks zone substations.

CENTRAL REGION



UnitedNetworks also takes supply at 11kV from four Transpower points of supply:

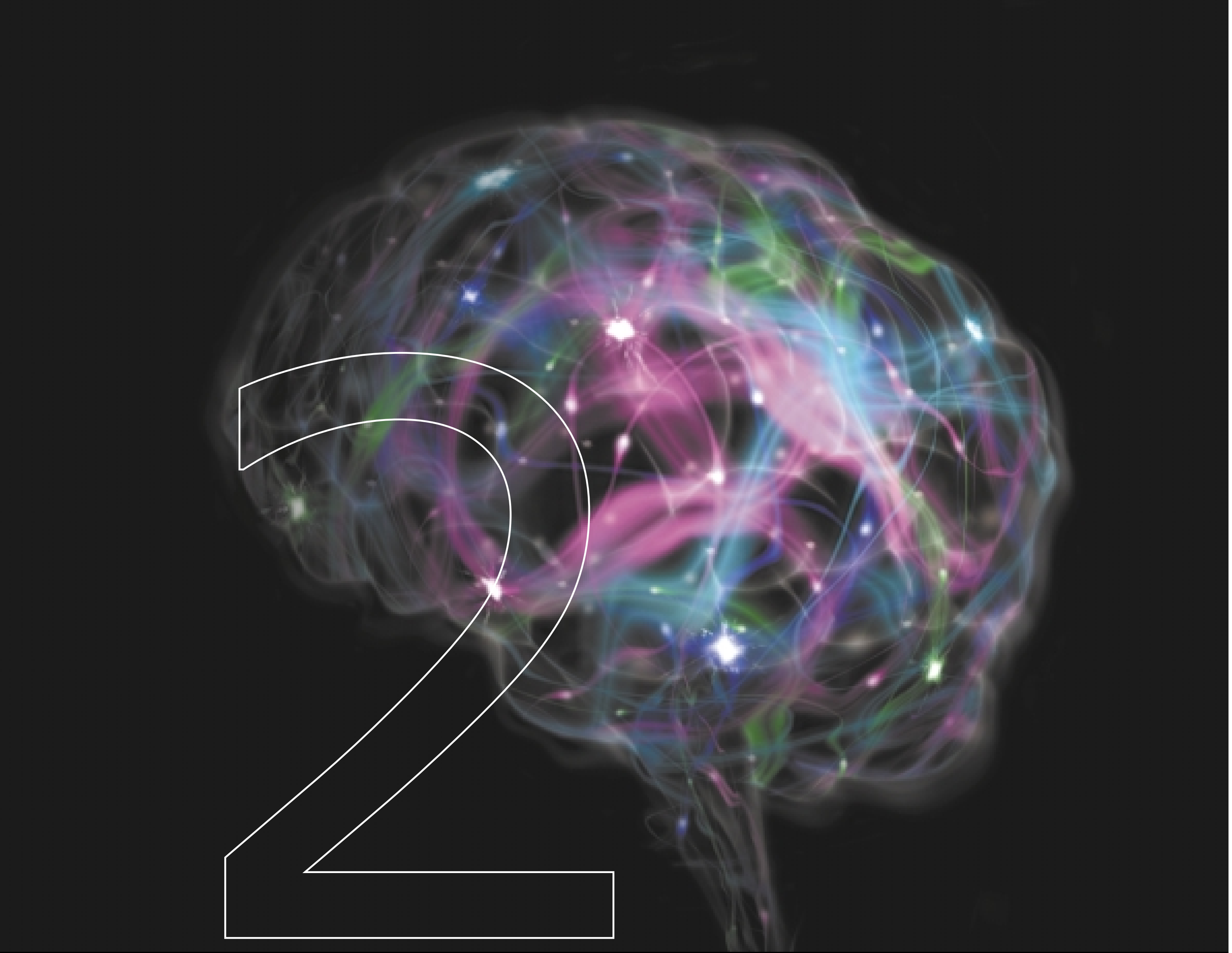
- Central Park
- Kaiwharawhara
- Melling
- Haywards

Electricity is stepped down at zone substations to 11kV for distribution. Traditionally distribution network design in the Hutt Valley/Porirua areas (previously owned by the Hutt Valley Energy Board) is quite different from that in the Wellington City areas (previously owned by the Wellington City Council). The design philosophy in the Hutt areas is quite similar to that in the Eastern and Northern Regions.

The 11kV and 33kV supplies at all Transpower points of supply are obtained via Dyn3 transformers, whilst all UnitedNetworks 33/11kV zone transformers in the Central Region are Yy0 transformers. As a result all the 11kV networks in the Central Region can be operated in parallel (except for high fault level situations). However in certain cases significant circulating currents occur because of the different paths taken to the 11kV network. In particular this occurs between sites supplied via 110/11kV transformers and 110/33kV-33/11kV transformers (i.e. Central Park 33 and 11).

A network of 11kV cables and overhead lines was constructed to distribute electricity to 11kV/400V transformers installed in commercial buildings, industrial sites, berm-side kiosks and overhead line poles. 400V cables and overhead lines are used to supply to the majority of the residential and business consumers.

The 11kV network in the Wellington CBD is arranged in a "closed ring" configuration with radial feeders interconnecting neighbouring "rings" or zone substations. This configuration offers a high level of security, which is commensurate with the need of the high profile consumers in the area. The 11kV network outside of the Wellington CBD area comprises interconnected radial feeders. In the event of equipment failure, supply to consumers can be easily switched to neighbouring feeders.



LEVELS OF SERVICE

2.1	Introduction	29
2.2	Customer/consumer research and expectations	29
2.3	Legislative requirements	29
2.4	Current level of service	30
2.4.1	Financial performance	30
2.4.2	Physical performance	30
2.5	Desired level of service	33
2.5.1	Setting the targets	33
2.5.2	Performance projections	34
2.5.3	Selection of company performance measures	34
2.5.4	Analysis of company performance measures	34
2.5.5	Targets	34
2.5.6	Cost vs reliability trade-offs	36
2.5.7	The value of reliability	36
2.5.8	UnitedNetworks approach to reliability engineering	36
2.5.9	Other quality of supply issues	37
2.6	Environmental	37

RETURN TO MAIN CONTENTS PAGE

2. LEVELS OF SERVICE

2.1 INTRODUCTION

As a means of focusing on the needs of stakeholders and communicating expectations, high performing companies set clear values and performance measures.

UnitedNetworks has established a dedicated performance team to identify, monitor and report on a set of internationally relevant performance measures. This will enable the company to view its business in the context of international best practice and drive it towards performance excellence. Financial performance targets clearly reflect shareholder interests while safety targets address the interests of both internal and external service providers. The voice of the customers/consumers and the market are addressed through the following performance measures:

- Reliability
- Customer/consumer satisfaction

Senior management and business line teams review performance indicators monthly and all significant gaps between actual performance and target performance are analysed objectively so that alternative strategies are identified.

2.2 CUSTOMER/CONSUMER RESEARCH AND EXPECTATIONS

UnitedNetworks has adopted the internationally recognised indices for network reliability, namely SAIDI, SAIFI and CAIDI. The annual targets for these indices have been set at a level which reflects UnitedNetworks commitment to continuous improvement based upon both international and New Zealand benchmarks. At the same time, UnitedNetworks has a responsibility to balance reliability costs against customer/consumer and stakeholder needs. The service level targets have thus been based upon surveyed customer/consumer needs and comparisons with utilities in New Zealand, Australia and USA/Canada.

The customer/consumer-focused philosophy that has been adopted by UnitedNetworks will ensure that these targets are continuously reviewed to keep pace with changing customer, consumer, shareholder, regulatory and legislative demands.

In its quest to achieve ever increasing levels of performance UnitedNetworks is committed to a company reliability improvement programme. Reliability, its measurement, analysis and continuous improvement are embraced within the company as an integral part of “what we do around here”.

The security of the system (the ability of the system to function on the failure of any one component) is continuously monitored to ensure that service is not compromised.

2.3 LEGISLATIVE REQUIREMENTS

UnitedNetworks is required to disclose information pursuant to the Electricity (Information Disclosure) Regulations 1999 and Electricity (Information Disclosure) Amendment Regulations 2000. This requires an annual public release of its Asset Management Plan under the following broad headings:

- Summary of the Asset Management Plan
- Details of Asset Management Plan background and objectives
- Details of assets covered
- Details of proposed level of service

- Details of network development and life-cycle asset management plans
- Details of risk policies, assessment and mitigation
- Details of performance measurement, evaluation, and improvement.

The NZ Electricity Regulations 1997 detail requirements such as Health and Safety, Registration and Licences, Systems of Supply, and technical regulations.

2.4 CURRENT LEVEL OF SERVICE

2.4.1 Financial performance

Accountability for financial performance is clearly defined and allocated to those senior managers best able to manage the outcome.

Delegated authorities for expenditure are similarly well defined and provide for appropriate levels of expenditure beyond which detailed business plans are required prior to any financial commitment being entered into.

Delegated authority for expenditure procedures ensure that actual costs are monitored, and higher authorisation is necessary should actuals vary from budget by more than a prescribed amount.

2.4.2 Physical performance

UnitedNetworks has established a dedicated company performance function, tasked with identifying, monitoring and reporting on those performance measures which will enable the company to view its business from a world class framework and drive it towards performance excellence. Physical performance measures tracked against world class performance include:

- Reliability
- Customer/consumer satisfaction
- Company culture
- Safety

Reliability

The overall performance of a network is generally measured by three indicators, viz:

- System average interruption duration index (SAIDI)
- System average interruption frequency index (SAIFI)
- Customer/consumer average interruption duration index (CAIDI)

From a philosophical point of view, SAIFI can be viewed as an asset performance indicator whereas SAIDI can be seen as a contractor/operator performance indicator. SAIFI reflects the number of times network components fail and is affected by the quality of maintenance as well as the planning and design standards. SAIDI on the other hand relates to the length of time the system is not available to consumers/customers when the network fails and is largely affected by how fast supply can be restored when a fault occurs.

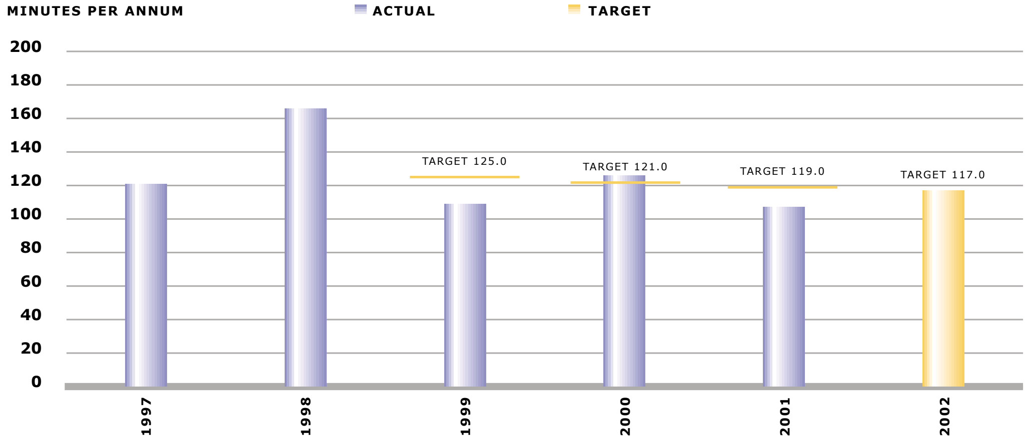
The following table shows the performance of UnitedNetworks network in the past six calendar years as measured by the above indicators:

OVERALL

Year	96	97	98	99	00	01
SAIDI (minutes)	136	121	166	109	126	107
SAIFI	2.59	2.15	2.21	1.66	2.0	1.54
CAIDI (minutes)	53	56	75	65	62	70

UnitedNetworks has, and continues to, set itself reliability performance targets which aim for continuous improvement. The following charts compare the historical reliability performance against the respective targets. Severe storms during 1998 and 2000 resulted in the SAIDI/SAIFI targets not being met.

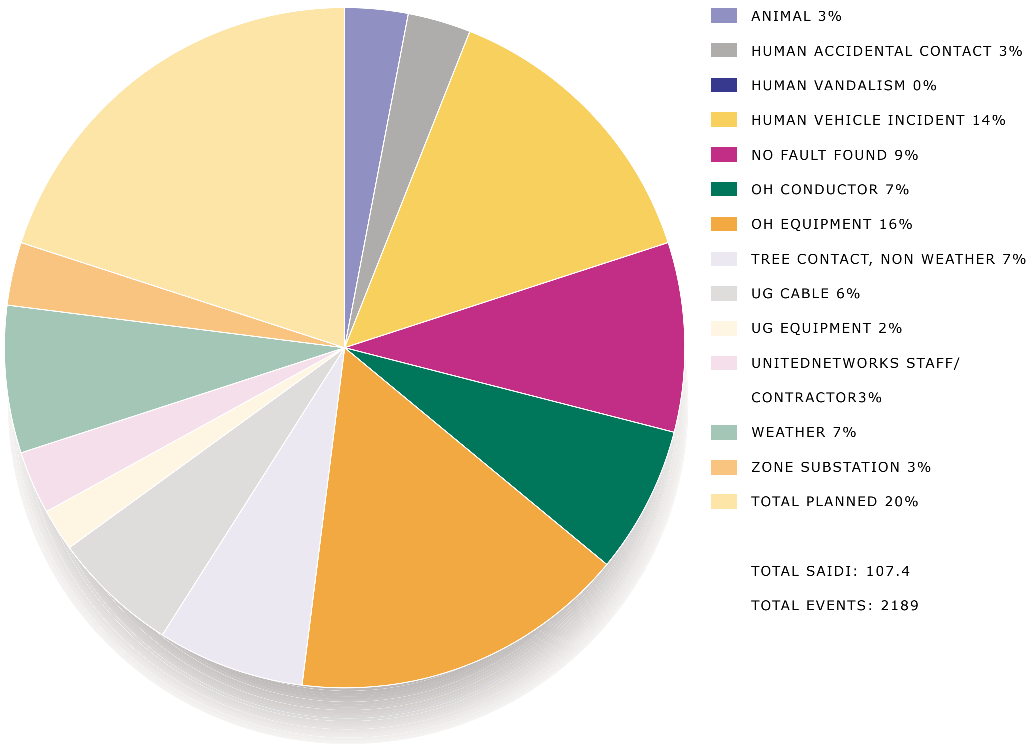
SAIDI - SYSTEM AVERAGE INTERRUPTION DURATION INDEX



SAIFI - SYSTEM AVERAGE INTERRUPTION FREQUENCY INDEX

The following chart illustrates the network outage performance statistics by type for the period January 2001 through December 2001.

UNITEDNETWORKS
OUTAGE PERFORMANCE STATISTICS: 2001



Company culture

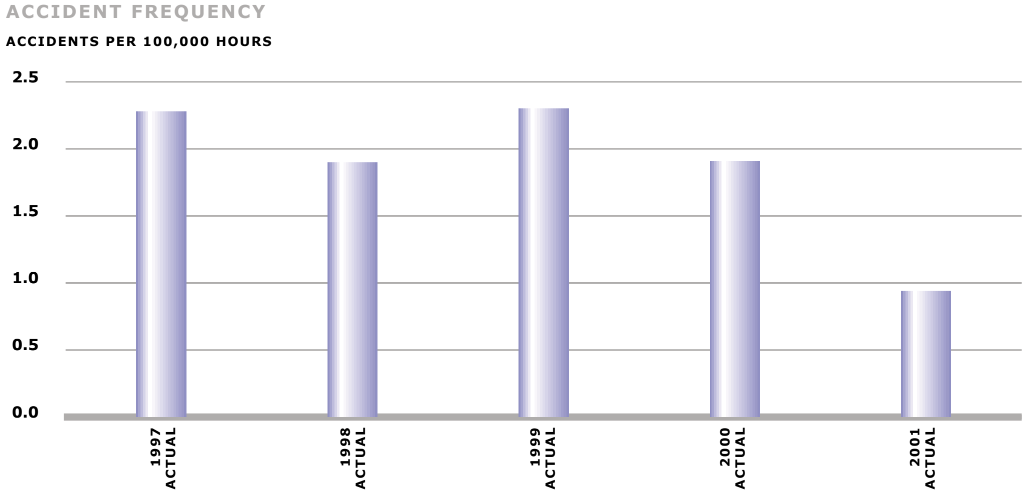
UnitedNetworks is committed to developing a dynamic, flexible and achievement focussed culture. The company also recognises the need to create an environment that enables people to deliver on business strategy. For that reason UnitedNetworks has introduced a series of initiatives which include a Leadership Development Programme, a Performance Development Programme, Peer Coaching and culture surveys to ensure team members are satisfied, committed and skilled to succeed. These initiatives, paired with recruitment practices that focus on selecting new team members that have the right competencies and values, are critical to ensuring UnitedNetworks meets its customers needs.

Health and safety

UnitedNetworks recognises that the effective management of health and safety is a fundamental responsibility of the company, and an essential factor in the ongoing success of the business. This is reflected in the company's commitment to best-practice health and safety management and is demonstrated by the steady improvement in safety performance over the past three years.

UnitedNetworks' commitment to the continuous improvement of its health and safety management systems was further demonstrated by the attainment of ACC Safety Management Practices certification in early 2001. The divestment of the contracting division of the company to Siemens Energy Services in mid 2001 provided the opportunity for the company to implement a range of safety performance measures which have been instrumental in advancing the safety culture within the total organisation, and further reducing accidents.

The company is continuing to work with its contract partners to identify innovative and effective ways of further improving the safety of its electrical networks operations.



The above health and safety figures are the combined values for both electrical and gas networks (gas figures being included from May 2000)

2.5 DESIRED LEVEL OF SERVICE

2.5.1 Setting the targets

From its own experience in operating distribution systems within New Zealand, UnitedNetworks recognises that the performance of different networks diverge widely. For example, the type of distribution system constructed in a high rise central business district (CBD) is likely to be tightly meshed with high levels of redundancy, reflecting a high concentration of significant load. In a rural situation the network is likely to be radial in nature, with little redundancy and less able to withstand failure. While significantly different in configuration, both construction methods are fit for their respective purposes in terms of providing a cost-effective delivery of supply electricity.

The Australian Competition and Consumer Commission (ACCC), recognises the different characteristics of networks and has categorised them as follows:

- CBD
- Urban
- Short rural
- Long rural

UnitedNetworks distribution systems contain portions of all these categories. For example:

- The Central network contains both CBD and urban distribution. (2001 SAIDI of 27 minutes)
- The Northern network contains both urban and short rural. (2001 SAIDI of 120 minutes)
- The Eastern network contains areas of urban, short rural and long rural. (2001 SAIDI of 165 minutes)

The wide divergence of network characteristics make it difficult to benchmark against world best practice or even the aggregated service levels disclosed under the Electricity Disclosure Regulations by other lines companies in New Zealand.

In determining its forward reliability target UnitedNetworks set objectives which reflect a cost-effective convergence of reliability in each specific network category.

2.5.2 Performance projections

UnitedNetworks establishes its key performance measures and/or indicators for tracing progress as an essential element of its strategic planning and strategy deployment process.

UnitedNetworks sets its projected performance measures to provide an appropriate framework for communicating company performance expectations and comparing its performance against previous history and international best practice.

2.5.3 Selection of company performance measures

As a guide to its selection of company performance measures UnitedNetworks endeavours to ensure that they:

- Support the strategic planning process
- Promote the cost/financial understanding of improvement options
- Are measurable based on data available
- Are effective and directly applicable to daily operations
- Are referenced to similar industries
- Enable the company to track its overall organisational performance
- Represent a balanced view of the total business

2.5.4 Analysis of company performance measures

UnitedNetworks employs processes that ensure that its performance measures provide a basis for:

- Gap analysis
- Cause/effect correlation
- Supporting performance reviews of senior management
- Remuneration setting
- Setting resource priorities
- Trending analysis

The comparison between projected performance and actual performance represents an integral part of UnitedNetworks organisational development and effectiveness programme and is a key element in the company quest for performance excellence.

2.5.5 Targets

The chosen indicators for measuring reliability performance are the internationally recognised power company benchmarks of SAIDI, CAIDI, SAIFI and failure rate-faults per 100 kms (high voltage and medium voltage lines/cables). Targets are presented for a five-year period.

The following table shows UnitedNetworks reliability performance targets for the next five years:†

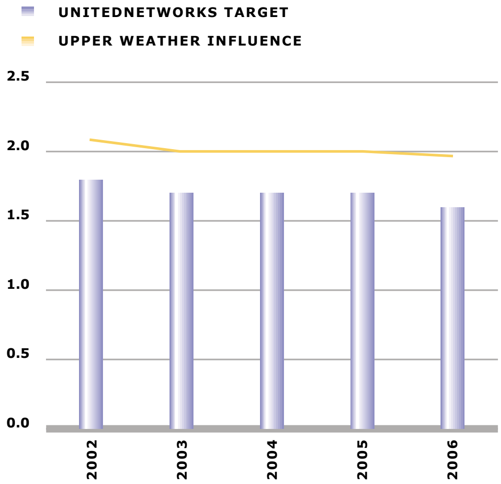
OVERALL

Year	2002	2003	2004	2005	2006
SAIDI (minutes)	117	114	112	110	109
SAIFI	1.76	1.73	1.69	1.66	1.64
CAIDI (minutes)	66	66	66	66	66

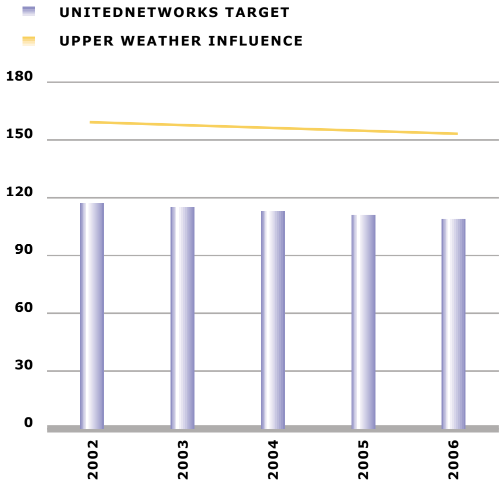
† Weather has a profound effect on performance and targets are based on average weather patterns. UnitedNetworks models the impact of weather on reliability and can estimate the range of outage frequencies from varying weather patterns. The targets indicate an upper bound based on the most extreme weather.

Levels of service

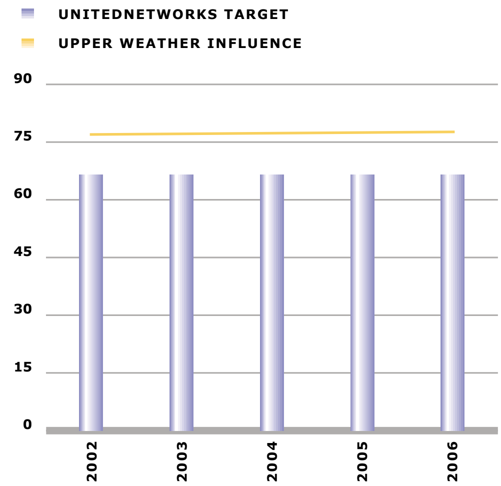
AVERAGE NUMBER OF INTERRUPTIONS PER CUSTOMER (SAIFI)



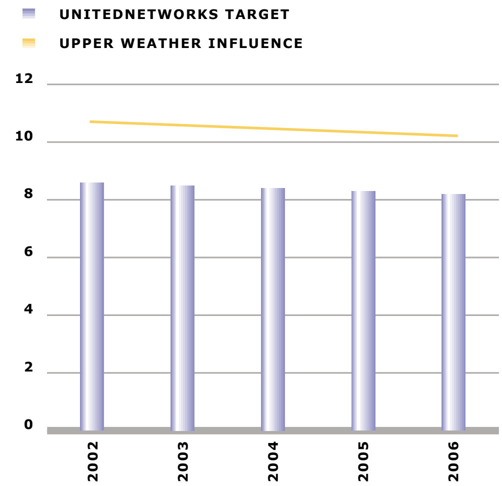
AVERAGE MINUTES OFF SUPPLY PER CUSTOMER (SAIDI)



AVERAGE OUTAGE DURATION PER CUSTOMER (CAIDI)



FAILURE RATE – FAULTS PER 100 KILOMETRE

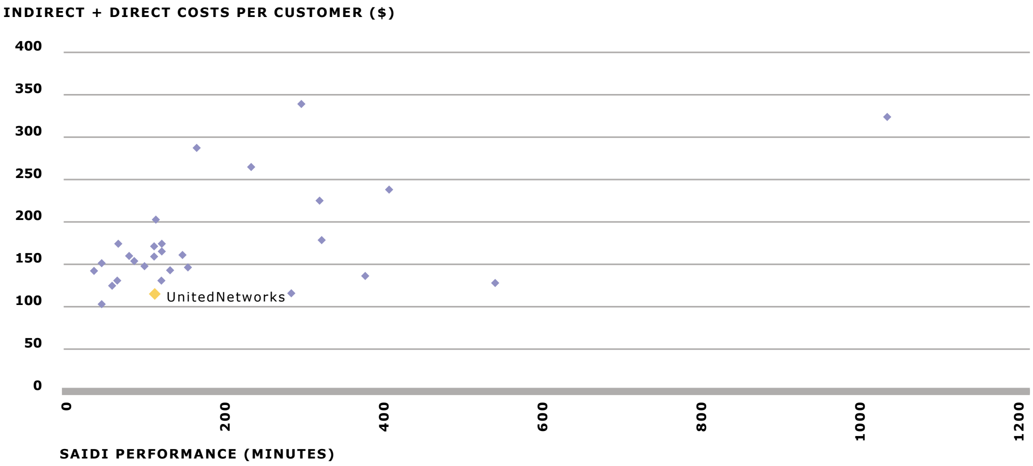


2.5.6 Cost vs reliability trade-offs

International experience suggests that in the case of a mature well performing distribution system the incremental investment required to improve reliability on a sustainable basis may be as high as $1 million per SAIDI minute.

The international benchmark group UMS have attempted to correlate reliability with maintenance costs. The results generally suggest that, for a specific type of network, reliability is improved by additional maintenance up to a point beyond which the effectiveness of additional maintenance spend diminishes rapidly. While it is difficult to establish an optimal maintenance/SAIDI regime without considering the exact type of network, previous benchmarking studies have indicated that UnitedNetworks SAIDI should lie in the 110/150 range. The following diagram illustrates UnitedNetworks SAIDI/cost performance in comparison with other New Zealand electrical lines businesses.

COST VS RELIABILITY



Source: 2001 NZ Electricity Distribution Company Analysis, Cap Gemini Ernst & Young

2.5.7 The value of reliability

Extensive surveys conducted both in New Zealand (including by UnitedNetworks predecessor company) and internationally have sought to determine the underlying value of reliability by establishing the additional cost that a customer might be prepared to pay to avoid a loss of supply. Predictably, these surveys have determined that the amount that a customer may be prepared to pay depends very much on the nature of the customer, the cost consequences of loss of supply and whether the event can be anticipated or not.

In assessing the cost benefit of any reliability enhancement UnitedNetworks measures cost against the perceived value for improved reliability based on the results of its surveys.

While the cost of non supply is a function of the period for which supply is lost, UnitedNetworks typically uses values of between $4,000/$13,000 per MWhr, depending on the specific nature of the end use customers affected. This range is consistent with international practice.

2.5.8 UnitedNetworks approach to reliability engineering

UnitedNetworks regards reliability engineering as an integral part of asset management and is dedicated to the systematic monitoring, analysis and improvement of system performance.

The key element of UnitedNetworks approach to reliability engineering includes:

- Classification of end use customers (consumers)

  All end use consumers connected to UnitedNetworks network are identified by their load group to provide the principal means of assessing the loss of supply.

- Classification of feeders

  All the feeders, or sections of feeders, are coded to reflect the predominance of end use consumers connected

- Targets set for individual feeder performance

  Each category of feeder is assigned a performance target to reflect the nature of the connected load. Typical performance targets include:
  - *number of outages per area*
  - *total duration of outages*
  - *duration of any single outage*

- Feeder monitoring

  Each of UnitedNetworks circa 700 feeders is monitored against the performance targets set. Poor performing feeders can then be readily identified for subsequent investment and treatment via either increased maintenance or by investment in reliability enhancement equipment

- Fault response analysis

  The time for the fault crew to arrive at the faulted feeder (the response time), the time required to isolate the fault and the time to fix the fault are monitored continuously. This provides the basis for validating resource levels and the potential effectiveness of any reliability enhancement

- Geographic disposition of faults

  The geographic disposition of faults is monitored and recorded to identify the potential effect of local conditions

2.5.9 Other quality of supply issues

UnitedNetworks acknowledges that the quality of supply, in terms of spikes, sags and harmonics is of increasing importance to not only the domestic end use consumer segment, with the proliferation of home computers, but also to the commercial industrial end use consumer groups which employ increasingly sophisticated control systems. UnitedNetworks contractors use sophisticated power quality monitoring equipment in order to solve power quality problems which are affecting consumers.

2.6 ENVIRONMENTAL

UnitedNetworks recognises the importance of sound environmental management while delivering efficient, reliable network services that create value for its stakeholders. It is committed to reducing the potential adverse effect of the activities of all levels of its business, through responsible and diligent governance of its operations in the environment.

UnitedNetworks is committed to developing and implementing principles of environmental sustainability as they apply to its business.

In particular it is UnitedNetworks policy to;

- Develop and maintain an effective environmental management system
- Improve energy efficiency
- Reduce waste
- Reduce greenhouse gases where possible
- Comply with all applicable legislation
- Continuously improve environmental performance and practice suitable benchmarking
- Actively encourage business partners and suppliers to adopt similar practices

An example of UnitedNetworks commitment to sound environmental practices is the Takapuna zone substation which was commissioned in 2000. This project won the 2001 IPENZ Arthur Mead Environmental Award, which considered factors such as:

- Sustainability
- Environmental effects and values
- Environmental enhancement and innovation
- Mitigation of environmental risk
- Community views and consultation

ASSET UTILISATION AND FUTURE DEMAND

3.1	Asset capacity/performance	40
3.1.1	Asset utilisation	40
3.1.2	Fault level	40
3.1.3	Equipment ratings	40
3.2	Demand forecast	41
3.2.1	Load forecasting assumptions	41
3.2.2	Regional demand forecast	41
3.2.3	Total demand forecast	44
3.3	Demand management, changes in technology and non-network solutions	44
3.3.1	Generation	44
3.3.2	Smart metering	45
3.3.3	Power quality meters	45
3.3.4	Superconductors	45
3.3.5	System protection	45
3.3.6	Demand side management (DSM)	45
3.3.7	Automated direct load management (DLM)	46
3.3.8	Reactive demand and capacitors	46
3.3.9	Under-frequency load shedding	46

RETURN TO MAIN CONTENTS PAGE

3. ASSET UTILISATION AND FUTURE DEMAND

3.1 ASSET CAPACITY/PERFORMANCE

3.1.1 Asset utilisation

The overall performance of an electrical network can also be measured in terms of utilisation. The following table details some key utilisation related statistics for the network.

GENERAL SYSTEM STATISTICS (YEAR ENDING MARCH 2002)

Peak load (MW)	**1,424***
Energy entering the system (GWh)	**6,806**
Load factor/ratio	**55%**
Zone transformer capacity (ONAN MVA)	**2,576**
Zone transformer capacity utilisation	**55%**
Distribution transformer capacity (MVA)	**3,730**
Distribution transformer capacity utilisation	**38%**
Network losses (GWh)	**393**
Loss factor/ratio	**5%**
Consumers	**506,035**

* True system load (i.e. before embedded generation contributions are removed)

It should be noted that the above utilisation factors result from the use of a peak load figure which is diversified and they are thus conservative when applied to the utilisation of individual components.

Also, extensive work is being done on assessing capacities of underground cables. The revised cable ratings obtained as a result of newer information on soil condition, asset information, etc, will be used to update SCADA alarm settings, protection settings, and utilisation benchmarks.

3.1.2 Fault level

In a number of cases the 11kV fault levels at zone substations have reached their ratings (or marginally exceeded them). From an operational perspective if the 11kV fault levels exceed the equipment ratings for the solid 11kV bus configuration it is UnitedNetworks policy to operate the substation with a split 11kV busbar.

No major equipment fault rating issues are expected within the planning period.

3.1.3 Equipment ratings

It is UnitedNetworks general policy to use the SCADA system to provide equipment with overload protection (as opposed to protection relay equipment whose primary function is to quickly and safely clear system faults; i.e. fault protection).

Given the high number of underground cables owned it is generally UnitedNetworks policy to rely on manufacturers' cable ratings. However, UnitedNetworks expends significant effort investigating the ratings of underground cables. Detailed studies have been carried out on all critical 11kV and 33kV cable circuits. These studies have been carried out utilising a sophisticated computer software programme. UnitedNetworks overall objective is to identify those cables which are likely to be at risk of overload and to accurately calculate cable ratings. This involves investigating unknown thermal resistivities, soil temperature, or other factors that may cause low dissipation of the heat generated by cables.

3.2 DEMAND FORECAST

3.2.1 Load forecasting assumptions

Historical information shows that the demand for electricity is generally linked to the population, climate and economic activities in a given area. The key sources of information used by UnitedNetworks for demand growth projection are:

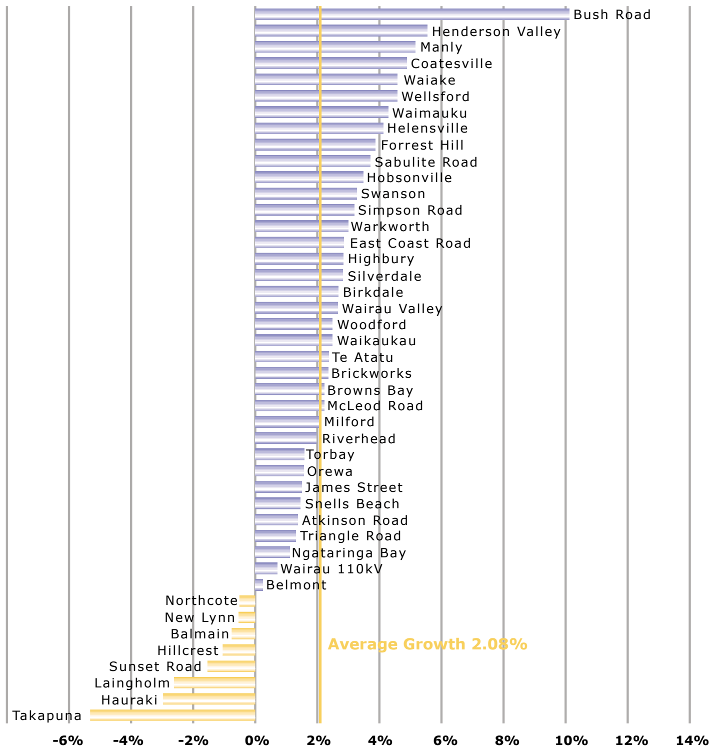
- Population and household projections obtained from Statistics New Zealand
- Economic factors and employment growth projections obtained from expert investigations and surveys
- Known commercial, residential and industrial developments

In the short-term electrical demand is particularly sensitive to climatic conditions and one cold snap, for example, can significantly increase the demand for electricity in any given year. Conversely, a warm winter could result in a lower demand. Hence on a year by year basis, the peak electrical demand can vary significantly. However, historical information shows that the growth in electrical demand growth exhibits a steady trend despite the year by year aberrations.

3.2.2 Regional demand forecast

Northern Region

NORTHERN REGION: HISTORICAL % RATE OF LOAD GROWTH AT ZONE SUBSTATIONS
1993 – 2001

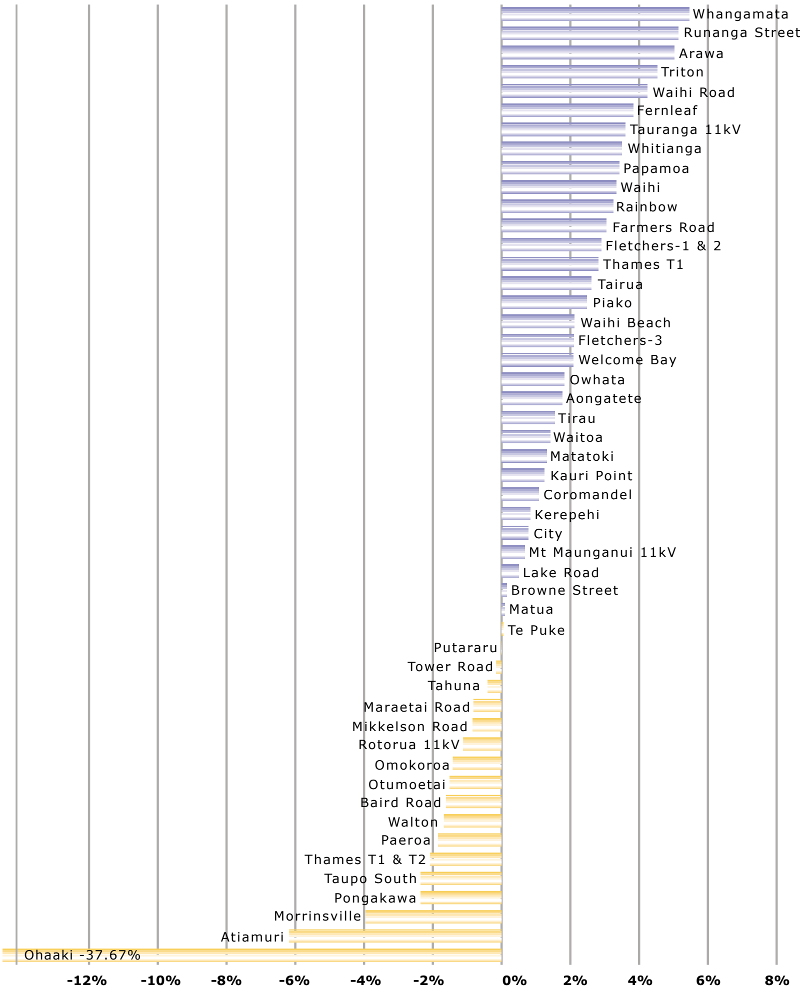


The Northern Region covers the North Shore City, Waitakere City, and Rodney District. It supplies residential (both rural and suburban), commercial and industrial developments. Most of the commercial and industrial developments centre around the Albany Basin, Takapuna, Glenfield, Henderson and Te Atatu areas. Apart from scattered small townships the areas north of the Whangaparaoa Peninsula and west of Henderson are predominantly rural residential. In total the Northern Region accommodates a population of about 400,000.

By New Zealand standards the load growth in the region is relatively high (at around 2% per annum). The highest load growth in this region is expected to occur around the Albany Basin with the development of industrial and retail businesses. With the opening of the new motorway from North Shore to Orewa (which is planned to be extended to Puhoi), it is expected that significant residential developments will take place in areas north of Silverdale. Electricity demand in established areas such as Northcote and Devonport is expected to remain relatively static.

Eastern Region

EASTERN REGION: HISTORICAL % RATE OF LOAD GROWTH AT ZONE SUBSTATIONS
1998 – 2001



The Eastern Region includes the area covered by the Thames-Coromandel, Hauraki, Matamata-Piako, South Waikato, Rotorua, Taupo, Tauranga and Western Bay of Plenty Districts.

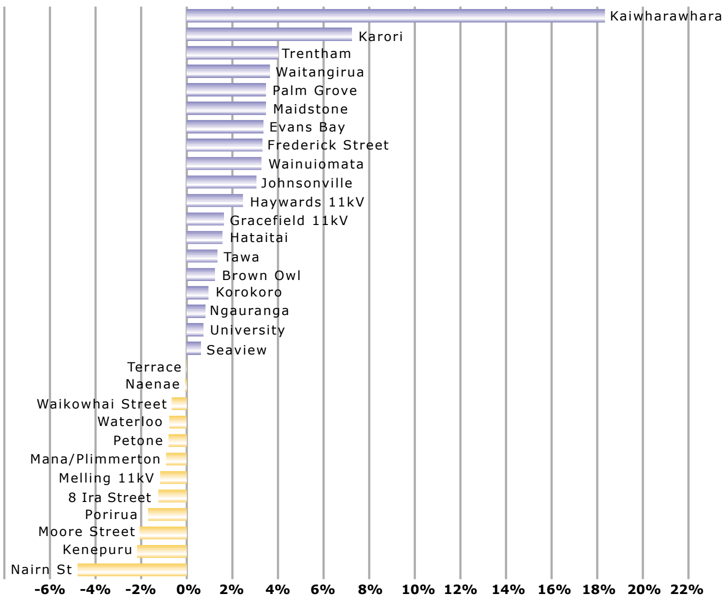
This region contains a mixture of rural and urban developments with a number of large industrial sites (foundries, dairy factories, mines, saw mills, etc) scattered around the Thames and Waikato areas. Resort developments centre around Rotorua, Taupo, and the coastal areas of Coromandel Peninsula. Tauranga accommodates one of the busiest ports in New Zealand.

By New Zealand standards the average projected load growth for the Thames Valley area is relatively low (about 0.3% per annum), while that for the remaining area is relatively high (3.2% per annum). Growth in the Tauranga area is expected from the business areas in the Tauranga CBD, the industrial areas near Judea, the Ports of Tauranga as well as the residential areas of Papamoa, Bethlehem and Mt Maunganui. Growth in many areas supplied by the Thames Valley network is tied to industrial growth that is dependent largely on the economy, which could fluctuate due to world market conditions in a short space of time. Moderate growth is expected from the areas around Rotorua and Taupo town centres. Reasonable residential development is also expected in areas around Lake Taupo.

Central Region

CENTRAL REGION: HISTORICAL % RATE OF LOAD GROWTH AT ZONE SUBSTATIONS

1998 – 2001



The Central Region includes the cities of Wellington, Porirua, Lower Hutt and Upper Hutt. The region is predominantly a service centre with about 87% of the population engaged in this sector of the economy (as compared to about 10% for the whole country). The total population in the region is about 350,000.

Wellington City is one of the major metropolitan centres in the country with high-density high rise commercial developments. It accommodates the seat of Parliament, head offices of many large businesses and government departments, local and regional governments, an international airport and is a retail and commercial centre. The Wellington CBD is by far the most significant business and retail centre in the region. There are also business and retail centres scattered around the region at Lower Hutt, Porirua, Upper Hutt, Seaview, Gracefield, Petone and Johnsonville. Small industries and warehouse developments centre along the Lower Hutt, Ngauranga George, Petone, and Naenae areas.

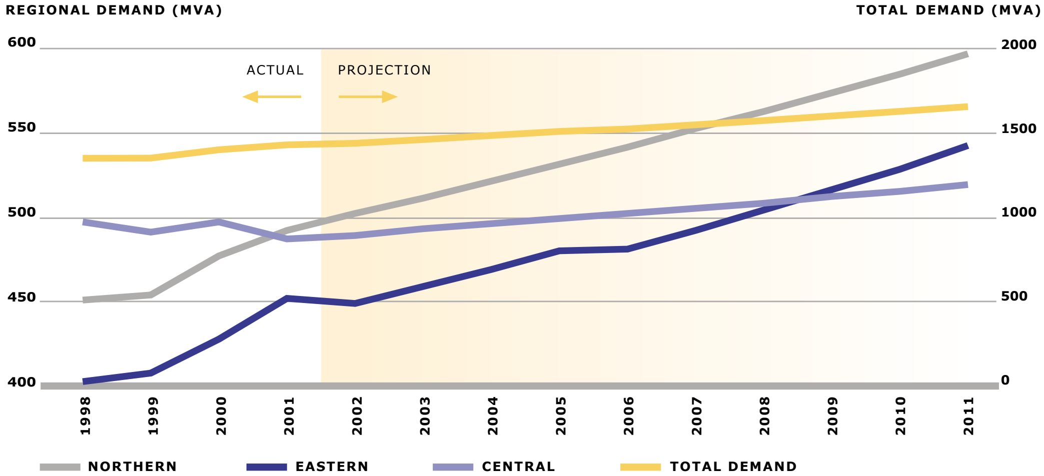
Individual customer loads are relatively small. No single industry has a recorded load larger than 3.5 MVA although a number of sites have aggregated demands marginally exceeding 4 MVA. There are less than forty companies that have a recorded maximum demand in excess of 1 MVA.

Overall the demand growth in the region is expected to be low (in the region of 0.8% per annum). Most of the growth is expected to take place around the Wellington CBD area.

3.2.3 Total demand forecast

The following diagram illustrates the historical and future expected regional and total network demand.

ELECTRICAL LOAD GROWTH



On average the total electrical demand over the ten year planning period is expected to increase at a rate of 1.6% per annum, with localised growth in demand in developing regions occurring at rates exceeding 10% per annum.

3.3 DEMAND MANAGEMENT, CHANGES IN TECHNOLOGY AND NON-NETWORK SOLUTIONS

The demand on the network can be significantly affected by both the consumers demand and the way in which the demand is supplied. Over the past decades, the introduction of home computers, the wide spread use of air conditioning in commercial buildings (particularly in commercial/industrial areas), changes in government policies and the structure of the economy, improvements in the living standards of the general population, etc, have led to some significant changes in the demand patterns. A notable impact is that the Wellington and Takapuna CBD peak demand has gradually changed from that of a winter peak to a summer peak. On the other hand, emerging technologies are making demand control and distributed generation more and more economic and accessible. Smart meters, for example, provide power companies with the ability to offer more demand-related tariff options, which could result in consumers changing their demand patterns. It is expected that these technologies are going to have a significant impact on the future development of the transmission and distribution networks.

3.3.1 Generation

In recent times a great deal has been written regarding the emergence of distributed generation as the future source of electricity supply. A number of likely sources of distributed generation have been identified. These vary from co-generation plant and micro turbines located within the distribution system to fuel cells installed in residential homes. Current indications are:

- **In the short-term**, the installation of small Combined Heat and Power plant (CHP) will increase. In the New Zealand context this hypothesis has already been demonstrated with the installation of landfill generators, wind turbines and co-generation plant over the past decade. Due to the economic size of these types of plant, this form of generation will initially impact on the transmission grid.
- **In the long-term**, the installation of small scale generation sources, as they become more

economic, is expected to occur widely within electrical distribution networks. This type of distributed generation has not yet become a reality in New Zealand and the timing of its emergence is not entirely clear. It relies heavily on the decreasing costs associated with emerging generation technologies (i.e. fuel cells, micro-turbines and photovoltaic cells).

Given the uncertainty regarding the emergence of major levels of distributed generation, coupled with the uncertainty of the likely location of the plant, allowance has only been made for identified generation projects in this plan.

3.3.2 Smart metering

The introduction of multiple channel interval recorders has enabled the introduction of pricing incentives that encourages consumers to shift their demands during times of system peaks to other times. Intelligent meters exist that enable electrical utilities to initiate demand management signals through communication media such as ripple injection, power line carriers, etc, to manage the demand of the network. Other smart metering technologies also allow demand to be shed to respond to under-frequency or low voltage signals as a means of maintaining system stability and reducing generation reserves. While it is UnitedNetworks intention to continue to encourage the installation of intelligent metering for managing electrical demand the ownership of all meters within UnitedNetworks supply areas lies with electrical retailers.

Generally the use of smart metering is economic for larger consumers but has yet to become economic for residential or small business consumers.

3.3.3 Power quality meters

The installation of power quality meters and system event loggers enables network managers to track the quality of the delivered power at the various points in the network and analyse any system disturbances so that the performance of the network can be monitored and benchmarked.

UnitedNetworks is committed to evaluating new methods of monitoring the quality of the power delivered by its network assets.

3.3.4 Superconductors

Superconductors have the potential to provide an efficient means of delivering electricity, and also an effective means of improving power quality. However widespread economic application of superconductors in the power industry is still some years away.

3.3.5 System protection

Low-cost, high performing, multi-function digital relays are now a viable and proven option for distribution network protection. Most schemes can be interfaced to a fibre-optic signalling channel, allowing fast and secure unit protection across a feeder or transformer, without the need for high-voltage isolation. Protection algorithms are constantly being developed and improved, the objective being to offer the best protection performance for a given application. Fault data and event records are retrievable from digital relays, providing a better understanding of events and faults on the network. Relays are equipped with on-board standard communications protocols for interface to SCADA master stations. Relay communications and peer-to-peer protection signalling across a LAN/WAN is now possible and the idea of plugging a protection relay into a network (as you would a computer) is already reality. UnitedNetworks policy is to install modern smart protection systems, with a view to gradually upgrading protection systems and the associated communication networks.

3.3.6 Demand side management (DSM)

A demand side management trial that included step pricing, peak/off-peak pricing and energy efficiency was undertaken in UnitedNetworks Northern Region. The results of this investigation indicated that installation of smart metering technology is key to the success of any demand side management programme (facilitating the delivery of real-time pricing signals to customers/consumers). The widespread installation of smart metering technology is not envisaged during the planning period.

3.3.7 Automated Direct Load Management (DLM)

Automated Direct Load Management (DLM) systems are used by UnitedNetworks to manage domestic, commercial and industrial demand such as cold storage, water and space heating. Pilot wires and ripple (both rotary and static) injection plants are used to manage the peak demand on the networks. The DLM systems are used extensively to maintain acceptable network operating conditions (alleviate network restrictions), defer network capital investments and reduce transmission charges.

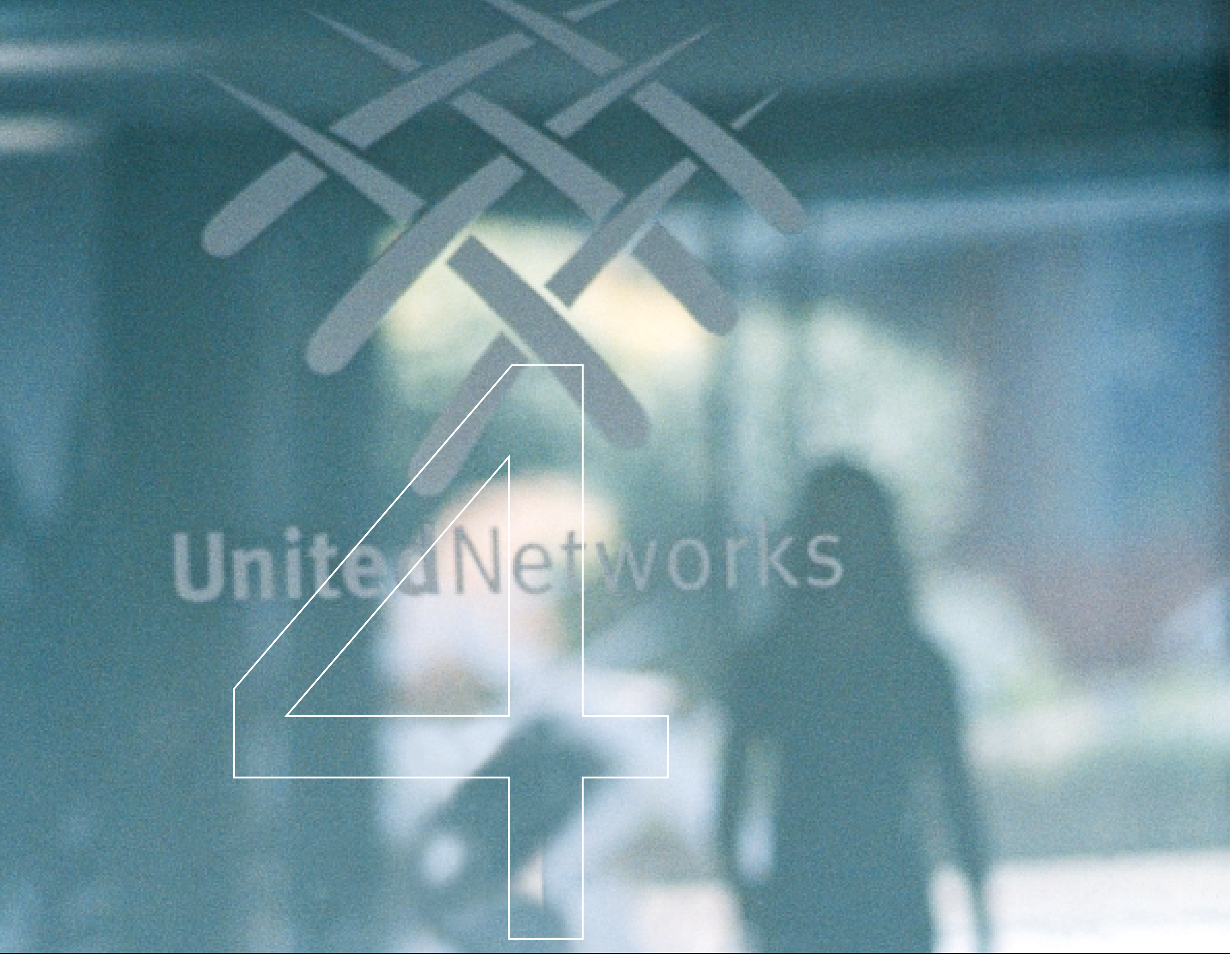
3.3.8 Reactive demand and capacitors

During 1998/99 UnitedNetworks installed a significant number of capacitors within its Northern and Eastern Regions for the purpose of providing voltage support to the distribution and transmission networks. It is estimated that the installation resulted in a reduction of network loading (MVA) of 2%.

UnitedNetworks continually reviews network power factors and voltage levels, and where economic installs network capacitors.

3.3.9 Under-frequency load shedding

Under-frequency relays are installed at various points in the network to disconnect feeders in the event of any major loss of generation that may lead to severe frequency reduction and/or voltage collapse. This is an industry wide initiative which is managed by the national grid operator Transpower.



MAINTENANCE

4.1	Strategy	48
4.2	Maintenance management	48
4.3	Maintenance by asset class	49
4.3.1	Overhead lines	49
	Subtransmission overhead lines	49
	Distribution overhead lines	50
4.3.2	Underground cables	50
	Subtransmission underground cables	50
	Distribution underground cables	51
4.3.3	Overhead structures	52
4.3.4	Zone substation equipment	53
	Power transformers and tapchangers	53
4.3.5	Protection	55
4.3.6	Circuit breakers	55
4.3.7	Distribution transformers	57
4.3.8	Distribution switchgear	57
4.3.9	Capacitors	58
4.3.10	Earth installations	59
4.3.11	Miscellaneous distribution equipment	59
4.3.12	Vegetation	60
4.3.13	Load control plant	60
4.3.14	SCADA and communications	60

RETURN TO MAIN CONTENTS PAGE

4. MAINTENANCE

4.1 STRATEGY

Electricity networks contain many asset types, often in large numbers, that need to keep performing their design function under all operating and weather conditions with the least possible interruptions. To achieve this a number of maintenance techniques can be used, and include:

- Reactive maintenance or repair on breakdown
- Time based preventative maintenance
- Predictive or condition based maintenance
- Proactive and reliability based maintenance

UnitedNetworks approach to maintenance is not the same for each asset class and includes a mixture of the above practices. In general, UnitedNetworks maintenance policy has involved building on historical practices and standards, and developing condition assessment programmes that support asset performance analysis. The adoption of this approach allows informed decisions to be made on asset maintenance and reliability enhancements.

In order to manage its electrical assets UnitedNetworks has adopted a common asset hierarchy across all regions. Asset related information is stored in an 'asset register' in the following asset classes:

Class	Sub-classes
Overhead lines	Subtransmission, distribution
Underground cables	Subtransmission, distribution
Overhead structures	Poles, towers
Zone substation equipment	Power transformers and tapchangers, busbars/structures, instrument transformers, grounds and buildings, DC systems
Protection	
Circuit breakers	Grid exit point/subtransmission/distribution
Distribution transformers	
Distribution switchgear	
Capacitors	
Earth installations	Subtransmission/distribution
Vegetation	
Misc distribution equipment	Distribution accommodation, miscellaneous
Load control plant	Ripple, pilot wire, cyclo and DC bias
SCADA & communications	

UnitedNetworks seeks to improve reliability and life-cycle profitability through investigating whether existing maintenance regimes can be replaced by condition and reliability based maintenance activities. Opportunities lie in the analysis of each regime and tuning maintenance activities to take into account differences in environmental factors and operating context. For example, fixed interval inspections for particular asset types may ignore the fact that some items might be elderly, have high utilisation factors and be subject to a hostile environment while some may be young, have low utilisation and operate in a benign environment.

4.2 MAINTENANCE MANAGEMENT

Maintenance management requires a number of tools and plans to be in place, including:

- Works management and maintenance management systems. UnitedNetworks currently uses manual systems for raising, controlling and reporting on maintenance work. Work has begun on the development of a computerised maintenance management system
- Maintenance strategies. UnitedNetworks has produced maintenance strategies and policies to cover the majority of its assets

- Specific long term maintenance and replacement plans. UnitedNetworks has developed maintenance and replacement plans and budgets that cover individual assets for the planning period
- External review. An external review forms part of the production of maintenance and replacement strategies
- Performance tracking. Supply and cost performance systems are in place and continue to be enhanced

4.3 MAINTENANCE BY ASSET CLASS

4.3.1 Overhead lines

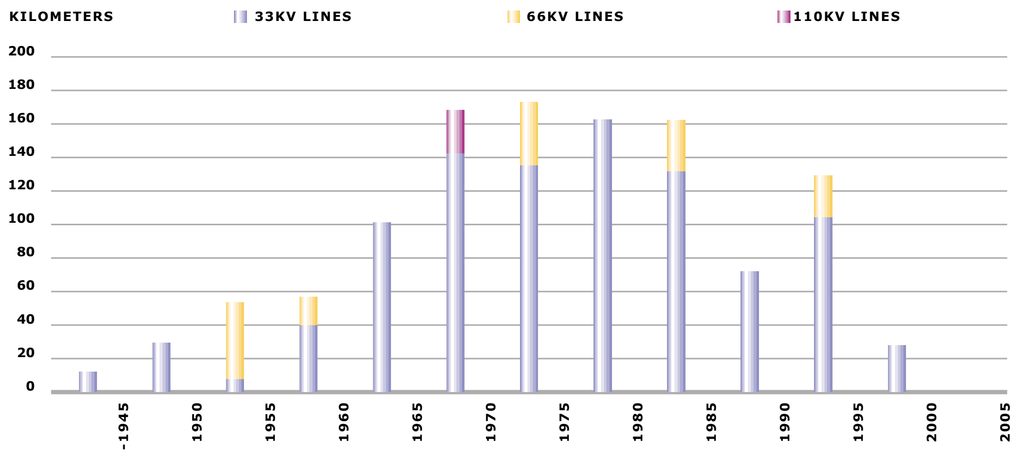
Subtransmission overhead lines

Subtransmission lines convey power from the Transpower owned grid exit points (GXP) to UnitedNetworks zone substations. Voltage levels are 110kV, 66kV and 33kV. The lines consist of conductors supported on overhead poles or tower structures. The physical electrical conductors are made of copper or aluminium and are all bare.

Physical description

UnitedNetworks overhead subtransmission lines consist of 27 circuit-km of 110kV lines, 156 circuit-km of 66kV lines and 1027 circuit-km of 33kV lines. Generally the Northern Region has all-aluminium conductor lines (AAC), the Eastern Region has steel reinforced aluminium conductor lines (ACSR) and the Central Region has ACSR with a small amount of copper.

SUMMARY STATISTICS



Issues

Over the planning period individual component failures are expected on crossarms, insulators or binders. However no widespread failure or safety issues have been identified.

Preventive and predictive maintenance is based on asset condition surveys. Although there are time based inspection surveys, the asset maintenance undertaken is based on the condition of the assets as revealed by the surveys. Maintenance work is then initiated using a combination of condition assessment results, network security of supply standards and asset criticality.

Replacement strategy

Replacement decisions include consideration of condition, age, function, location, criticality, fault levels, performance and cost history.

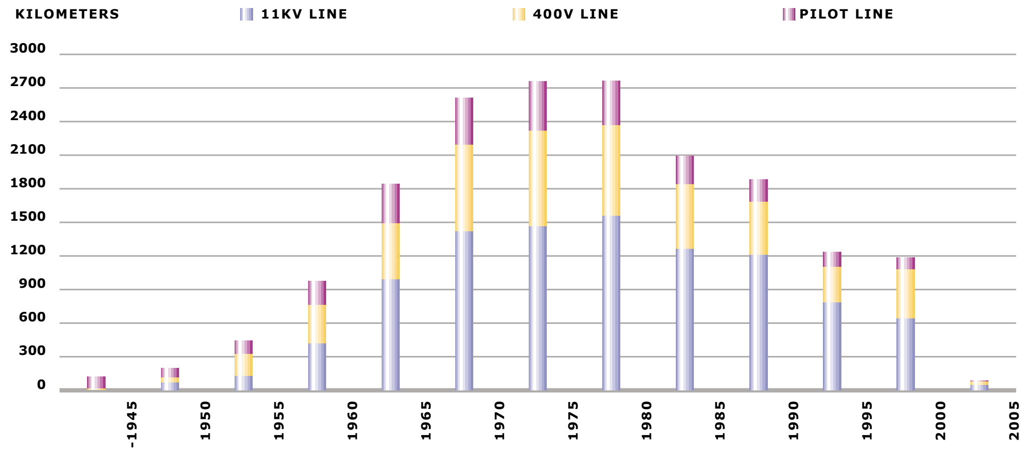
Distribution overhead lines

Distribution lines convey power between the subtransmission system and the consumer's point of supply. Voltage levels are 11kV and 400V, with connections to consumers points of supply occurring at one or both these voltages. The lines consist of conductors supported on overhead poles. The physical electrical conductors are made of copper or aluminium and are both bare and covered.

Physical description

UnitedNetworks overhead distribution lines consist of 9,983 circuit-km of 11kV lines, 5,389 circuit-km of 400V lines and 2,839 circuit-km of 400V road lighting and hot water load lines. They are a mix of bare and PVC covered stranded all-aluminium conductors (AAC), bare steel reinforced aluminium conductors (ACSR), bare and PVC covered stranded copper conductor and bare all-aluminium alloy conductor (AAAC).

SUMMARY STATISTICS



Issues

Steel core corrosion in ACSR conductors has a propensity to occur in lines near the coast and near geothermally active areas. There are copper lines where the combination of age and load cycling has age hardened the copper.

Preventive and predictive maintenance is based on asset condition surveys. Although there are time based inspection surveys, the asset maintenance undertaken is based on the asset condition revealed by the survey. Maintenance work is then initiated by a combination of condition assessment results, network security of supply standards and asset criticality.

Replacement strategy

Replacement decisions include consideration of condition, age, function, location, criticality, fault levels, performance and cost history.

4.3.2 Underground cables

Subtransmission underground cables

Subtransmission cables convey power from the Transpower owned grid exit points (GXP) to UnitedNetworks zone substations. The operating voltage levels are 33kV.

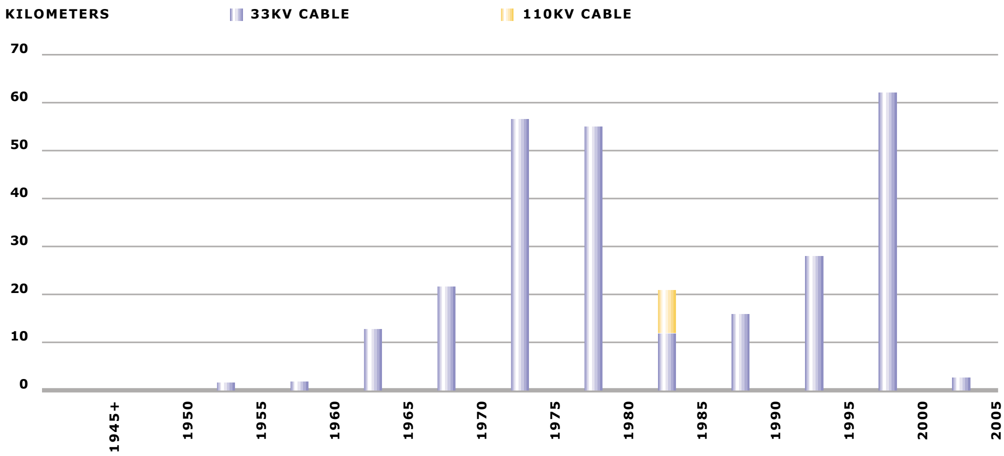
The cables are buried underground and are either of single or three core construction using a variety of different insulation types. The electrical conductors are either copper or aluminium.

In some cases submarine cables are used, which have additional layers of mechanical protection and waterproofing.

Physical description

UnitedNetworks underground subtransmission cables consist of 280 circuit-km of 33kV cables. There are two 110kV cables in the Central Region which are operated at 33kV (total length of 9km). The Northern and Eastern Regions are predominantly XLPE insulated aluminium conductor cabling, with the Central Region cabling being a mix of gas or oil-filled paper insulated cabling.

SUMMARY STATISTICS



Issues

The 1998 Auckland CBD cable failures highlighted the need to continually monitor the operating status and condition of subtransmission cables, particularly oil or gas filled ones. It is UnitedNetworks policy to monitor the capacities of all highly loaded, high risk cables. In addition UnitedNetworks continues to survey cables located in geothermal areas that are subject to high ambient ground temperatures. No areas of major concern have been identified although thermal cycling has caused mechanical joint failure in a cable supplying the Moore Street substation and other cables in the same position have been examined.

UnitedNetworks continues to expend effort mitigating the damage caused by third party excavators (most commonly thrust borers).

Replacement strategy

Partial discharge mapping and time domain reflectometry have been used by UnitedNetworks to assess whether critical cables should be replaced. Replacement decisions include consideration of condition, age, function, location, criticality, fault levels, performance and cost history.

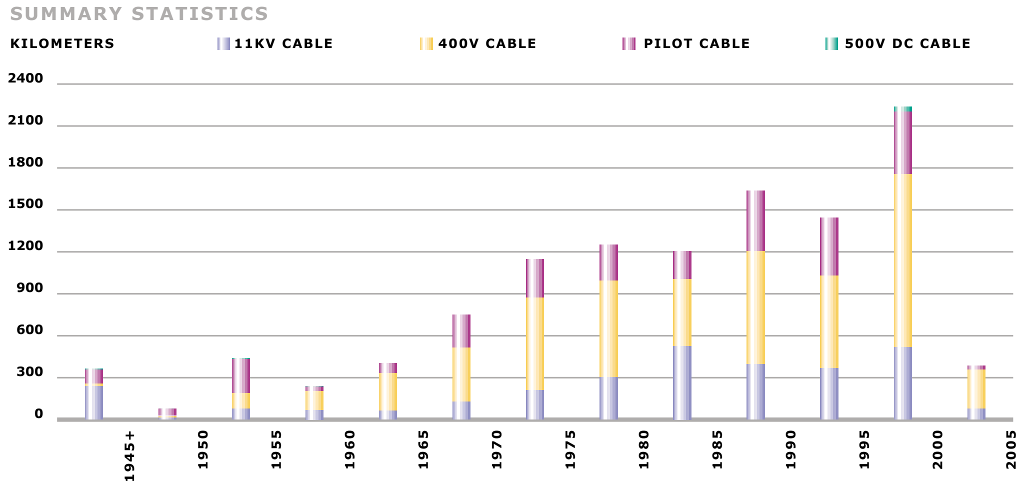
Distribution underground cables

The distribution system conveys power between the subtransmission system and the customer point of supply. Voltage levels are 11kV and 400V, with connections to consumers points of supply at one or both of these voltages.

The cables are buried underground and are a mixture of single or three core construction using a variety of different insulation types. The electrical conductors are either copper or aluminium. The bulk of the older 11kV cables are insulated with oil-impregnated paper, inside a lead sheath. Younger 11kV cables are generally insulated with solid cross-linked polyethylene (XLPE) plastic, inside a polyvinylchloride (PVC) sheath. At the 400V level, the cables are insulated with PVC in a PVC sheath or are PILC cables.

Physical description

UnitedNetworks underground distribution cables consist of 2,991 circuit-km of 11kV cables, 5,758 circuit-km of 400V cables and 2,881 circuit-km of 400V road lighting and hot water load control cables.



Issues

UnitedNetworks continues to expend effort mitigating the damage caused by third party excavators (most commonly thrust borers).

Replacement strategies

Replacement decisions include the consideration of condition, age, function, location, criticality, fault levels, performance and cost history.

4.3.3 Overhead structures

Where the distribution network is made up of overhead conductors there is a requirement to support them at a specified height above the ground and at a specified separation from each other. This is done using a structure comprising a pole and pole top elements such as crossarms, insulators and braces. Poles can be made of various types of wood (hardwood, softwood) or concrete (reinforced or pre-stressed). Crossarms are made from wood, steel or composite materials. UnitedNetworks also owns 120 lattice towers made of steel.

Physical description

UnitedNetworks owns 59,066, 87,852 and 40,927 pole structures located within the respective Northern, Eastern and Central Regions. The majority of pole structures are made of reinforced/pre-stressed concrete (roughly 90%, 73% and 46% in the respective Regions), with the remaining structures largely being made from wood.

SUMMARY STATISTICS

Issues

Kidney insulators are prone to failure and need to be replaced. Porcelain insulators are prone to puncture failure that leaves the insulator otherwise undamaged and able to temporarily recover its insulating properties in dry weather. Laminated cross arms are prone to failure and need to be replaced.

In the Northern Region the wooden poles on the 110kV double circuits between the Transpower Albany substation and UnitedNetworks Wairau Valley substation are marginally beyond mid-life and will require more frequent climbing inspections in the future.

The Central Region has pole-sharing arrangements with TelstraClear, Citylink and First Media for fibre-optic and co-axial cables. There are problems associated with over-tensioning of support wires, and the presence of the communication cables makes for frequent double handling and hence extra cost in doing pole work.

Preventive/predictive maintenance is based on time based asset condition surveys. The asset maintenance undertaken is based on the information revealed by the surveys. Maintenance work is then initiated using a combination of condition assessment results, network security of supply standards and asset criticality.

Replacement strategy

Replacement decisions include consideration of condition, age, function, location, criticality, fault levels, performance and cost history. Towers will be replaced with concrete poles where possible, on a condition assessment basis.

4.3.4 Zone substation equipment

Power transformers and tapchangers

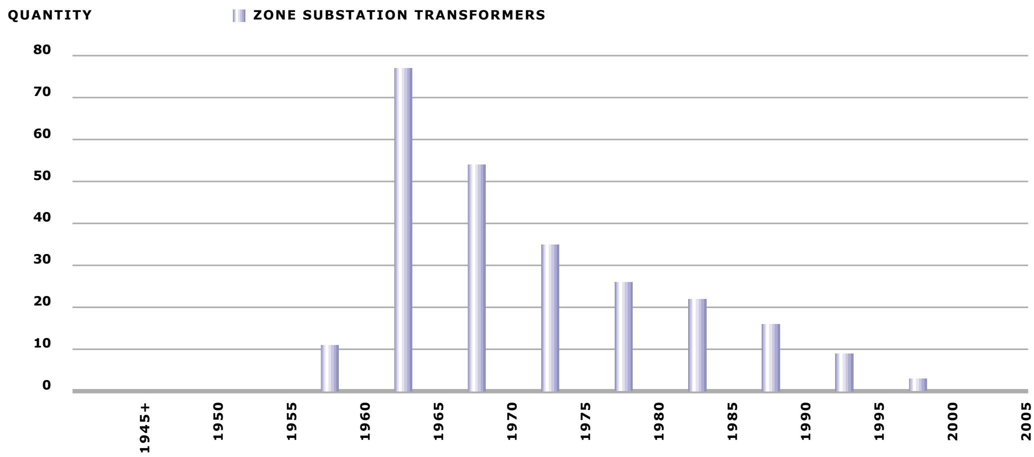
Power transformers are used to transfer significant amounts of electrical power from subtransmission voltage levels to distribution voltage levels (11kV). They usually have an associated tap change mechanism that enables the distribution voltage to be regulated. All power transformers currently in service have their windings insulated with paper insulation which is immersed in a tank of mineral insulating oil. Tap changer mechanisms are insulated in a separate tank of mineral insulating oil. Heat generated by power transformers is removed by circulating the oil from the tanks through radiators that are cooled by ambient air.

Physical description

There are 197 power transformers currently installed and being maintained by UnitedNetworks. They are all designed for outdoor use, but many have been enclosed in some manner for weather protection or noise abatement.

The Northern Region has 68 zone substation power transformers. The majority of the transformers are 33/11kV with a Dy1 (+30°) or Dy11 (-30°) vector group. The Eastern Region has 75 power transformers. The majority of transformers being either 33/11kV or 66/11kV with a Dy11, Dy9 and Yy0 vector group. The Central Region has 54 power transformers. They are all 33/11kV with a Yy0 (0°) vector group.

SUMMARY STATISTICS



Issues

In general UnitedNetworks transformers are located in areas of high rainfall and humidity and there is a propensity for zone transformers to accumulate excessive moisture in the windings. The only effective solution is off-line refurbishment. In some coastal locations a high level of corrosion has also been observed and some transformers have been enclosed.

Power transformer maintenance is being transitioned from a schedule based on time and operation to a schedule driven by a combination of condition analysis, operating cycle and elapsed time. This will allow maintenance intervals to be more flexible with a view to co-ordinating opportunity maintenance and minimising the number of zone substation site visits, without compromising the condition of the power transformers.

As a standard procedure to restore performance levels, transformers are scheduled for mid-life refurbishment after approximately 30 years. This involves removal to a workshop where the windings are dried, cores are checked and the oil replaced.

Replacement strategy

Transformer replacement is made on a case by case basis, using the transformer condition as the criteria rather than the expected transformer life. Factors that are considered include condition, performance levels, criticality, age, spares, design and marginal maintenance costs. No zone transformer retirement is currently scheduled within the planning period.

4.3.5 Protection

Damage or danger can be a consequence of electrical overload, electrical fault or external intervention (human or natural). Protection equipment is used to monitor the electrical power flowing through the network and to disconnect parts of the network with adequate speed and sensitivity to prevent significant damage to the network, or danger to personnel. UnitedNetworks owns electromechanical, static-electronic and digital-numerical protection relays.

Physical description

UnitedNetworks owns and maintains 4,784 protection relay units and 674 auxiliary relay units.

Issues

The majority of the electromechanical relays are reaching the end of their lives. The static relays are relatively new, and perform well.

A protection review of the Eastern Region undertaken during 2000 concluded that the relays in service were well maintained and in good working order. The review highlighted several areas where the protection scheme required upgrade.

Preventive/predictive maintenance for electromechanical protection equipment is on a time-based schedule. There is no preventative/predictive maintenance for static protection equipment.

Replacement strategy

Factors that are considered include condition, performance levels, criticality, age, spares, design and marginal maintenance costs. New installations will take advantage of the enhanced features of modern protection relays and cater for fibre optic communication.

4.3.6 Circuit breakers

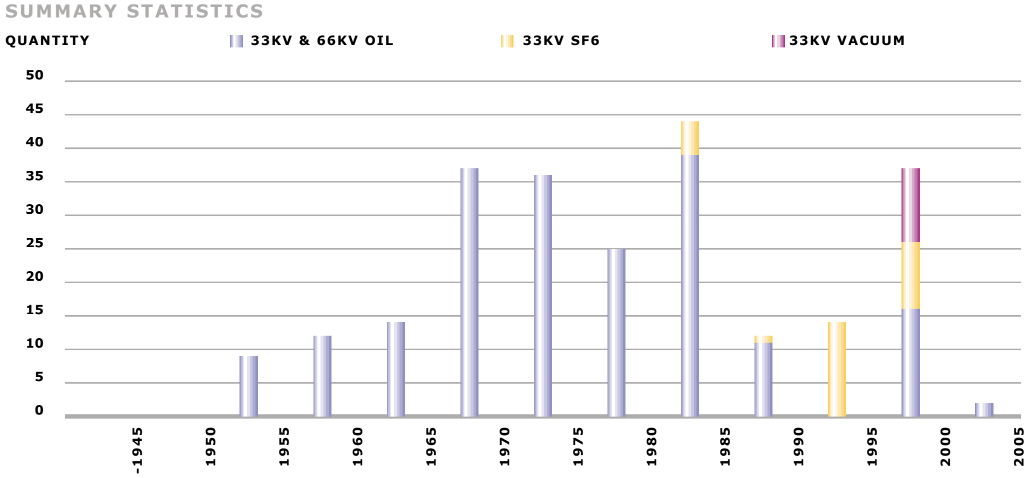
Circuit breakers are used to interrupt current flowing in electrical power circuits. They do this safely and repeatedly under both normal load and fault conditions. Older circuit breakers use oil as an insulating/interruption medium. Modern circuit breakers use sulphur hexafluoride (SF_6) or vacuum. Regardless of the insulating/interruption medium circuit breaker contacts deteriorate whenever fault and rated load current is interrupted. Oil circuit breakers have the most rapid contact deterioration rate.

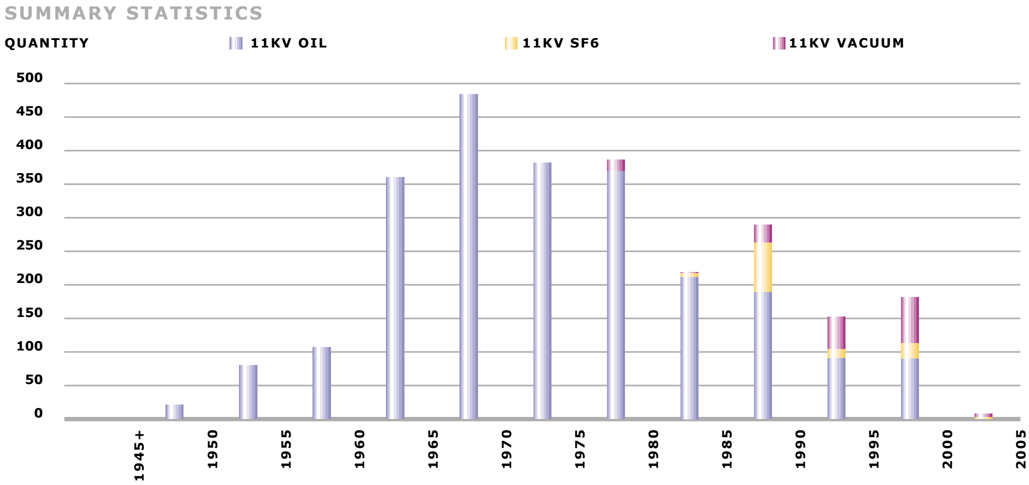
Physical description

UnitedNetworks owns 72 circuit breakers located at Transpower owned points of supply. All these breakers are housed within Transpower's fenced boundaries with the exception of the 11kV breakers at Kaiwharawhara which are housed in an adjacent UnitedNetworks owned building. Generally the 33kV breakers are mounted outdoors, with the associated protection equipment housed inside Transpower's buildings at each site. In contrast the 11kV breakers are complete indoor metal-clad switchboards.

UnitedNetworks owns 244 circuit breakers within its subtransmission network (66kV and 33kV), between grid exit points and distribution feeders.

UnitedNetworks owns 2,676 distribution circuit breakers in zone substations and on overhead lines (including 11kV incomers/bus couplers, feeder breakers and reclosers).





Issues

Circuit breakers have been well maintained and as such have experienced little failure. They continue to deliver a very high level of service reliability and availability. The following locations contain circuit breakers that are owned by UnitedNetworks and which have been identified as being close to the end of their lives:

- 33kV breakers at Wellsford, Atkinson Road, Warkworth, Taupo South and Maraetai Road substations
- 11kV breakers at Atkinson Road, Hauraki, Triangle Road, Browns Bay, Te Atatu and Evans Bay substations.

These circuit breakers continue to provide the required level of service, but are subject to a more intensive maintenance programme.

Circuit breaker maintenance is being transitioned from a time and operation based schedule to a schedule driven by a combination of condition analysis, operating cycle and elapsed time. This has allowed intervals to be changed with a view to co-ordinating opportunity maintenance and minimising the number of zone substation site visits, without compromising the condition of the circuit breakers.

Replacement strategy

Replacement decisions include consideration of circuit breaker condition, age, function, location, criticality, fault levels, performance and cost history.

It is UnitedNetworks general policy not to purchase oil insulating circuit breakers.

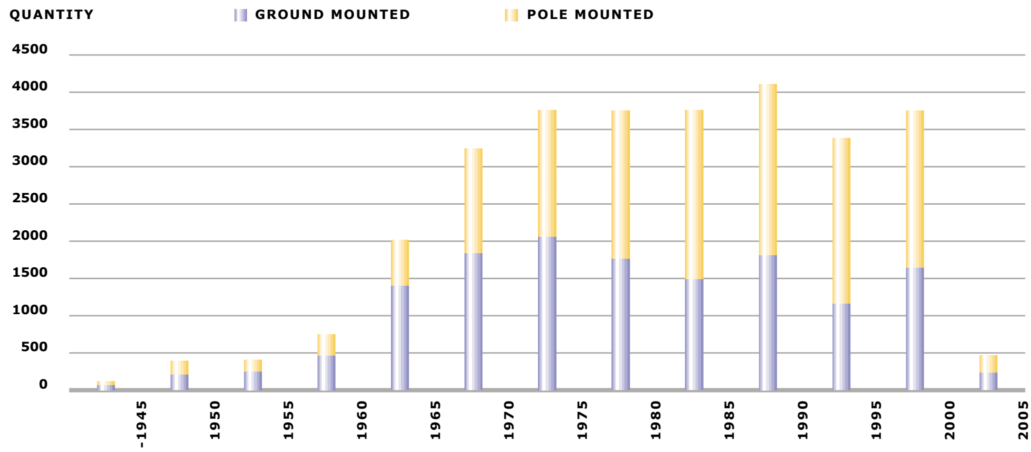
4.3.7 Distribution transformers

Distribution transformers are used to transfer relatively small amounts of electrical power from distribution voltage levels (11kV) to the end user (400V). All UnitedNetworks distribution transformers have paper insulated windings immersed in a tank of mineral insulating oil.

Physical description

UnitedNetworks currently owns approximately 30,000 distribution transformers. Approximately 46% of them are ground mounted and the remaining pole mounted. The ground mounted transformers are large and range from roughly 50kVA to 2MVA. The pole mounted are generally smaller than 100kVA. In comparison to the other two regions the Central Region has a relatively small number of high capacity transformers.

SUMMARY STATISTICS



Issues

Distribution transformers are relatively simple and robust. They deliver a very high level of service reliability and availability.

Pole mounted transformers need more frequent inspections because of seismic risks. Some distribution transformers close to the coast are experiencing corrosion.

Condition surveys include the use of thermal imaging.

Replacement strategy

Where economic it is UnitedNetworks policy to refurbish distribution transformers.

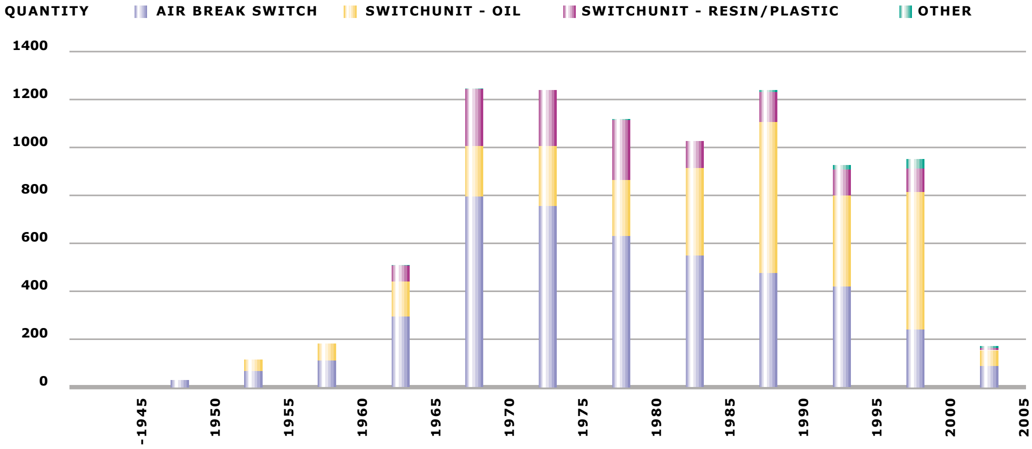
4.3.8 Distribution switchgear

Distribution switchgear includes switches that make and break electrical circuits that are carrying their rated electrical load or less. This switchgear is not intended to interrupt circuits under fault conditions. The switches may be operated manually or using a motorised mechanism, and may be air, resin, oil, SF_6 or vacuum insulated.

Physical description

UnitedNetworks currently owns approximately 8,800 distribution switchgear. Of these roughly 8% operate at 33kV, 1% at 66kV and the remaining 91% at 11kV. Roughly 38% are air insulated 11kV air break switches and the remaining are 11kV resin, oil, SF_6 or vacuum insulated switches.

SUMMARY STATISTICS



Issues

There have been a number of failures of type SD oil filled ring main switchgear units. A key finding during investigations has been that the switchgear needs to be kept on a level base during its service life to prevent this problem occurring. In addition Magnefix units have suffered badly from humidity, with a tendency for the links to corrode and lock in place, with the result that tracking occurs over the insulating surfaces.

Replacement strategy

Replacement decisions include the consideration of switchgear condition, age, function, location, criticality, fault levels, performance and cost history. On average the oldest switchgear is located downstream of the Tauranga City, Thames and Moore Street substations.

4.3.9 Capacitors

Capacitors are generally used on electrical networks to improve power factors and elevate network voltages. Improved network power factors enable higher levels of useful power to be transferred across the electrical network. Capacitors consist of sealed tank units with internal metal plates surrounded by an insulating gel. The capacitor tanks are static, with no moving parts and are generally shunt connected to the electrical network.

Physical description

UnitedNetworks owns 123 power factor correction capacitor banks. Two are 33kV, 18MVAr, ungrounded-wye-connected, ground mounted capacitor banks located at the Wairau Valley substation. The remaining are 11kV, 750KVAr, ungrounded-wye-connected, pole mounted capacitor banks, and are installed in the Northern and Eastern Regions. Roughly 50% of the 11kV capacitor banks are switched with the remaining being fixed.

Issues

All capacitors are relatively new and are reliable. Capacitor banks located in areas where the electrical network carries control signals (i.e. power line carrier) can affect the signal levels.

Replacement strategy

Replacement decisions include consideration of condition, age, function, location, criticality, fault levels, performance and cost history. It is anticipated that the capacitor switches will require replacement prior to replacement of the actual tanks themselves.

4.3.10 Earth installations

Earthing systems are required to limit network over-voltages, ensure the operation of protection, carry earth fault current safely and generally minimise the risk of electrical shock.

Earth systems consist of buried electrical conductors in a variety of shapes and sizes, chosen to best suit the local conditions and requirements. Copper is the preferred conductor, chosen for its electrical conductivity and resistance to corrosion in the ground.

Subtransmission earth installations

Earth installations for subtransmission purposes are generally earth banks at zone substation sites or equipment sites on subtransmission circuit routes. The banks consist of copper conductor, usually bare multi-strand cable, buried and electrically bonded at all conductor intersections. Vertically driven copper-clad or galvanised steel rods are often installed to reduce the overall earth resistivity, and are bonded to the conductor grid.

Physical description

There are 129 subtransmission earth bank installations located at UnitedNetworks substations.

Issues

UnitedNetworks has an ongoing programme to ensure that subtransmission earth installations meet the New Zealand electrical codes of practice. The programme employs a combination of physical inspections and detailed theoretical analysis utilising the latest analytical software.

Distribution earth installations

Earth installations that are required for distribution purposes are generally made up of earth banks located at various equipment sites. The banks are made from copper-clad or galvanised steel rods driven vertically and bonded to copper conductor (usually bare multi-strand cable). The rods and cable are buried in trenches radiating out from the equipment site. At small sites, in its simplest form, the earth installation is a single driven rod connected to the equipment with a flexible copper tail.

Issues

The 1997 electricity regulations changed the way in which earth installations were required to be tested. A system of measuring the overall impedance to earth was replaced with a requirement to comply with specified touch and step voltage potentials at each site.

The pumice soil in the Taupo region means that it is particularly difficult to establish good earths.

4.3.11 Miscellaneous distribution equipment

Ground mounted housing for electrical distribution equipment consists of metal cabinets, block enclosures or simple fencing.

Distribution fuse units and links at 11kV are used to connect and protect sections of the network.

There is a small amount of DC equipment in the Central Region associated with the power supplied to the Wellington city trolley buses.

Physical description

The largest number of enclosures is in Central Region, with 990 kiosk and customer distribution substations and 770 berm substations.

There are 696 link units and 15,106 fuse units.

Issues

Access to enclosures, particularly service pillars, is often compromised. Cast iron pothead cable terminations have a relatively high failure rate. The DC trolley bus supply equipment was built in 1949 and is close to the end of its life.

Replacement strategy

Replacement is based on equipment condition assessment surveys.

4.3.12 Vegetation

Vegetation is not an asset owned by UnitedNetworks, but due to the effect that it has on network performance UnitedNetworks manages vegetation using its asset hierarchy maintenance system.

Physical description

There are some 630,000 trees that threaten UnitedNetworks lines and require management. Roughly 55%, 28% and 17% are located within the respective Eastern, Northern and Central Regions.

On average UnitedNetworks assets have 46.71 trees per pole kilometre.

Issues

UnitedNetworks current vegetation trimming programme is based on 'hot-spot' trimming. Although current performance statistics (SAIDI, SAIFI) are within expectation there is a probability that vegetation growth into clearance zones has occurred in recent times, and that vegetation related problems will increase within the first twelve months of this plan. UnitedNetworks uses approved herbicides to manage re-growth and field surveys to manage vegetation near lines.

Pending Government legislation regarding tree management has the potential to affect the cost of vegetation management. This will continue to be monitored.

4.3.13 Load control plant

UnitedNetworks load control systems use either signal injection methods (i.e. power line carrier) or pilot wires. A mixture of static, rotating or DC injection plant is used to inject control signals.

Numerous load control plant are close to the end of their lives and will require replacement. In the majority the static plant owned by UnitedNetworks is in reasonable condition. There are 1,838 km of overhead pilot wire and 2,346 km of underground cable pilot in the Northern Region.

4.3.14 SCADA and communications

System control and data acquisition (SCADA) equipment is used to control and monitor the electrical network from a remote central control room. Communication equipment is used to transfer data between a master station and remote terminal units (RTU), and to act as a voice communication link for staff operating the network.

Physical description

All regions operate a radio communication network providing both voice and data transmission.

The majority of RTUs at zone substations are Leeds & Northrup C225 RTUs. All 43 zone substation radios currently in use are Motorola GP300 or TAIT 2000 radios. There are radio repeater sites in all regions. A leased cell phone network provides voice communication from all Taupo, Rotorua and Tauranga zone substations, switching stations and load control buildings.

The Northern Region employs an extensive cable voice and data network. The cables are multi-core aerial cables connecting each zone substation with the national control centre at Takapuna. The network primarily supports SCADA data transmission, telephone communication, differential protection tripping and instantaneous load control.

Issues

In the Northern Region there is no spare capacity or redundancy on the communication cable between the master station and Albany Hill. During the planning period additional capacity, possibly in the form of a microwave link, needs to be considered. The manufacturer support for a large number of RTUs is unlikely to continue for the planning period and the RTUs will likely have to be replaced. The age of the SCADA cables and the cumulative effects of accidental damage has led to increased difficulty in maintaining them.

DEVELOPMENT

5.1	Planning criteria	63
5.1.1	Deterministic methods	63
5.1.2	Probabilistic methods	63
5.1.3	Network security of supply standard	64
5.1.4	Probabilistic network security model	64
5.1.5	Planning process	65
5.1.6	Subtransmission planning	65
5.1.7	Distribution planning	65
5.2	Network investment model	66
5.3	Power flow models	67
5.4	Major developments	67
5.4.1	Northern Region	67
5.4.2	Eastern Region	73
5.4.3	Central Region	80

RETURN TO MAIN CONTENTS PAGE

5. DEVELOPMENT

Optimisation of investment in network development must take into account the full life-cycle costs of the assets concerned, not only the initial cost. UnitedNetworks adopts a long-term network planning approach that emphasises the achievement of dynamic efficiency.

The first step in this approach is to establish the need for investment in terms of catering for future load growth, meeting consumer service level requirements and making modifications to comply with statutory requirements or to address environmental or safety concerns. The second step is to demonstrate that proposed investments form part of a least cost network development strategy over and beyond the planning period. This ensures a coherent and consistent approach over time, rather than inefficient piecemeal additions to the network. These steps are followed by specific assessments of financial and economic return and risk.

All development and planning methods adopted by UnitedNetworks take account of and emphasise efficiency and equity in capital investment.

This section considers all those new works which upgrade or improve an existing asset beyond its existing capacity, and which generally result from growth, regulatory or environmental needs.

5.1 PLANNING CRITERIA

A planning criteria describes the limits or constraints placed upon the system elements to which any network development must conform. UnitedNetworks has adopted specific planning criteria to ensure consistent evaluation of the alternatives and appropriate operating margins exist across all of its network.

For the purpose of this Plan:

- Security of supply is "the inherent ability of the network to meet customer demand for energy without interruption" and
- Reliability of supply is "the actual performance of the electrical system in terms of the amount of interruption actually experienced by the consumer"

Generally speaking the approaches taken to analysing the security of an electrical network can be separated into the following two categories:

- Probabilistic methods
- Deterministic methods

5.1.1 Deterministic methods

A design philosophy that is often employed on urban networks is to ensure that zone substations are capable of supplying consumers even in the event of the loss of any single network component at times of maximum demand. This planning philosophy is generally referred to as (N-1) security of supply and is a deterministic based design.

The fundamental weakness of this approach is that it provides full backup at all times but it does not take into account the random nature of component failure or the cyclical characteristics of demand. Neither does this approach take into account the economics of providing a high level of security to consumers.

In contrast rural networks have a relatively low customer density and few commercial or industrial areas. This has made the provision of (N-1) security of supply in many areas prohibitively and unjustifiably expensive, and more risk (and lower reliability) has therefore been accepted.

5.1.2 Probabilistic methods

Probabilistic methods are widely used at generation and transmission levels and are now more commonly used at lower voltage levels, particularly at the subtransmission level. Increasing adoption of probabilistic methods has been driven by the need to more comprehensively assess investment proposals and business risks.

Probabilistic methods for determining system performance use operational performance data to derive an expected failure rate for individual network components or circuits. From this, the expected likelihood of interruption of supply to customers can be derived. An assessment of risks and consequence can then be used to determine the appropriateness of investments in the network.

Investment based solutions to supply security are not the only alternative considered. Non asset based factors such as speed of response to faults and communication with customers may be preferable to expensive capital solutions.

5.1.3 Network security of supply standard

The October 2000 edition of the "Handbook for Optimised Deprival Valuation of System Fixed Assets of Electricity Line Businesses" required UnitedNetworks to develop a set of deterministic Network Security Standards for valuation purposes. The Security Standard adopted by UnitedNetworks is as follows:

SECURITY OF SUPPLY CRITERIA

Class	Group Peak Demand (GPD) MVA	Examples	Minimum Demand to be met after 1st (Tx/cct) Outage	Minimum Demand to be met after 2nd (Tx/cct) Outage
A1	Up to 1.0	Overhead spurs (LV or HV) Lightly loaded feeders	100% GPD in repair time, target 3 hrs urban 6 hrs rural	Repair time
A2	Up to 0.8	Underground spurs (LV or HV) Lightly loaded feeders	100% GPD in repair time, target 3 hrs urban 6 hrs rural	Repair time
B1	Up to 12	Urban feeders Urban zone substations	100% GPD within 3 hrs	100% GPD in repair time
B2	Up to 12	Rural feeders Rural zone substations Rural grid connection points	50% GPD within 6 hrs, 100% GPD in repair time	
C1	12 - 60	Urban zone substations	100% GPD immediately	50% GPD within 3 hrs, 100% within repair time
C2	12 - 40	Remote grid connection points Rural zone substations	75% GPD within 6 hrs, remaining load in repair time	100% GPD in repair time
D1	60 - 200	Zones substations supplying high density load areas	100% GPD immediately	100% GPD within 2 hr
D2	40 - 300	Normal grid connection points	100% immediately	50% GPD within 3 hrs, 100% within repair time

Where GPD = Group Peak Demand

5.1.4 Probabilistic network security model

UnitedNetworks recognises that deterministic (N-1) security levels are not always appropriate when considering:

- The networks load disposition and ability to economically duplicate and/or intermesh the network
- The competitive and business drivers towards increased asset utilisation
- Anticipating load changes and network development
- Different types of equipment, circuit reliabilities and risks
- The speed of response to faults

As a result UnitedNetworks has adopted a probabilistic approach to network security assessment. This is facilitated by a Network Security Model developed to quantify the risk UnitedNetworks and consumers are exposed to due to outages on network components. The Network Security Model identifies the various conditions and areas where the loss of a network component could result in the loss of supply to consumers. Fault statistics are used to identify the probability of equipment failure. Based on the expected demand and the capacity of back up supplies, the model calculates the demand not met due to the loss of a network component failure. Using this information, together with load duration characteristics and the average time required to restore supply, an estimate of the energy not served due to the fault is assessed. In this way, the model analyses the cost of non supply due to the failure of network components (i.e. transformers, busbars and subtransmission circuits) and compares them with the cost to remove the risks. This provides a guideline regarding reinforcement expenditure.

5.1.5 Planning process

UnitedNetworks approach to the network planning process is to use the above deterministic Security of Supply Standard to pre-screen the security of individual network sub-systems. Network sub-systems that do not meet the security standard are then evaluated in more detail using UnitedNetworks' Network Security Model.

In addition to using the Network Security of Supply Standard and Security Model as planning tools, UnitedNetworks uses investment models to assess the economics associated with network expansion.

5.1.6 Subtransmission planning

UnitedNetworks uses a rolling plan approach to the development of the subtransmission system, with horizon year plans modified annually to reflect changing circumstances. The long range plans emphasise key future issues, such as:

- The point of supply capacity requirements
- The zone substation capacity requirements
- Zone substation locations
- The subtransmission circuit requirements
- 11kV feeder plans
- Optimal voltage selection

Achieving these objectives is necessary for optimal and efficient network development, and the reduction of planning risk.

As network development takes place there is a need to consider the selection of future zone substation sites that are located in the vicinity of the effective load centre. The expected future load distribution is calculated using load predictions on the existing subtransmission and distribution networks and the likely load growth areas based on vacant land and land type designations and other district plan provisions. Usually a compromise has to be made between the available site positions and the electrical load centre. Economic comparisons, including a present worth study, between the available sites and options are undertaken. In selecting a suitable zone substation site a number of points are critically evaluated:

- Size, shape and nature of the site
- Site zoning and likely consenting process
- Ease of access for subtransmission and distribution feeders
- Load growth potential of the area

To limit the initial capital expenditure when establishing a new zone substation, the substation is usually only developed with a single transformer and associated load busbar. When the load grows and the risk exposure is increased, the second transformer is added.

5.1.7 Distribution planning

Distribution system planning is generally based on a shorter planning horizon of five years, is 11kV feeder orientated and emphasises such operational objectives as:

- Overload relief
- Voltage correction and control
- Zone substation feeder load balancing
- Zone substation load re-distribution
- Distribution transformer location and utilisation
- Network loss reduction
- Power factor correction
- Service level improvement
- Operational maintenance
- Improvement to operating efficiency
- Contingency and risk management

Achieving these objectives is a necessity for effective day-to-day operation of an electrical network. UnitedNetworks uses probabilistic planning techniques to evaluate major distribution expansion options.

Historical practices have allowed radial urban 11kV feeders to be loaded up to a maximum of 50% of their maximum continuous ratings (MCR). The rationale for this criteria was largely driven by the deterministic single contingency principle and the ability to back up all demand at any time with one switching operation. In addition it was considered (for overhead lines) that this was the optimal economic feeder loading (taking into account the various factors such as electrical losses, etc.).

In recent times peak feeder utilisation levels have been allowed to reach about 75% of their MCR before off-loading is initiated on those feeders experiencing continued growth. This is largely due to the following factors:

- Availability of more intelligent planning and operational tools (SCADA and GIS)
- A change in the economics associated with constructing a network, particularly the significantly higher costs associated with underground reticulation
- The adoption of the 75% feeder loading principle allows the load from a faulted feeder to be transferred to each of three adjacent feeders, thus implying 100% backup at a feeder level, but involving a number of switching operations

For those feeders that have lower levels of backup, the target loading level is generally lower than the 75% level, depending on the cost of reinforcements and risk of non-supply. For rural networks, the target loading and security level has to be assessed on a case by case basis as very often the low load growth and the high cost of reinforcement makes it uneconomic to enhance the security of supply.

In certain situations (i.e. Wellington central business district) the 11kV distribution system is required to have a higher level of network security. For these situations UnitedNetworks generally uses a closed ring distribution system with lower feeder utilisation levels.

5.2 NETWORK INVESTMENT MODELLING

Network expansion projects (both commercial and residential) are evaluated using financial models in order to ensure their economic viability. In the event that a small number of parties are requesting the expansion (i.e. subdivision developer) those parties are asked to contribute towards any shortfall in revenue associated with the project. In the case where expansion is the result of multiple parties (i.e. at the subtransmission level with domestic consumers) the economic viability is checked using a high level investment model that has inputs that include:

- Revenue delivered via standard line pricing
- Operating costs
- Maintenance costs
- Transmission costs
- Upstream/downstream capital costs

5.3 POWER FLOW MODELS

UnitedNetworks employs a power flow programme to analyse the capacity, security and voltage performance of its network. Network information stored in UnitedNetworks' Geographic Information System (GIS) can be dumped directly onto a load flow model. The model is used to review the network voltage, capacity and security performance.

5.4 MAJOR DEVELOPMENTS

This section describes the constraints that are projected to occur on the network within the planning period. Also presented are the alternatives for resolving the constraints and, where possible, the preferred option.

It should be noted that the alternatives outlined in this document are based on the existing information available to UnitedNetworks. When more information becomes available the Plan will be reviewed.

5.4.1 Northern Region

In general, the load density in the area surrounding Takapuna and Henderson is relatively high. In contrast the load density of the north-western areas of the Northern Region are relatively low. Generally speaking the urban feeders are faced with capacity issues whereas the rural feeders are likely to experience voltage constraints before capacity constraints occur.

Auckland isthmus

At present the Transpower 220kV lines supplying the area north of the Auckland isthmus pass through a single Transpower point of supply (Henderson). The total demand supplied by the 220kV lines north of the Auckland isthmus is about 650 MVA. Transpower has indicated that up to 500MVA of load will be lost if the 220kV double circuit line fails during peak conditions. The situation is expected to get worse as the load increases. The expected repair time for the line is about two to three days. The 110kV lines connecting Otahuhu substation (via Transpower's Mt Roskill and Mangere substations) to Henderson and Hepburn Road substations are operated normally open to avoid overloading under 220kV circuit contingency conditions. This configuration reduces the security of the transmission grid.

The provision of a transmission corridor for future cross-isthmus use or supply to the UnitedNetworks' Wairau Road substation remains an important long term objective. UnitedNetworks is securing easements for a section of a corridor from Transpower's Albany substation to the Wairau Road substation (North Shore Transmission Corridor). The corridor follows a route relatively close to the existing Albany-Wairau 110kV dual circuit, and makes provision for both 110kV and 220kV circuits.

During 2001, Transpower and the line companies in the Auckland region agreed to establish the Development Co-ordination Group (DCG) to oversee the development of solutions to mitigate the risks of supply to the Auckland isthmus and north (referred to as the Power Links Project).

Albany 33kV point of supply

The Transpower Albany 33kV point of supply is already loaded above its firm maximum continuous capacity (two 60/120MVA transformers). Taking into account the cyclical nature of the capacity of the transformers, the load profile, the security criteria and the ability to transfer load to the Wairau Road substation, reinforcement is required to meet the 2004 winter peak. In addition, there have been a number of complaints in relation to poor power quality from the industrial customers in the Albany area.

At present a 220kV double circuit tower line that runs from the Transpower Albany substation to a proposed Transpower Silverdale (220/33kV) point of supply site is operating at 33kV and supplying the UnitedNetworks' Silverdale, Orewa, Manly and Helensville substations. Establishing a new 220/33kV point of supply at Silverdale and transferring these substations away from the Albany point of supply provides an efficient means of reducing the Albany 33kV load and providing an improved level of reliability to consumers in the Albany Basin region. Transpower have been requested to establish a new point of supply in the Silverdale area with a commissioning date before the winter peak of 2003, subject to agreement on the commercial terms.

Henderson point of supply

Two 220/33kV, 60/120MVA transformers were installed in 1999 to replace the two 50MVA units and thus provide ample capacity for the substation. However, the installation of the two new neutral earthing resistors at this substation has required that higher voltage-rated surge diverters be used on the 33kV lines that emanate from this point of supply.

Hepburn Road point of supply

The Transpower Hepburn Road substation supplies both UnitedNetworks and Vector. The combined load at this point of supply in 2001 was about 115MVA. This substation is equipped with a 100MVA transformer and a 50/100MVA transformer. Under contingency conditions, depending on which transformer fails, the remaining transformer may not be able to carry the full demand. Continuity of supply to customers relies on the backup supply via UnitedNetworks 33kV network (and the 11kV network in Vector's case). Discussions have started with Transpower and Vector regarding the options to reinforce the supply to the area. The exact timing of network reinforcement depends on the resolution of the technical and commercial issues. In the interim, a seventh single-phase transformer unit on site provides a single contingency security level.

Wellsford point of supply

The Transpower point of supply at Wellsford supplies the Wellsford, Warkworth and Snells Beach substations via two 110/33kV, 30 MVA transformers. There are no plans to upgrade the supply point within the planning period.

Albany 110kV point of supply (Wairau Road substation)

UnitedNetworks' Wairau Road substation takes supply from the Transpower Albany substation via three overhead 110kV circuits that consist of:

- a single circuit overhead line following a route via the suburbs of Greenhithe, Glenfield, Marlborough and Wairau Valley.
- a double circuit overhead line following a route via the suburbs of Albany, Meadowood, Forest Hill and Wairau Valley.

Currently the loss of the dual circuit line would result in a significant loss of supply to consumers during peak network loading conditions. In addition, based on the present load projection, by 2005 the failure of a single circuit will result in loss of supply to consumers. This accounts for the ability to transfer load to the Albany 33kV point of supply (via the James Street and Forest Hill substations).

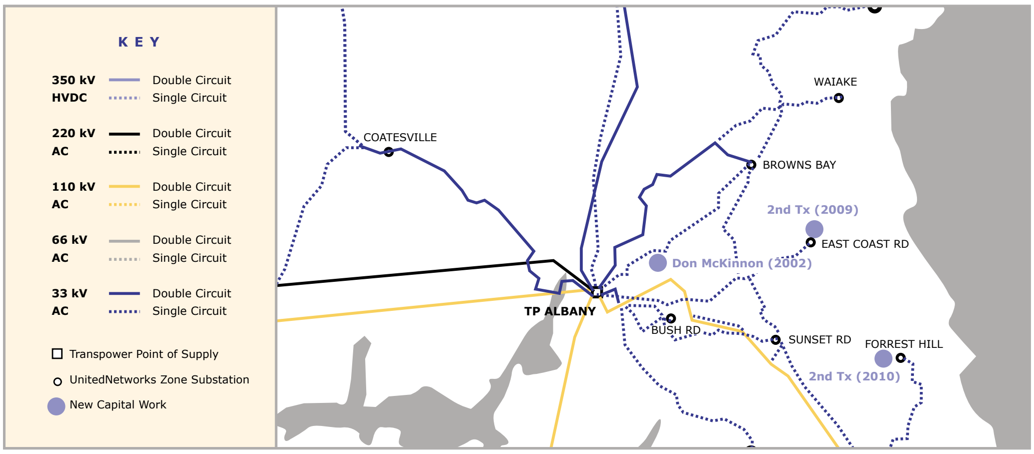
The need to reinforce the Wairau substation was recognised a decade ago and has been the subject of a number of reports that have usually been linked to reinforcing the transmission supply across the Auckland cross isthmus. These reports have clearly identified the need to secure a transmission corridor between the Transpower Albany substation and the UnitedNetworks' Wairau substation, coupled with the need to include the cross isthmus transmission corridor requirements. During 2001/2002 UnitedNetworks designated a transmission corridor between Albany and Wairau (North Shore Transmission Corridor).

In order to defer the reinforcement of the Wairau substation UnitedNetworks has begun to offer incentives to consumers with on-site generators to reduce their demand when called upon. This will enable the peak demand at Wairau Road substation to be reduced and is expected to defer Wairau reinforcement beyond 2007.

With the commissioning of the Silverdale point of supply in 2003, it will become possible to transfer some of the Wairau Road load to the Transpower Albany 33kV point of supply. UnitedNetworks plans to reinforce it's 33kV network such that both the Forest Hill and Milford substations can be supplied from the Albany 33kV point of supply. This would enable the 110kV reinforcement of Wairau Road substation to be deferred to beyond 2011.

In addition, the possibility to provide 220/33kV step down facilities from the proposed 220kV cross isthmus cable, which will pass through the neighbourhood of Wairau Road substation, requires further investigation. This alternative will be investigated once the investigations on the cross-isthmus Power Links Project are completed.

Albany Basin/East Coast Bays/Forrest Hill/Milford area

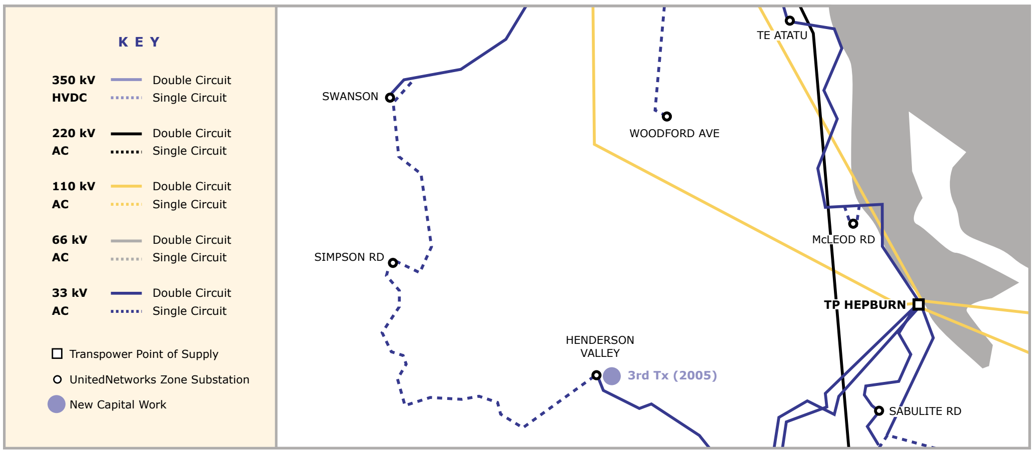


Over the past decade there has been significant growth in the area around the Albany basin due to major commercial, retail, community and residential developments. This trend is expected to continue for the next decade. The load in the area is supplied by 11kV feeders from the neighbouring Bush Road and Browns Bay substations. As the load grows, it is expected that the feeder utilisation will increase resulting in the erosion of capacity margins. As a result UnitedNetworks is constructing a new zone substation on Don McKinnon Drive during 2002. The 11kV distribution network in the Albany region will also be rearranged to optimise backup capacity under contingency conditions.

Extensive residential development has taken place in the area around East Coast Road on the eastern side of the motorway. This is expected to continue for the next few years. The East Coast Road substation is equipped with a 12/24MVA transformer (2001 peak demand of 11MVA). For the purpose of this Plan, it is assumed that a second transformer will be installed in 2009.

The Milford and Forest Hill substations are equipped with single bank 12/16MVA transformers. As demand growth occurs 11kV reinforcements will be required to shift load away from these substations. In the long term it is proposed to add a second transformer at Forest Hill in 2010.

Henderson Valley/New Lynn area



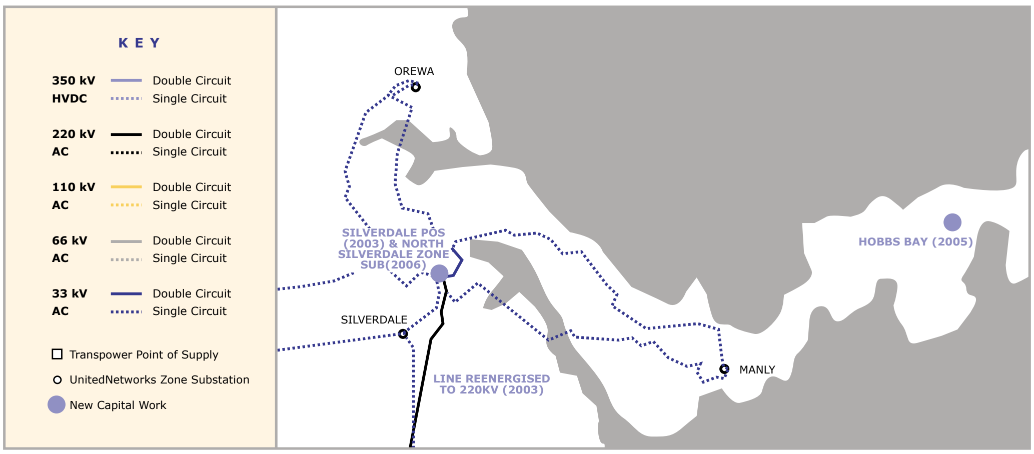
Henderson Valley substation is supplied by two 12.5/16MVA transformers (2001 demand of 24MVA). Switching is required to restore supply in the event of failure of one of the transformers.

Given that the load growth is predominately around the Henderson Valley substation, the most economic solution is to install a third transformer (two additional bays already exist). For the purpose of this Plan, it is assumed that the third transformer will be added in 2005.

It is expected that load growth in the area will continue, driven in part by Auckland's regional growth and transport strategies. For example, during 2001 UnitedNetworks investigated supply options for a proposal to introduce an electric train to service to the western suburbs of Auckland.

There has been moderate residential growth in the coastal resort of Piha. Given that the bulk of the load is concentrated towards the end of the feeder, voltage regulation is starting to become an issue for the area. It is proposed to upgrade the 11kV supply to Piha feeder in stages.

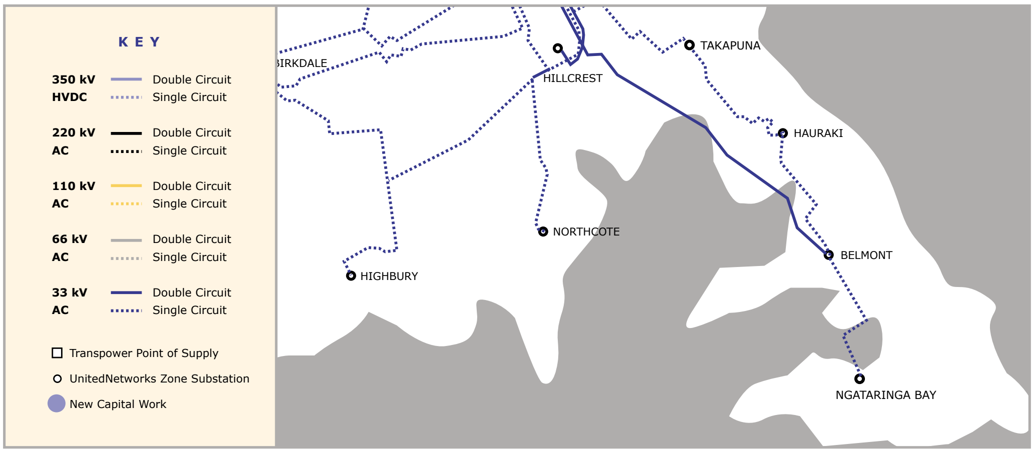
Hobbs Bay/Manly/Silverdale area



There has been significant residential development in the Whangaparaoa Peninsula, which is largely supplied via the Manly substation (two 12.5MVA transformers with a 2001 peak demand of 22MVA). The peninsula provides access to reinforce the network from only one end. The options for reinforcing the area include establishing a new substation at Hobbs Bay or installing a third transformer at Manly substation. Given that the majority of demand growth is occurring at and adjacent to Gulf Harbour, for the purpose of this Plan it is assumed that a new Hobbs Bay substation will be established in 2005. UnitedNetworks has already designated the substation site.

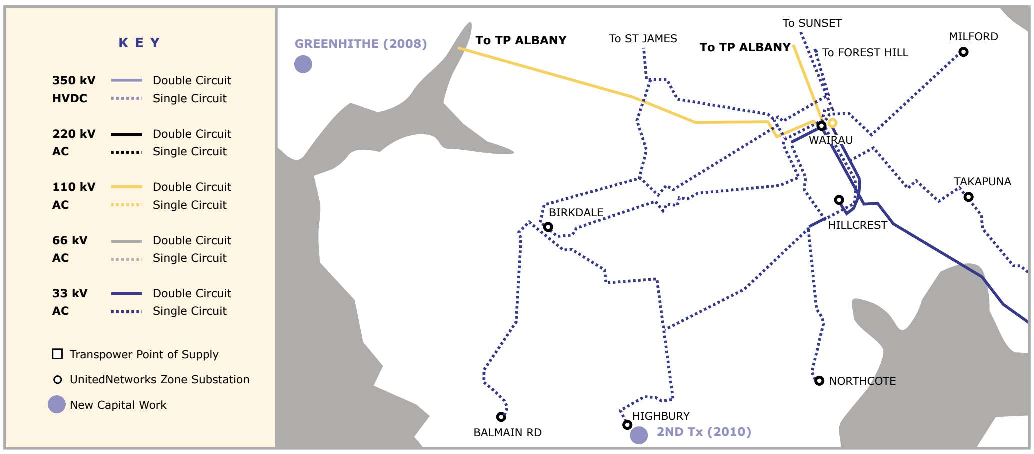
The area between Silverdale and Orewa is expected to experience significant growth (mainly due to residential development), particularly in the areas around the northern parts of Silverdale. Demand growth is, in part, being driven by the opening of the new northern motorway. The Silverdale substation is equipped with a single 12.5MVA transformer and the load is expected to exceed the substations capability by 2004. The options to relieve the situation include installing a second transformer at the existing Silverdale substation or establishing a new substation. As the load growth is expected to occur in the northern part of the area, the most economic option is to establish a new substation at north Silverdale. With the decision to establish the Transpower Silverdale point of supply, it becomes possible and logical, to establish the proposed north Silverdale substation within the site of the point of supply. For the purpose of this Plan, it is proposed to establish a zone substation inside the Silverdale point of supply in 2006.

Takapuna/Ngataringa Bay area



Ngataringa Bay is equipped with a single 12.5MVA transformer supplied by a single oil filled cable (2001 load of 9MVA). This substation supplies an area bound by water on three sides and 11kV backup is limited. As load increases the security margins will be eroded. Negotiations are underway with industrial customers in the area and agreement has been reached in principle for 1.2 MVA of backup generation to be available on-call. A further 1.2 MVA of backup generation is also being negotiated. This generation will significantly reduce the risk of non-supply in the area.

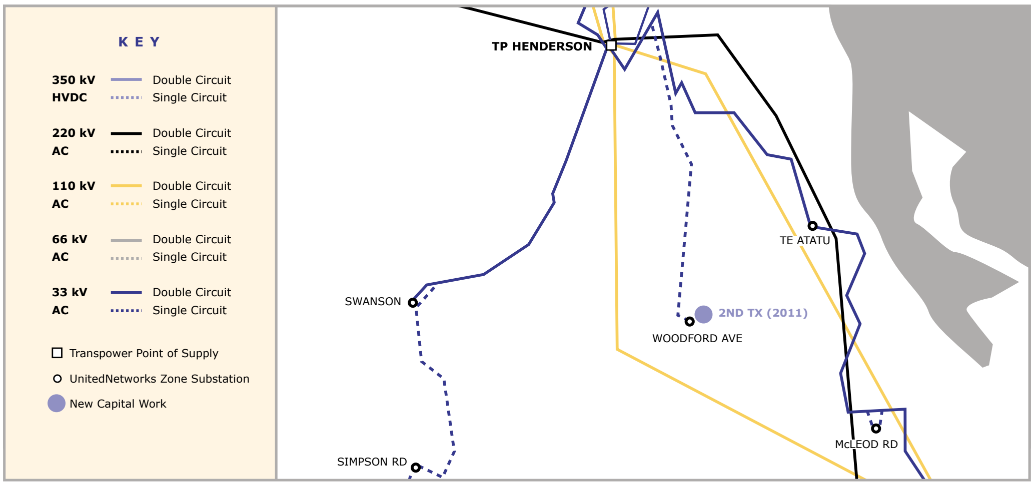
Highbury/Balmain/Birkenhead/Greenhithe area



The Highbury and Birkenhead areas are experiencing slow but steady load growth. Highbury, Balmain Rd and Northcote substations are all equipped with single bank transformers. It is expected that the security margin will be eroded significantly towards the end of the planning period. In the short term reinforcing the 11kV distribution network will improve security levels. In the long term it is planned to install a second transformer at Highbury substation in 2010.

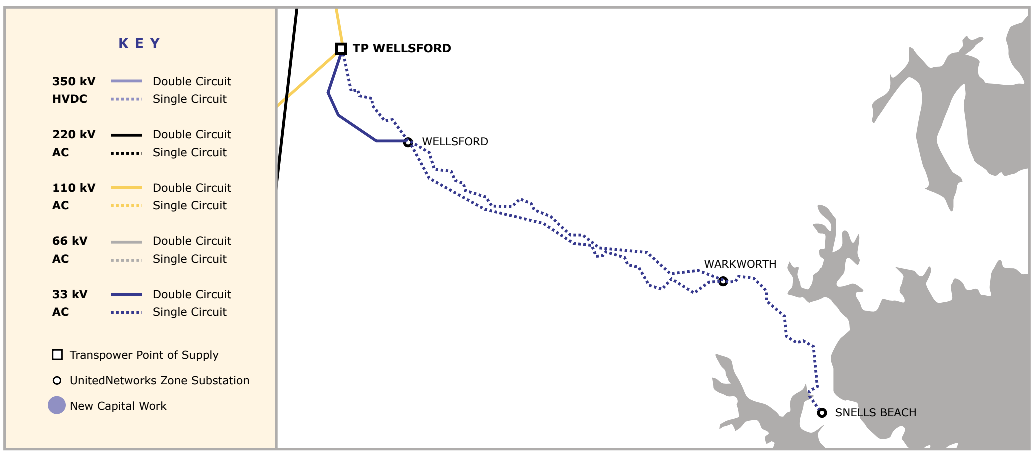
The West Harbour/Greenhithe area is experiencing slow but steady load growth. Reinforcement of the area is required to maintain acceptable security levels. In the short term the 11kV distribution network will be reinforced to improve security levels. In the long term it is planned to install a substation at Greenhithe in 2008. UnitedNetworks has already designated the substation site.

Hobsonville/Te Atatu/Woodford area



Woodford Substation is a single bank substation supplied by a single 33kV line. The 2001 peak load at the substation was 11.6 MVA. It is expected that the security margin will be eroded during the planning period. In the short term the 11kV network will be reinforced. In the long term, it is proposed to install a second transformer at Woodford substation in 2011 (i.e. beyond the planning period).

Warkworth/Wellsford area



The 11kV supply to the Woodcocks and Matakana areas are heavily loaded (Warkworth substation). During 2002 11kV reinforcement is planned to improve the security margin in the area.

Eastern Region

In general the load density in the Eastern region is relatively low, except for those areas surrounding Tauranga and Mt Maunganui, and small pockets surrounding the Taupo and Rotorua townships. As a result the region has long feeders with few consumers connected, and voltage constraints generally occur prior to capacity constraints. A major problem in this region is that of momentary voltage dips occurring in remote areas due to the starting of relatively large motors. UnitedNetworks is exploring active devices (such as real time power factor controllers) to reduce the voltage dips so as to minimise the impact to neighbouring consumers.

Rotorua, Tauranga and Mt Maunganui 110kV transmission network

At present the Transpower Rotorua, Tauranga and Mt Maunganui points of supply are connected to the Transpower 110kV network with injection coming mainly from a single 220/110kV interconnector at Tarukenga. The power flow of the transmission network is such that equipment overloading and low voltage will occur upon the failure of the Tarukenga interconnector. A second 220/110kV interconnector transformer at Tarukenga will significantly improve the security of the 110kV network in the region.

Another significant issue facing the region is that the failure of any one of the two 110kV lines supplying Transpower's Tauranga and Mt Maunganui substations during peak times will result in unacceptable delivery voltages to UnitedNetworks zone substations.

Mt Maunganui point of supply (33kV supply)

During 2001 a second 110/33kV transformer was installed at the Transpower Mt Maunganui point of supply. This has significantly improved the security of supply to the area and provides sufficient capacity to supply the growing load, particularly in the Triton industrial area.

Mt Maunganui point of supply (11kV supply)

Due to its age and condition, it is anticipated that the 11kV switchboard at Transpower's Mt Maunganui point of supply will need to be replaced in 2006.

The two existing 110/11kV transformers at Mt Maunganui are highly utilised. In the short term, load will be transferred to the Papamoa substation to maintain an acceptable level of security. In the long term the two 110/11kV, 10MVA transformers will be replaced with larger units in 2011.

Tauranga point of supply (33kV supply)

The TrustPower owned Kaimai generating scheme is connected into UnitedNetworks 33kV subtransmission network at the Greerton switchyard, and supplies a significant amount of the load within the distribution network. The Tauranga 33kV point of supply is equipped with two 110/33kV transformer banks (30MVA and 50/100MVA). Upon the loss of the 50/100MVA unit backup supply can be made available from Mt Maunganui via UnitedNetworks 33kV network.

In the short term, as demand growth occurs, the 33kV circuits between Transpower's Mt Maunganui point of supply and UnitedNetworks' Triton substation will need to be upgraded to provide an acceptable level of network security. In the long term the existing 30MVA transformer bank at the Tauranga point of supply will need to be replaced by a 50/100MVA transformer in 2005.

Tauranga point of supply (11kV supply)

In 2002 the two 110/11kV, 10MVA transformers are scheduled to be replaced by two 30MVA units and will significantly improve the security of supply in the area.

Wairakei point of supply

The Rotokawa power station (28MVA) and the Hinemaiaia generation scheme (6MVA) supply a significant amount of load within the Wairakei distribution system. The Wairakei point of supply is equipped with a single bank 220/33kV, 37.5/50MVA transformer. If the transformer fails during peak times, for technical reasons the existing embedded generation cannot quickly supply any of the load while isolated from the grid. This is due to the fact that the Hinemaiaia generation scheme was not designed to operate in an islanded mode and the Rotokawa station needs the connection of a standby generator or an external 11kV supply in order to undertake a blackstart. Discussions are being conducted with the relevant parties with the objective of obtaining blackstart capability for Rotokawa by using an 11kV supply from the Ohaaki point of supply. This will provide some degree of backup should the transformer at Wairakei fail.

During 2002 the 33kV switchboard at Wairakei point of supply will be replaced. This will improve the reliability of supply in the area, particularly given that it will provide UnitedNetworks with a means of faster restoration through the ability to remotely control the 33kV circuit breakers.

Te Matai point of supply

The Transpower Te Matai substation is equipped with a single bank 110/33kV, 30MVA transformer. The 33kV and 11kV distribution network provide some degree of backup. In the short term the risks associated with customer non-supply are relatively small and are accepted. In the long term it is planned to install a second transformer bank at Te Matai in 2009.

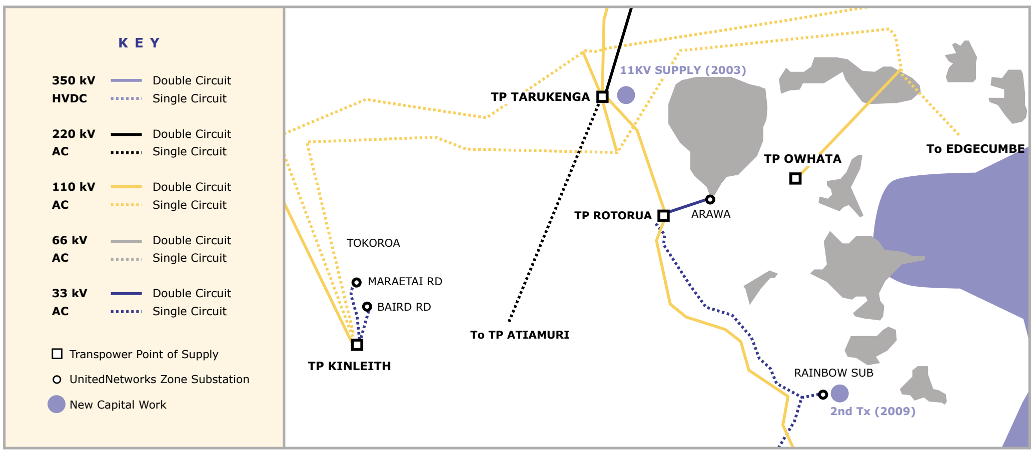
Owhata point of supply (11kV)

The substation is equipped with two 110/11kV, 10MVA transformers (2001 load of 14MVA). There is significant 11kV backup supply available from the nearby Rotorua point of supply, and any future demand increases will be off-set by reinforcing the 11kV distribution network.

Hinuera point of supply

Hinuera is equipped with one 110/33kV, 30MVA transformer (single-phase banks) supplying a load of about 30MVA. There is a limited amount of backup supply from the adjacent Waihou and Kinleith points of supply (33kV and 11kV). A fourth single-phase transformer bank on site provides a single contingency security level. The expected repair time (Transpower) would be about six hours. Based on current demand growth it is expected that a second transformer will need to be commissioned in 2003.

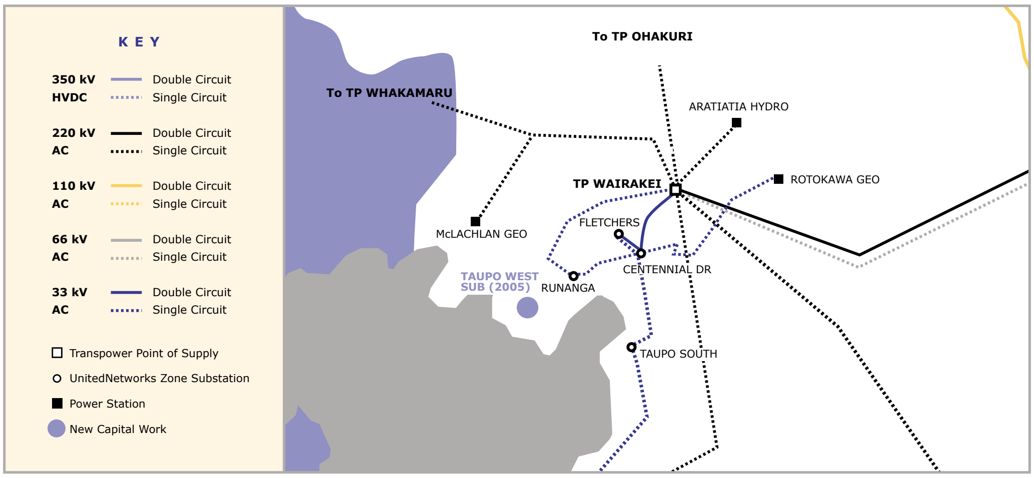
Rotorua area



The Rotorua area is supplied via the Arawa substation and the Transpower Rotorua and Owhata points of supply. Arawa substation supplies the Rotorua township and portions of the north-western rural areas, while the other two supply the surrounding western and eastern areas. The 11kV feeders at both Arawa and Rotorua substations are highly loaded. This is compounded by a reduction in rating due to high soil thermal resistivity. In the short term undersized/under-rated cables outside the Rotorua and Arawa substations are being replaced or having thermal backfill installed. Another problem for the area is the long overhead lines (some in excess of 40km). In a number of cases consumers are experiencing voltage related problems. A significant reduction in capacity and voltage issues will be achieved by the establishment of a 110/11kV point of supply at the existing Tarukenga point of supply, planned for completion in 2003.

The Rainbow substation is equipped with a 5MVA transformer that is made up of four single phase banks (peak 2001 load of 4.7MVA). In the event of the failure of any banks, replacement can be effected within a few hours. There is limited backup from the surrounding 11kV network. During 2009 it is planned to install a second transformer, or replace the existing transformer with a larger one.

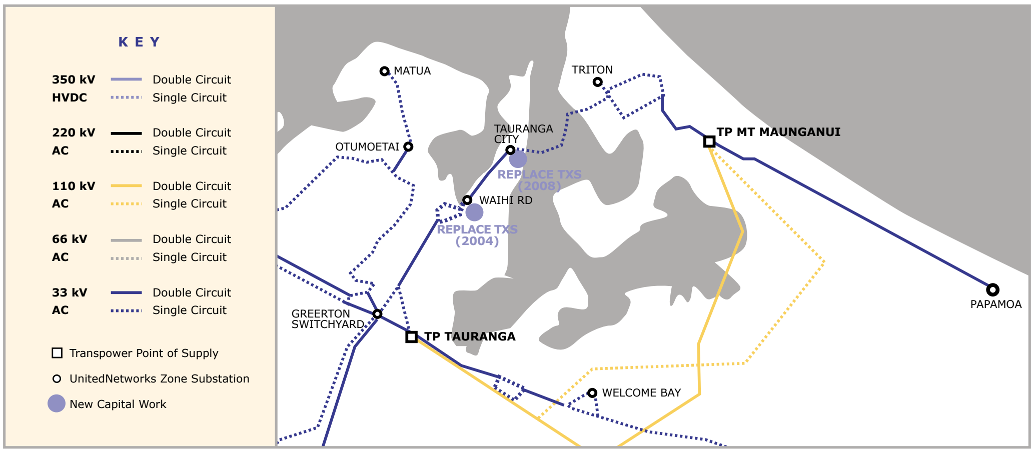
Taupo area



The Runanga substation supplies the northern part of the Taupo township (two 15/18MVA transformers). The southern part of the Taupo township is supplied by a single 9/15MVA transformer at the Taupo South substation. The load in the Acacia Bay and Kinloch areas has been increasing steadily due to increased business activity and subdivision development. As load growth occurs the security margins are expected to be significantly eroded from both the Runanga and Taupo South substations. In the short term the 11kV distribution network between the substations will be reinforced. In the long term a new 33/11kV substation will be established on the west side of the Taupo township in 2005.

The area around Matea Road is experiencing steady growth as farmers convert their land to dairy farming. The area is presently supplied via a 33kV line connected to the Taupo South substation and the Hinemaiaia generating station. As demand grows a decision needs to be made as to whether to continue with the existing 33kV/400V supply configuration or to introduce a new substation and the associated 11kV supply.

Tauranga / Mt Maunganui area



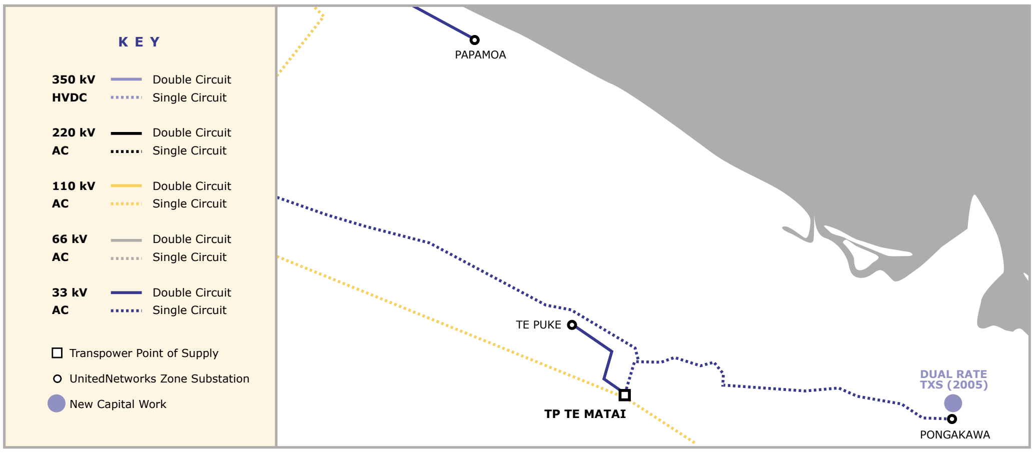
Tauranga downtown and the surrounding area including the Ports are supplied by five transformers located in two substations (Waihi Road and Tauranga City). Due to historical reasons, the transformers at these two substations have a different vector group relative to the transformers located in the surrounding substations. This means that load cannot be transferred between the two groups of substations without a short supply interruption to consumers. There is also a limited amount of interconnection capacity within the Tauranga City substation group and with the surrounding substations. As the load grows, the risk of non-supply will increase. The long term plan is to replace the transformers at Waihi Road and Tauranga City with larger transformers that have the same vector group as the transformers in the surrounding substations.

In the short term the distribution network between the substations will be reinforced and in 2004 it is planned to relocate one of the 11.5/23MVA transformers from the Trentham substation (Central Region) to Waihi Road. The Trentham transformer has a Yy0 vector group (fits into the long term strategy for the area) and can be implemented at very low cost. The two 5MVA transformers released from Waihi Road would be released for installation at the proposed Taupo West substation.

In the long term the replacement of the Tauranga City substation transformers by two larger units (of Yy0 vector group) is scheduled for 2008.

Significant load growth is occurring in the areas supplied by the Papamoa, Welcome Bay and Triton substations. Significant 11kV distribution reinforcement is scheduled to occur during the planning period.

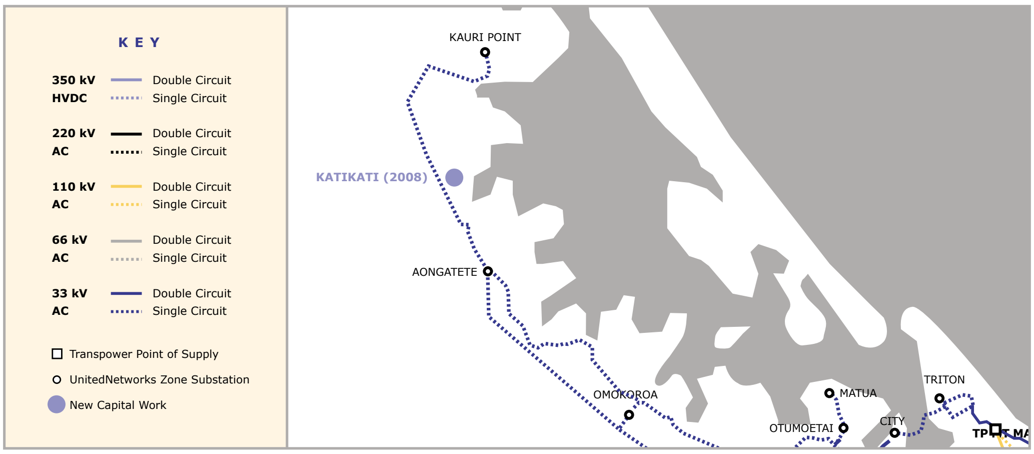
Te Puke/Pongakawa area



Due to increasing demand it is planned to enhance the 11kV distribution network in the Te Puke area.

Pongakawa substation is equipped with two 5MVA transformers (2001 peak demand of 5.3MVA). Due to the technical reasons the transformers cannot be operated in parallel and the full load at this substation is supplied via one of the transformers (the other one energised on standby). To cope with the projected growth in demand the transformers will be dual rated in 2005.

Katikati/Omokoroa/Judea area

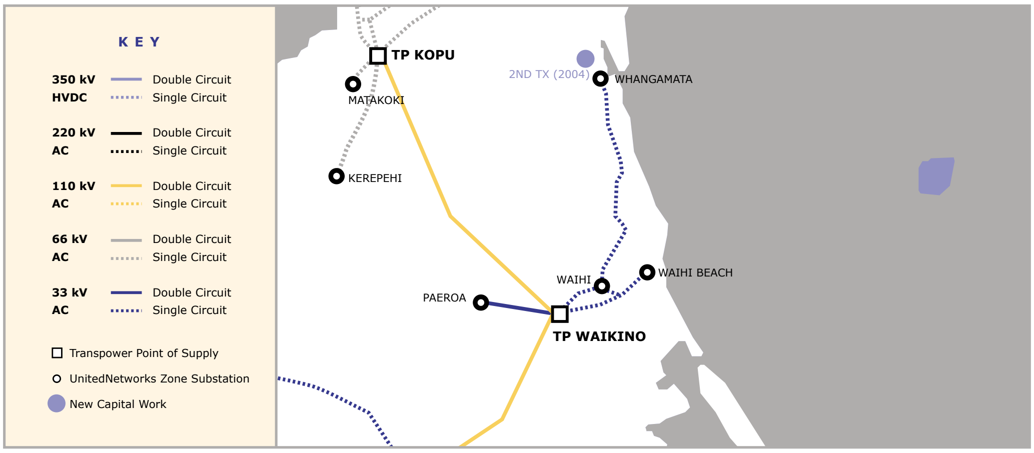


There has been considerable residential subdivision activity adjacent to the Kauri Point and Aongatete substations and load growth has been steady. The capacity margin of the network supplying the area has been significantly eroded. In the short term the 11kV network will be reinforced.

A 33kV line has been built from the Aongatete substation to the Katikati area. The line currently operates at 11kV to provide additional capacity to the area. As load growth occurs this line will be used to supply a new zone substation located at Katikati (currently planned for 2008).

The load in the area around Judea is experiencing steady growth due to industrial development. Further increases in load will be catered for by reinforcing the 11kV network from the Waihi Road substation.

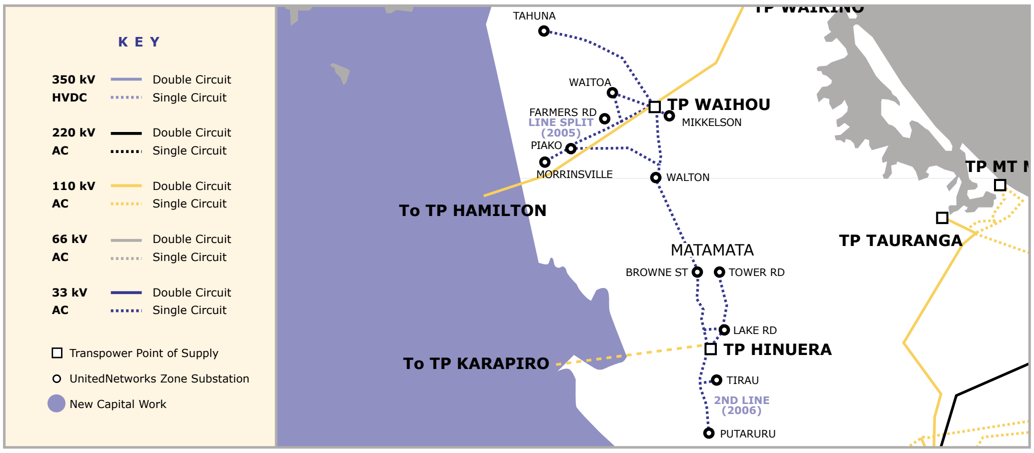
Waihi/Paeroa/Whangamata area



There are two 33/11kV, 7.5MVA transformers supplying the Waihi substation. The substation is highly loaded, with about 65% of the load attributable to the Waihi gold mining operation. Arrangements have been made with the gold mine that in the event of supply failure, the supply to their site will be cut back so as to maintain supply to the neighbouring township. This arrangement avoids the need for expensive reinforcement of the network.

The Whangamata substation is equipped with a single transformer supplied by a single 33kV line. A limited amount of 11kV backup capacity is available from Waihi substation. In the short term a new 11kV feeder is planned to off-load the highly loaded network supplying the township. The current load growth projection indicates that a second zone transformer will need to be installed at the substation in 2004.

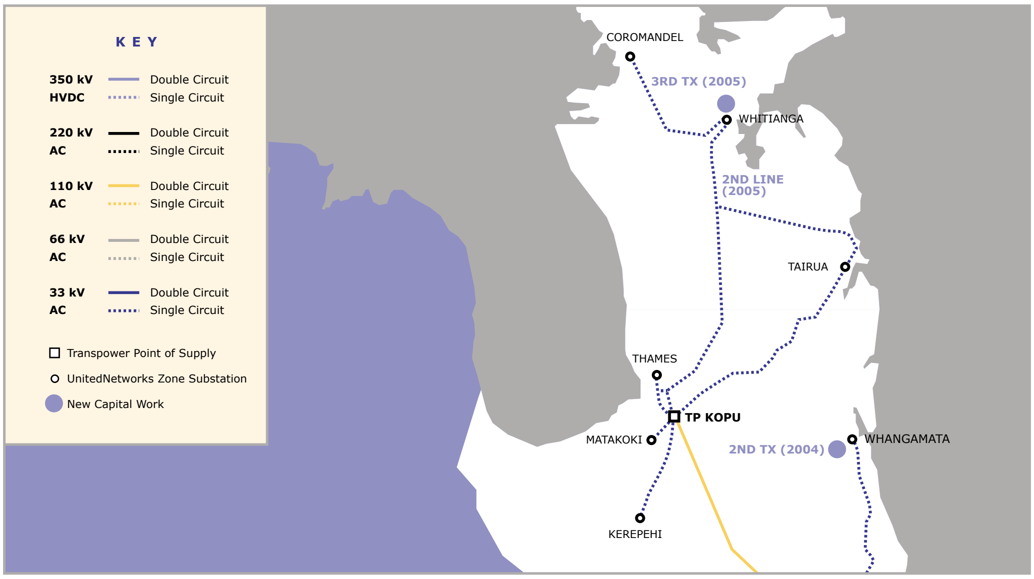
Matamata/Piako area



The Putaruru substation is supplied via a single 33kV line. There is limited backup capability within the 11kV network, particularly given that the same 33kV overhead line also supplies the neighbouring Tirau substation (that provides 11kV backup). Consumer non-supply will occur if the 33kV line fails. As load growth occurs the risks associated with consumer non-supply will increase. It is anticipated that a second 33kV line will need to be installed in 2006.

Presently the Waihou–Farmers Road–Piako 33kV line is a bonded double circuit, which when lost, results in the overloading of the Waihou-Walton-Piako 33kV circuit coupled with the loss of supply to Farmers Road substation. Investigations show that splitting the double circuit and installing circuit breakers at Waihou and Piako to form two independent circuits will provide improved reliability of supply to the area. It is planned to implement the split in 2005.

Thames/Whitianga/Coromandel area



The Whitianga and Coromandel zone substations take supply via two separate 66kV lines from the Transpower Kopu point of supply. These lines converge into one 66kV circuit which runs between Coroglen and Whitianga. There is limited 11kV backup and significant consumer loss of supply occurs upon failure of the 66kV line. It is planned to construct a second 66kV line between Coroglen and Whitianga in 2005.

Significant development is expected to occur adjacent to the Whitianga substation (marina development). In order to cater for the growth in demand it is planned to commission two new 11kV feeders during the planning period and install a third 66/11kV transformer at the Whitianga substation in 2005.

The Tairua substation supplies a distribution network that has limited backfeed capability between the 11kV feeders. This is due to the geographic nature of the townships of Tairua and Pauanui. Significant growth is expected during the planning period and it is planned to reinforce the network by either installing a submarine cable across the Tairua harbour or by installing a new 11kV feeder.

The Kerepehi substation is equipped with a single transformer supplied via a single 66kV line. The backup capacity from the neighbouring 11kV network is voltage constrained. During 2003 it is planned to install regulators/capacitors to increase the backup capability.

Central Region

In general, the network in this region is of the urban type with higher load density. The 11kV network in the Wellington city area is, in the majority, supplied via underground cable. As a result the Wellington network has a much higher reliability than the other networks owned by UnitedNetworks.

Pauatahanui point of supply

The Transpower Pauatahanui point of supply is equipped with a single 20MVA transformer (2001 peak demand of 18MVA) that is made up of four single phase units. Due to geographic layout, the 11kV backup between the Mana and Plimmerton substations (and the neighbouring zone substations) is limited. Should the transformer at Pauatahanui fail there will be significant loss of supply to consumers. The installation of a second transformer bank at the Pauatahanui point of supply is scheduled for 2002.

Wilton point of supply

In the event of the failure of the 110kV or 220kV circuits connected to the Transpower Wilton point of supply, or under specific HVDC transfer between the North and South Islands, there are load sharing problems between the 220kV and 110kV transmission network (i.e. overloading of the 110/220kV interconnector at Wilton). Transpower has indicated that the simplest way to mitigate the situation is to split the 110kV and 220kV systems under contingency conditions.

Haywards point of supply

UnitedNetworks takes supply from the Transpower Haywards point of supply at both 11kV and 33kV. The 33kV supply is via a single 27MVA, 110/33kV transformer. The 11kV supply is via a single 20MVA, 110/11kV transformer (backed up by a 5MVA regulator). Transpower has informed UnitedNetworks of their intention to replace the 11kV switchboard due to age and condition. In the short-term UnitedNetworks distribution network will be optimised by relocating one of the 11.5/23MVA transformers at Trentham to the Waihi Road substation (Eastern Region) and re-configuring the redundant 33kV Haywards–Trentham circuit as an 11kV interconnector between the Haywards and Trentham substations. This re-configuration is scheduled for implementation in 2003.

Melling point of supply

The two aging 110/11kV, 20MVA transformers at the Transpower Melling substation are scheduled to be replaced with larger units in 2002.

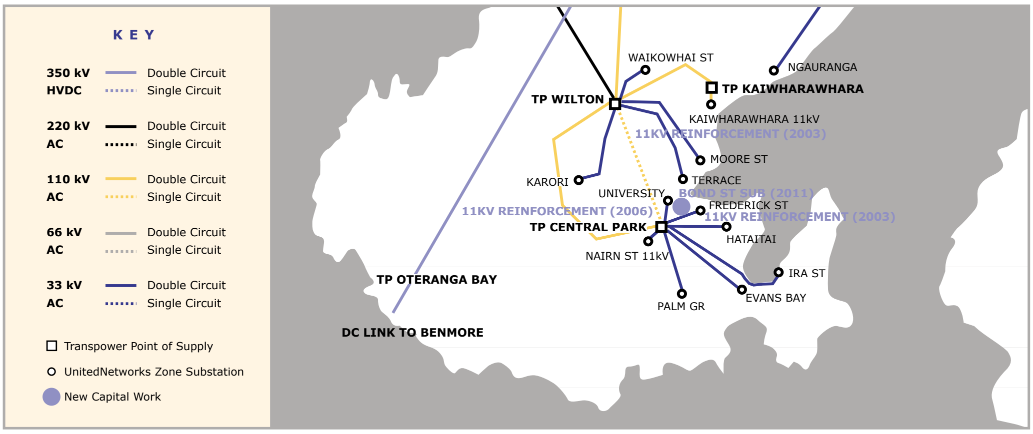
Central Park point of supply

UnitedNetworks takes supply from the Transpower Central Park point of supply at both 33kV and 11kV. The 33kV supply is via two well utilised 110/33kV, 50/100MVA transformers. The 11kV supply is via two lightly loaded 110/11kV 30MVA transformers. Transpower has informed UnitedNetworks of its intention to replace the two 110/11kV 30MVA transformers due to their age and condition.
The options require further investigation. For the purposes of this Plan it is assumed that a third 110/33kV transformer will be installed and the 110/11kV transformers will be replaced with 33/11kV units.

Kaiwharawhara point of supply

UnitedNetworks takes supply at this point of supply at 11kV. This substation is equipped with two 110/11kV 40MVA transformers. With the completion of the 2001 CBD reinforcement project a significant amount of load has been transferred to the Kaiwharawhara point of supply (from the Terrace and Moore Street substations). No further development is anticipated at this point of supply during the planning period.

Wellington area



The installation of six 11kV cables linking the Kaiwharawhara point of supply to the Wellington CBD was completed in 2001. These cables enabled the permanent transfer of about 20MVA of the load supplied by the Terrace and Moore Street substations to Kaiwharawhara. They also provide substantial backup to the Wellington CBD under contingency events. The completion of this project has significantly reduced the reliance of the CBD supply on the 33kV cables from Transpower's Wilton substation. Additional minor network reinforcement will be required during 2002/2003 to enhance the effectiveness of the CBD backup supply.

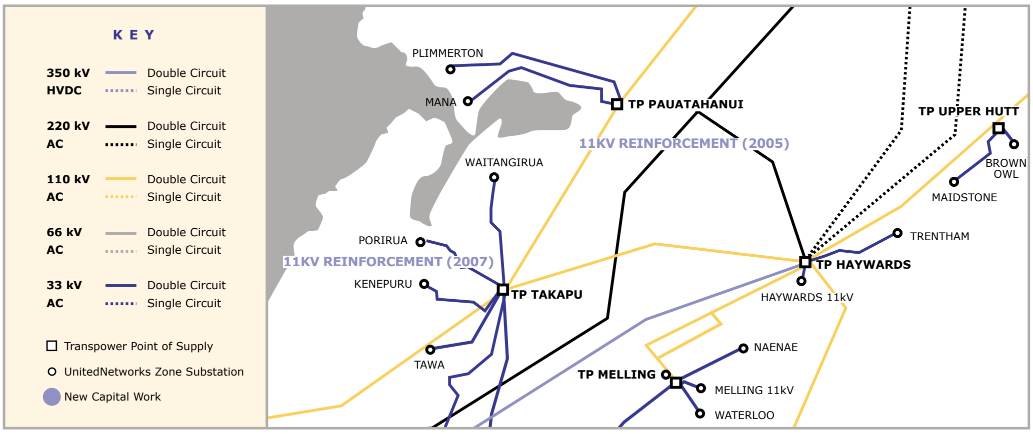
As the demand in the Wellington CBD and its fringe area grows it will be necessary to establish an additional zone substation. It is anticipated that the substation will be established in 2011, with 33kV supply coming from the Transpower Central Park point of supply. UnitedNetworks currently owns a vacant substation site in Bond Street.

The University zone substation is relatively well utilised. Steady growth is expected in the University area as a result of infill/redevelopment. The 11kV network surrounding the University zone substation will need to be reinforced in 2006.

The Frederick substation is relatively well utilised. Growth is expected to be around the Courtney Place area due to redevelopment. The 11kV network will need to be reinforced in 2004 in order to transfer load to the Nairn Street substation.

The expiry of the lease on Athletic Park means that this area is available for development. Current indications are that it will be developed into a residential / retirement park, with up to 3 MVA demand. As load growth occurs the 11kV network supplied by the Palm Grove substation will need to be reinforced.

Porirua/Plimmerton/Upper Hutt area

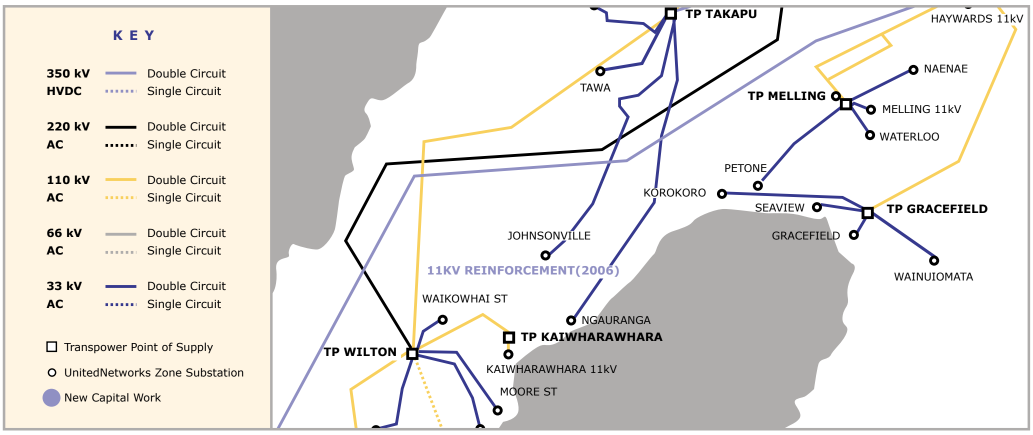


The closing down of a significant number of industrial/commercial businesses (Mitsubishi factory) has resulted in a surplus of capacity at the Porirua and Kenepuru substations . The recent completion of the development of the Mega Centre retail shops in the area has, to some extent, offset this loss. In addition the land previously occupied by a psychiatric hospital has become available for development. It is planned to reinforce/reconfigure the 11kV distribution network supplying the area in 2007.

The main area of growth in the Plimmerton/Mana area is that due to the residential subdivision development around Whitby. At present this area is supplied by 11kV feeders from the Mana and Waitangirua substations. Due to the geographic layout of the area, the feeders from Waitangirua substation supplying the area are relatively heavily loaded although the substation itself is lightly loaded. It is planned to reinforce/reconfigure the 11kV distribution network in 2005 such that additional Whitby load can be supplied via the Waitangirua substation.

No major network enhancements are expected within the Upper Hutt due to the relatively static load projection. However, it is proposed to optimise/rationalise the distribution network surrounding the Trentham substation (as outlined in the Haywards point of supply section listed above).

Johnsonville/Tawa/Lower Hutt area



The Johnsonville and Ngauranga zone substations have experienced continued commercial growth. Significant subdivision development is also emerging to the west of Johnsonville and to the northwest of Newlands. Significant 11kV network reinforcement will need to be undertaken in 2006 to cater for growth in demand.

No major network enhancements are expected for the Lower Hutt area due to the relatively static load projection. However, distribution network enhancements may be required to cope with localised growth.

RETURN TO MAIN CONTENTS PAGE

FINANCIAL SUMMARY

6.1	Network capital expenditure	84
6.2	Network maintenance expenditure	85
6.3	Other capital expenditure	85
6.4	Other operating expenditure	86
6.5	Trends from previous years	86
6.6	Asset valuation	87

RETURN TO MAIN CONTENTS PAGE

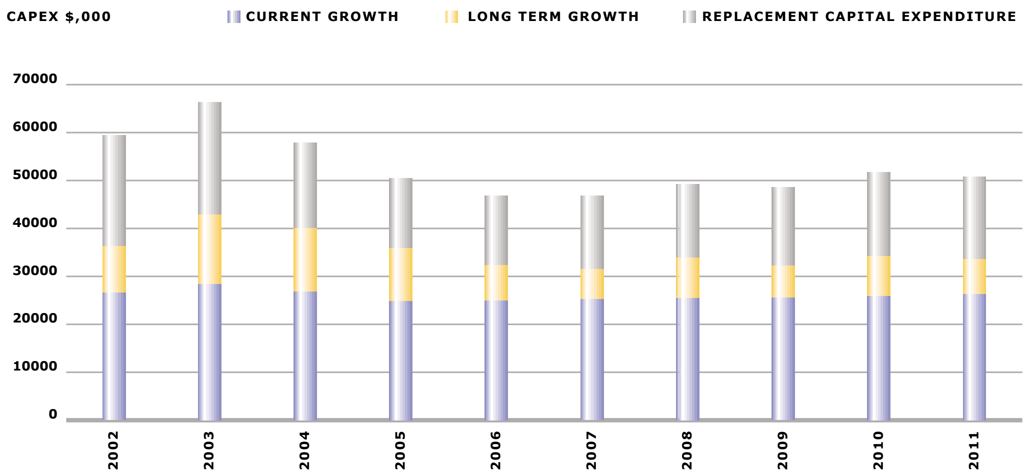
6. FINANCIAL SUMMARY

6.1 NETWORK CAPITAL EXPENDITURE

The following graph outlines the anticipated capital expenditure for the planning period and is split into the following high level categories:

- **Current growth expenditure**: this relates to that capital expenditure which is required to be spent on establishing new assets at the fringe of the network. It generally relates to expenditure on new 400V & 11kV assets that do not form the major backbone of the network (i.e. subdivisions and new connections). High levels of load growth drive expenditure in this area and given the physical nature and location of the expenditure in relation to the overall network it tends to be non-discretionary
- **Long term growth expenditure**: this relates to capital expenditure on the backbone of the network. It generally relates to major 11kV feeder reinforcement and/or subtransmission development. The expenditure tends to be of a 'lumpy' nature and discretionary in the short term due to the fact that the construction of these assets can be deferred. With continued load growth the deferral of expenditure in this area increases the risks associated with customer non supply
- **Replacement expenditure**: this relates to replacement capital which is spent on replacing existing assets which have failed or reached the end of their life. The level of replacement expenditure is generally driven by the level of assets that are being retired.

TOTAL CAPITAL BUDGET



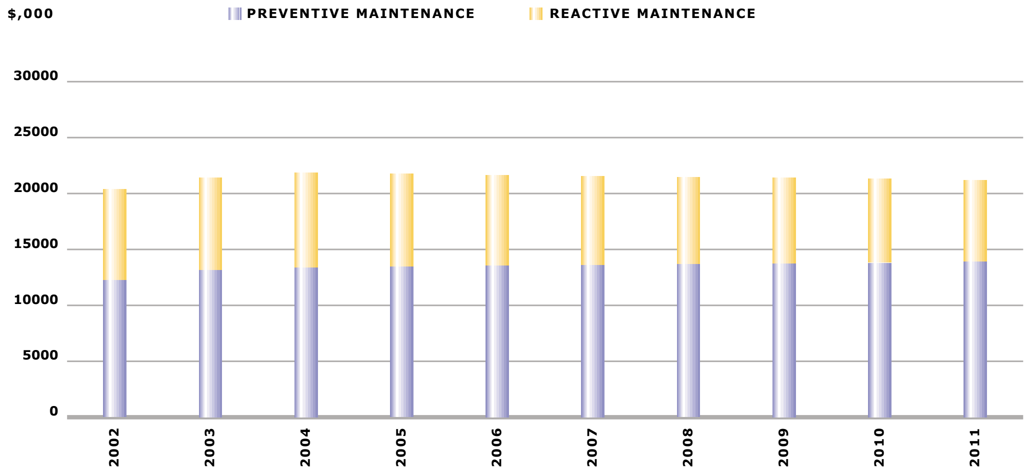
6.2 NETWORK MAINTENANCE EXPENDITURE

The following graph outlines the anticipated maintenance expenditure for the planning period and is split into the following high level categories:

- **Preventive maintenance**: this relates to maintenance expenditure that is undertaken on the asset in order to keep it 'fit for purpose'. This maintenance expenditure is, in many cases, prescribed by UnitedNetworks maintenance standards. Generally these standards require preventive maintenance to be undertaken at fixed intervals or as a result of asset condition surveys.
- **Reactive maintenance**: this relates to maintenance that is undertaken on a reactive basis. Generally the expenditure results from all those activities required to operate the network.

There are significant trade-offs between the reactive/preventive maintenance budget and the capital budget. Higher expenditures on preventive maintenance will result in lower levels of capital and reactive maintenance expenditure, and vice versa.

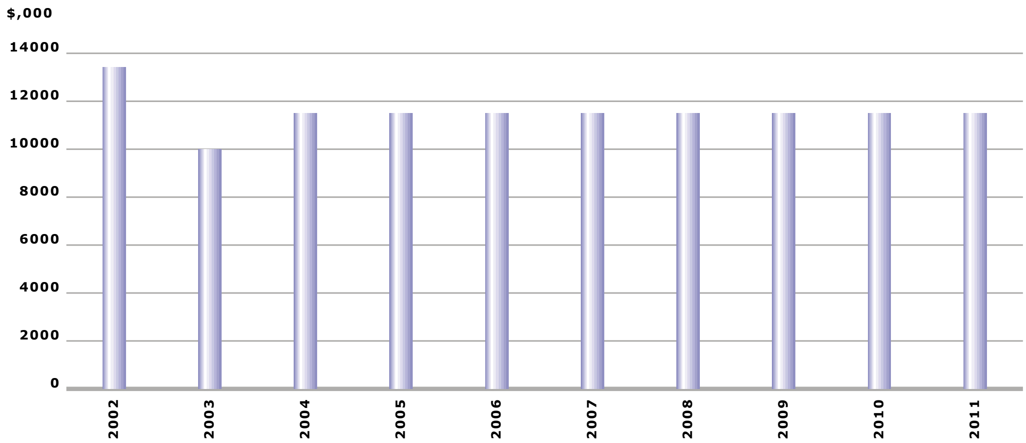
TOTAL MAINTENANCE BUDGET



6.3 OTHER CAPITAL EXPENDITURE

The following graph illustrates the capital expenditure which UnitedNetworks is projected to spend on assets which are non-network related. The high levels of expenditure that are projected at the front end of the planning period are due to UnitedNetworks commitment to improving its information systems, and thus significantly improving customer service and asset management practices.

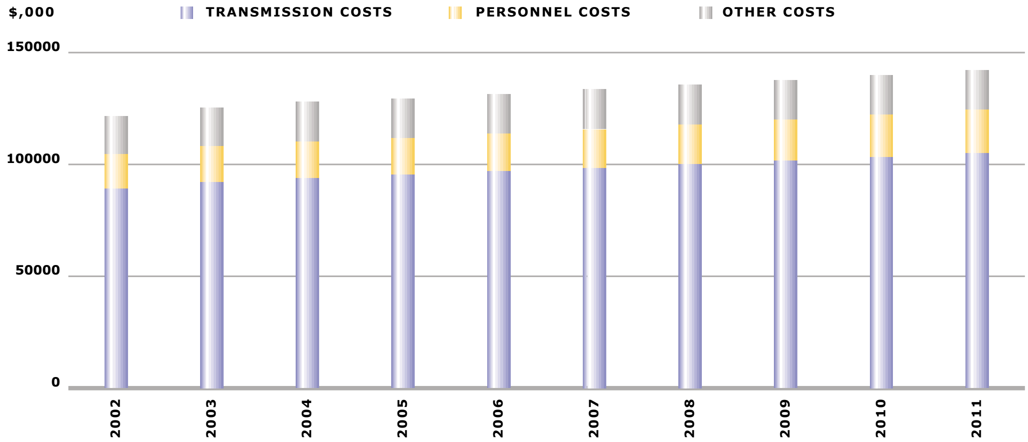
NON-NETWORK RELATED CAPITAL EXPENDITURE



6.4 OTHER OPERATING EXPENDITURE

The following graph outlines all "other" operating expenditure/cost that UnitedNetworks incurs, and which cannot be directly attributed to a specific network asset. It is expected that transmission costs will escalate marginally over the period due to electrical load growth.

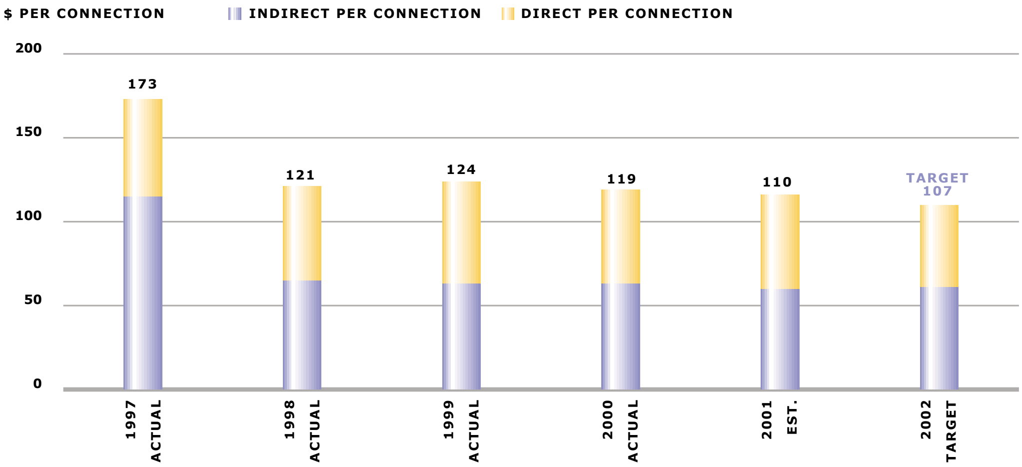
NON-NETWORK RELATED OPERATING EXPENDITURE



6.5 TRENDS FROM PREVIOUS YEARS

UnitedNetworks monitors financial performance in various ways. Of significant interest to stakeholders are the operating costs. UnitedNetworks continues to perform well in this area through the application of continuous improvement targets. The following graph illustrates UnitedNetworks historical operating cost performance coupled with future targets. The direct costs illustrated are those incurred while operating/maintaining specific network assets (linked to the maintenance expenditure discussed in section 4). In contrast the indirect costs are those that cannot be attributed to the operation/maintenance of one particular asset.

OPERATING COSTS PER CONNECTION (SOURCE: CAP GEMINI ERNST & YOUNG REPORTS)



6.6 ASSET VALUATION

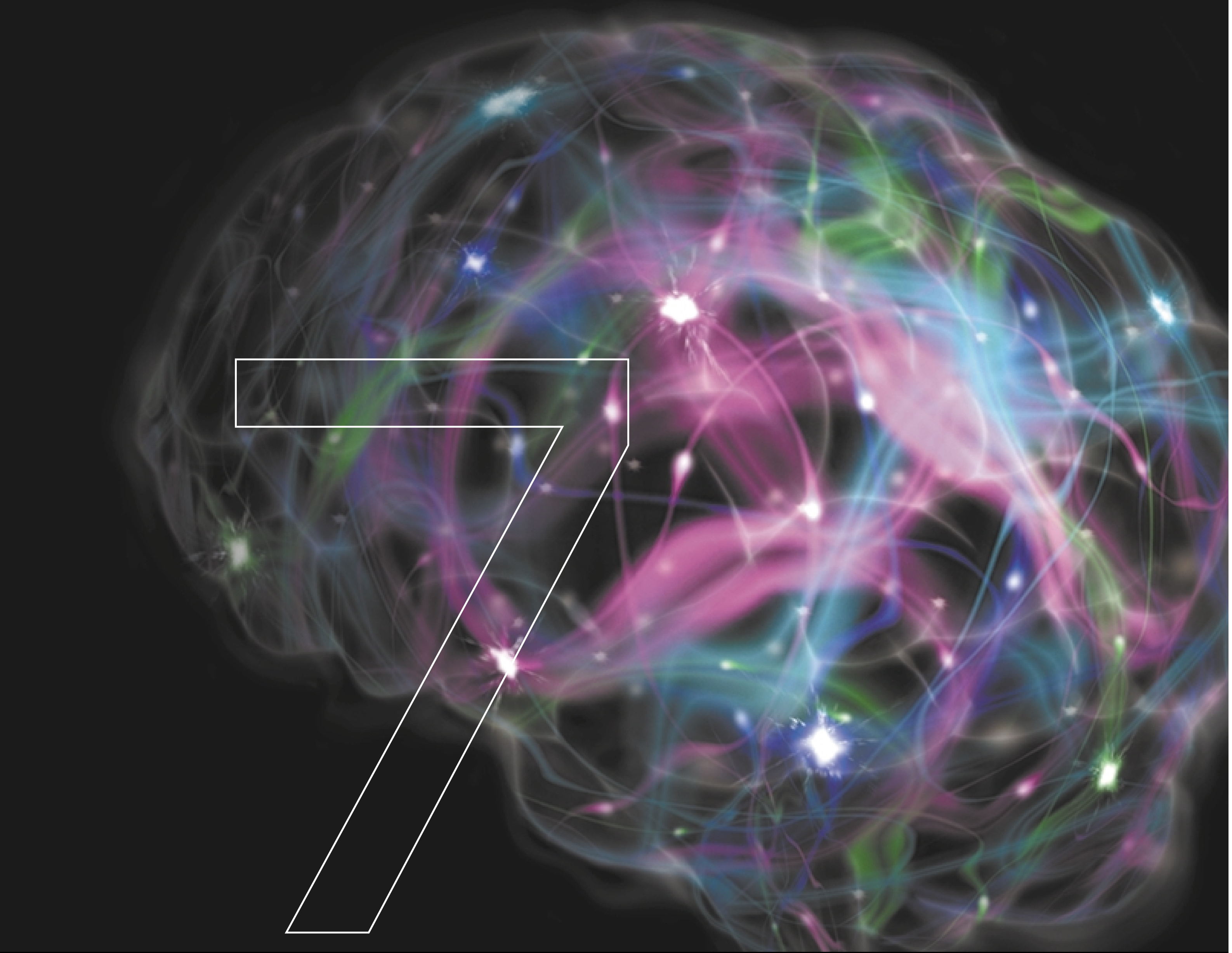
The aggregate Optimised Deprival Valuation (ODV) of UnitedNetworks' electrical network system fixed asset as at 31 March 2001 was $1,037.0 million.

The following table contains a breakdown of the asset valuation by network region.

Network	RC	DRC	ORC	ODRC	ODV
Northern	606,821.8	350,266.0	601,406.1	346,513.3	346,513.3
Eastern	695,628.2	412,650.7	683,434.6	406,519.2	405,839.9
Central	657,439.0	309,804.6	611,414.3	284,647.8	284,647.8
Total	1,959,889.0	1,072,721.3	1,896,255.0	1,037,680.3	1,037,001.0

The following table illustrates the historical network valuation trends over the past four years. The major reason for the reduction between 1998 and 1999 was the sale of $32 million of metering assets due to the split of the lines and energy businesses in the first quarter of 1999.

Region	1997	1998	1999	2000	2001
Northern	327,004	329,663	313,851	321,409	346,513
Eastern	420,098	420,078	389,729	381,712	405,840
Central	316,573	315,276	314,623	302,119	284,648
Total ODV	1,063,675	1,065,017	1,018,203	1,005,239	1,037,001



ASSET MANAGEMENT PRACTICES

7.1	Accounting/financial systems	89
7.2	Asset management systems	89
7.3	Asset information flow, processes and systems	89
7.4	Standards, guidelines and policies	90

RETURN TO MAIN CONTENTS PAGE

7. ASSET MANAGEMENT PRACTICES

7.1 ACCOUNTING/FINANCIAL SYSTEMS

UnitedNetworks employs comprehensive financial systems and reports actual financial performance against budget on a monthly basis. In particular, the following are reported monthly for analysis by senior management:

- Profit by division
- Consolidated profit and loss
- Profit and loss reconciliation by division
- Consolidated balance sheet
- Consolidated cash flow
- Capital expenditure
- Treasury

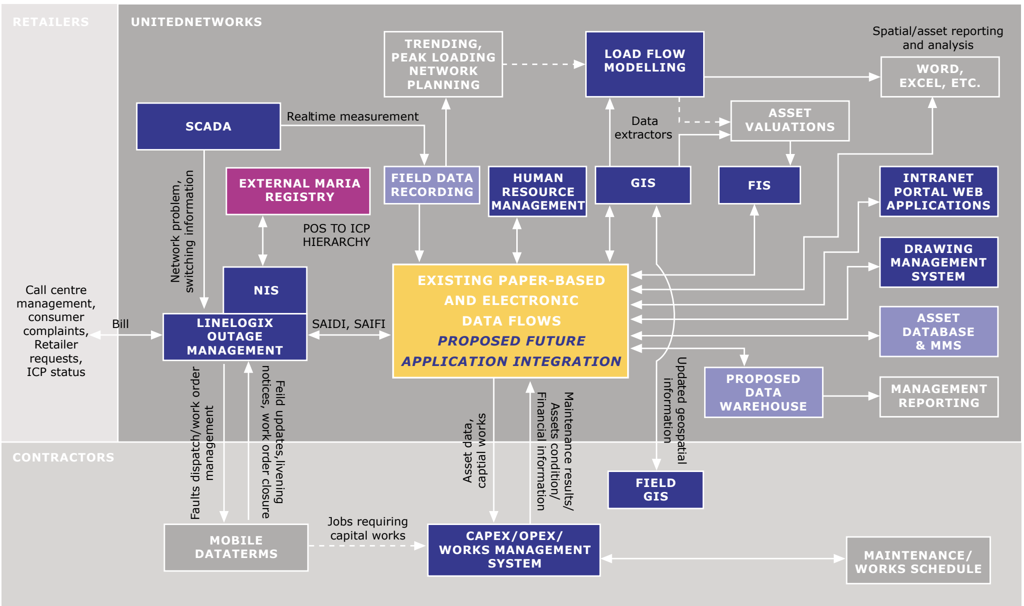
7.2 ASSET MANAGEMENT SYSTEMS

The need to optimise investment decisions over long asset life-cycles necessitates the use of economic modelling tools and access to detailed asset data. A better understanding of customer load profiles enables intelligent load switching and increased asset utilisation. This drives the need to integrate SCADA (System Control and Data Acquisition), customer and asset information. Responsibility for voltage levels and load constraints drives the need for load flow modelling. It follows that in order to deliver a cost effective, superior service UnitedNetworks must own a robust, flexible and powerful set of information systems.

7.3 ASSET INFORMATION FLOW, PROCESSES AND SYSTEMS

Currently the asset information systems owned by UnitedNetworks are partly integrated and partly regionally based. In a number of cases the information flow is manual. The vision for UnitedNetworks network information systems is to establish an enterprise-wide solution that will revolve around enterprise application integration (EAI). This will require a co-operative and open development environment to avoid duplication of information and functionality as systems exchange data.

The diagram below is illustrative of how the various asset management information systems function, in concept, and how they will be integrated electronically.



The Geographic Information System (GIS) acts as the key spatial interface to asset information, as provided by itself and other systems, for viewing the electrical network and undertaking network analysis and modelling. An outage management system (LineLogix) uses this network model, in combination with SCADA operational data, to provide real-time information on network faults and a basis for predicting their cause and dispatching fault crews.

The Network Information System (NIS) contains consumer related information, including billing and energy records.

The Maintenance Management System (MMS) links fault information with asset age and criticality to manage maintenance expenditure.

The Financial Information System (FIS) uses the more detailed asset information to provide accurate valuations of the network and helps to drive asset investment decisions.

All of these systems must link with one another in order to operate effectively.

7.4 STANDARDS, GUIDELINES AND POLICIES

UnitedNetworks has an extensive set of documents containing the approved versions of current company policies, standards, processes and procedures. These documents are managed within a structured management framework.

The framework, amongst other things, identifies when documents are required, what their function is and what the document inter-relationships are.

Every document has a designated owner (or owners) so that an identifiable and responsible person manages all comments, queries, proposals for change, interpretations and reviews.

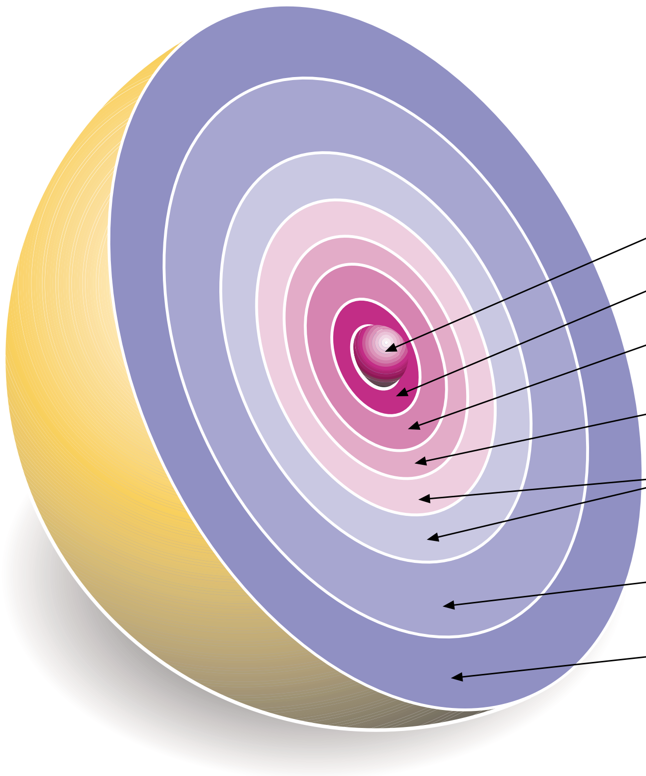
The following table is illustrative of the categories contained within the framework.

Build	Maintain	Operate	Other
Electrical Network Design Standards	Distribution Maintenance Standards	Network Operating Standards	Document change management
Electrical Network Material standards	Substation Maintenance Standards	Network Competency, Safety & Health	Network connection requirements
		Standards for Contractor Prequalifications	Quality Management System

The philosophy of the system is based on all documentation being aligned with UnitedNetworks strategic plan, as illustrated in the following diagram.

DOCUMENT PHILOSOPHY

UNITEDNETWORKS RESPONSIBILITY CONTRACTOR RESPONSIBILITY



RISK MANAGEMENT

8.1	Risk management framework	93
8.1.1	Approach to risk management	93
8.1.2	Risk management structure	93
8.2	Risk analysis	94
8.2.1	Evaluation process	94
8.2.2	Evaluation criteria	95
8.2.3	Quantifying risks	96
8.3	Electricity conveyance risks	96
8.3.1	Force majeure	96
8.3.2	Customer charter	96
8.3.3	Operational network security	96
8.3.4	Network risk register	98
8.4	Catastrophic risks	98
8.4.1	Earthquake	99
8.4.2	Landslide	99
8.4.3	Volcanic action	99
8.4.4	Tsunami	99
8.4.5	Flood	100
8.4.6	Wind	100
8.4.7	Malicious damage	100
8.4.8	TransPower	101
8.4.9	Regulatory compliance	101
8.4.10	Construction and maintenance	101

RETURN TO MAIN CONTENTS PAGE

8. RISK MANAGEMENT

8.1 RISK MANAGEMENT FRAMEWORK

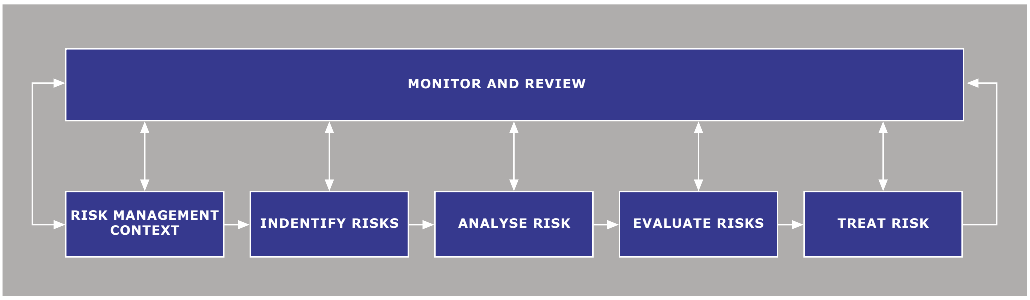
This section contains a risk management statement which sets out UnitedNetworks risk management structure and processes, and identifies all relevant risks on the network. This statement applies to all networks making up the three regional areas, and is confined to risks of the network and those business processes that directly relate to the network.

8.1.1 Approach to risk management

UnitedNetworks has a relatively low tolerance to risk exposure due to the nature of the essential service it provides, the safety aspects of conveying electricity and the need to protect both company image and free cash flows.

UnitedNetworks employs a quantitative approach to risk management that evaluates both risk likelihood and risk consequence. Where event outcomes may be quantified by a probability this is used in the risk analysis. Risk events of high consequence are more often characterised by uncertainty or surprise than classical probability, which relies on a past history of occurrence. Where past history is not a useful guide to future events, a systematic and rigorous process is needed to discover the risk possibilities.

UnitedNetworks uses a systematic and rigorous approach to risk identification and control. UnitedNetworks has adopted the AS/NZ 4360 Risk Management standard. Under this standard, risk management is undertaken in the manner illustrated below.



This standard includes four main elements:

Risk Context: which essentially defines the strategic, organisational and structured environment under which the risk management is carried out.

Risk Identification: which lists all the risks relevant to the risk context.

Risk Analysis: which estimates the likelihood of the identified risks occurring, the extent of loss and the cost implications.

Risk Treatment: which defines the actions to remove, mitigate or prepare for the risk. This involves contingency plans where appropriate.

8.1.2 Risk management structure

Risk Management is undertaken under the direction of the UnitedNetworks Electricity Business Line Risk Management Committee. The committee directs the systematic identification and analysis of electrical asset risks and forms part of UnitedNetworks company wide risk management structure. This structure records, collates and reports on all company risks on a monthly basis. Major risks are reported regularly to UnitedNetworks' Board.

8.2 RISK ANALYSIS

8.2.1 Evaluation process

The evaluation process is mainly captured by the following two areas, the Network Security Model and the Risk Assessor.

Operational contingency events are systematically set out and analysed in the Network Security Model (refer to section 5). This model estimates the capitalised cost of the risk in comparison with the cost to remedy the risk. The cost of the risk takes into account:

- Consumer’s value of non-supply
- Expected charter claim costs
- Potential litigation for service interruption

The Network Security Model is used as an economic test for capital investment to improve network security and a process for highlighting significant risks from those that are relatively insignificant. Where operational risks are shown with high consequences these may be transferred to the Risk Assessor.

The Network Security Model does not consider multiple failure of circuits. Where special risks apply as with multiple cable circuits laid in a common trench or multiple sub-transmission circuits on common towers, these are assessed in the Risk Assessor. The Risk Assessor captures the significant business, regulatory and special conveyance risks which include:

- Conveyance Risks
  - Network (by Region)
  - Transpower
- Catastrophic Risks
  - Earthquake
  - Volcanic
  - Flood
  - Windstorm
  - Landslide
- Regulatory Compliance Risks
  - Environmental
  - Health and Safety
  - Resource Management Act
- Business Risks
  - Supplier Risks
  - Latent Defects
  - Fire
  - Information Storage & Retrieval
  - Skills Gap etc

From both the Network Risk Register and the Risk Assessor actions are determined. These actions include either capital development, maintenance/operational enhancement, contingency planning, insurance or acceptance of the status quo.

8.2.2 Evaluation criteria

The risk management process outlined in AS/NZ 4360 requires the risk evaluation criteria to be stated within the risk context.

Unbiased assessment

The different regional networks of UnitedNetworks have been constructed to different design standards and are exposed to different internal and external risks. The historical design philosophy employed on urban networks has been to ensure that the network is capable of meeting the peak demand at all times against the failure of a single relevant item of sub-transmission or substation equipment. In contrast, the rural networks have a relatively low consumer density and few commercial or industrial areas. This has made the provision of single contingency reliability in many areas, even by switching, prohibitively and unjustifiably expensive and more risk has therefore been accepted.

These contrasts are driven by a difference in the cost/benefit of reliability and not by a different methodology of assessing risks. UnitedNetworks takes an unbiased view of risk assessment between the different network regions. All consumers of a particular type (i.e. domestic) are appraised equally in terms of the value they place on reliability.

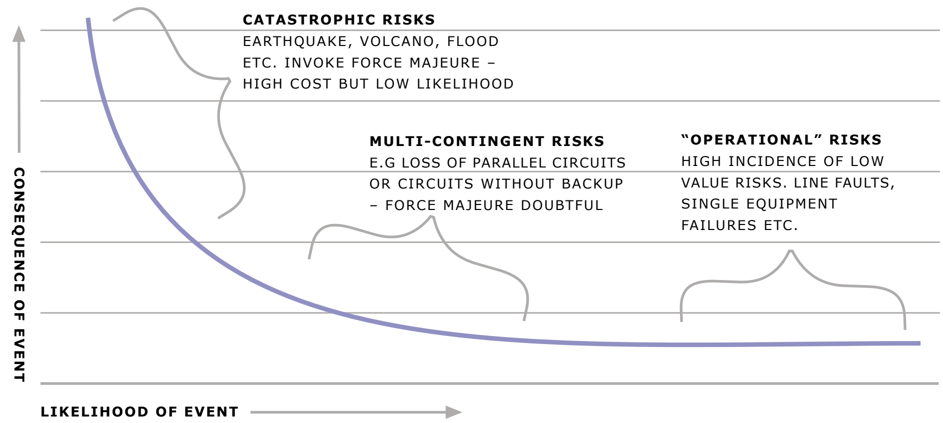
Credible risks

Credible risks comprise those failures due to aging processes, overloading, material deterioration, human error, poor workmanship, lightning, fire, earthquake, flood etc all within the past experience of UnitedNetworks and other similar electricity companies. Risk which could be deemed fanciful are not considered (i.e. aircraft crashing into substations where these substations are not near airfields or on recognised approach paths to airports).

8.2.3 Quantifying risks

The preferred approach is to quantify risk as the product of consequence and probability. Repetition of historic patterns is a reasonable assumption for probability, for example, the rate of occurrence of faults in distribution lines, return period of a flood or storm, etc. However, it should be noted that probability only works for predicting the outcomes of a large number of independent and homogenous events.

Practices in network design and operation tend to seek to avoid loss. As a result, events with high consequence are usually associated with low probability of occurrence. Conversely risks with high probability invariably associate with minor consequence (i.e. service fuse failure). This conceptual relationship between consequence and likelihood is illustrated below which shows where different types of risk can be placed on the 'risk continuum'.



8.3 ELECTRICITY CONVEYANCE RISKS

Failure to supply is a major risk context for UnitedNetworks. Costs of failure to supply fall onto UnitedNetworks, retailers and consumers. In a connected network, failure to supply may originate at many levels with differing consequences. Failure to supply has dimensions of magnitude of loss, how the costs fall and the ability to control risks. Failure of generation or bulk transmission is also involved.

8.3.1 Force majeure

Responsibility to supply may be excused where circumstances outside the control of UnitedNetworks frustrate the delivery of the network service. Earthquake or volcanic action are examples of force majeure. However the boundary of force majeure is not always clear. For example, an overhead line failing in a windstorm may be force majeure but may also be imprudent design and/or maintenance. Compliance with recognised design standards and "best practice" would be considered in discovering force majeure.

8.3.2 Customer Service Level Payments (charter)

UnitedNetworks' Use of Network Agreement (UNA) provides for the following payments to be made to retailers where UnitedNetworks fails to restore a complete loss of supply within 6 hours for unplanned rural outages, and 3 hours for unplanned urban outages:

- $40 for residential points of connection
- $100 for non-residential points of connection

These undertakings exclude circumstances such as force majuere and major maintenance shutdowns (which are normally completed well within six hours) and do not apply if the loss of supply is caused by agencies other than UnitedNetworks (i.e. Transpower).

The risk to UnitedNetworks of increasing payment is intended to act as a driver for asset management policy. The service levels are negotiated with UnitedNetworks by the retailers during the contract renewal process and should therefore reflect the service requirements of the end-consumers.

8.3.3 Operational network security

Operational security relates to the restoration of supply to consumers under fault or maintenance conditions for short periods during peak loading conditions. Single component network failures seldom result in significant direct cost to UnitedNetworks. However, network security needs to pass the test of prudent operation to protect UnitedNetworks from any claim of negligence. The methodology of consumer's value of non-supply is applied. UnitedNetworks evaluates the benefits of capital investment for network security based on:

- UnitedNetworks Security of Supply Standard (section 5.1.3)
- UnitedNetworks Network Security Model (section 5.1.4) that estimates the risk consequence based on the cost to consumers of energy not supplied
- An assessment of the probability of occurrence of risk events and the expected duration of the events

Network investment based solutions to improve network supply security are not the only option considered. Non asset based factors such as speed of response to faults and communication with customers/consumers may be preferable to expensive capital solutions.

8.3.4 UnitedNetworks Risk Assessor

Significant network risks are high consequence events arising from single or multiple failures of the network itself, (i.e. insulation failure within a zone transformer as opposed to an earthquake toppling a zone transformer.) Significant network risks could arise where parallel or consecutive failures of circuits occur due to common failure modes (lack of true independence) or lack of spatial diversity (i.e. multiple sub-transmission cable circuits in a common trench). Significant network risks may also be identified from the Network Security Model due to the high assessed consequence combined with the special circumstances that set the risk apart (for example, a line includes a long span supported on towers without spares or difficult access). This generally arises when special circumstances are combined with major supply circuits or busbars that do not have effective back-up.

UnitedNetworks Risk Assessor is a software package that holds a database of the different categories of risks. It is a live database that is updated regularly to record all identified risks, the actions required to mitigate these risks, the actions completed and the acceptance of these actions.

Key network risks for each region are:

Northern Region

The loss of the 110kV overhead line running from the Transpower Albany substation to UnitedNetworks Wairau Road substation. This is a double circuit overhead line run on a single set of wooden poles. Loss of this line during peak network loading conditions would result in loss of supply to 30% of lower North Shore customers. This risk is mitigated by the short repair time associated with overhead construction.

A number of zone substations are supplied via multiple cables that are run in the same trench. This leads to the possibility of a multiple failure from a single contingency event. The risk is mitigated through the availability of significant transfer capacity from adjacent substations. The Hobsonville and Browns Bay substations constitute the major risks in this category. At both locations multiple cable supplies run in the same trench over significant distances.

Eastern Region

A number of zone substations are equipped with only one transformer with limited backup via the distribution network. Substations in this category include Tirau, Coromandel, Kerepehi, Matatoki, Tahuna, Tairua, Whangamata, Omokoroa, Taupo South and Waihi Beach. UnitedNetworks does not carry out-of-service spares and in the event of a failure an in-service spare transformer would have to be shifted from another substation.

In some areas high ground temperatures due to geothermal activity obscure true cable ratings and result in the potential for inadvertent overload of underground cables and early failures. The Rotorua and Taupo regions are the most affected, with the cable supply to the Arawa substation representing the highest risk (two underground cables in the same trench). The longer repair times associated with cable failure may result in extended customer outages. UnitedNetworks continually monitors thermal activity along the major cable routes affected by geothermal activity.

A number of zone substations are supplied via single overhead sub-transmission lines without alternative subtransmission supply. Substations that fit into this category include Coromandel, Kerepehi, Matatoki, Putaruru, Thames, Tirau, Whangamata, Whitianga, Rainbow and Runanga St. The risk is mitigated by the ability to partially shift load via the distribution network to adjacent zone substations, coupled with the fast repair times associated with overhead lines.

Central Region

The Terrace and Moore Street zone substations have peak loads close to or exceeding the individual capacity of the cables and transformers supplying each of these substations. Should one transformer or cable fail during peak loading conditions load would have to be switched via the distribution network to an adjacent zone substation. Although the consequences of an outage at these substations would be high, such an outage would be of short duration.

The Terrace and Moore Street 33kV supply cables (2x2) all run in a common trench from the Transpower Wilton point of supply. Along the route the cables cross under a road bridge spanning a known fault line (there are no routes from Wilton to the Wellington central business district that would not cross a fault line). UnitedNetworks continually monitors excavations along this cable route.

Most zone substations are supplied from dual cables that are run in the same trench. This leads to the possibility of a multiple failure from a single contingency event. The risk is mitigated through the availability of significant transfer capacity from adjacent substations in the predominantly urban network.

8.4 CATASTROPHIC RISKS

Because external events may impact on whole sub-stations or extended areas of the network, major loss may occur as a result of catastrophic risk events such as earthquake, landslide, volcanic action, tsunami, floods, wind storms or fire.

8.4.1 Earthquake

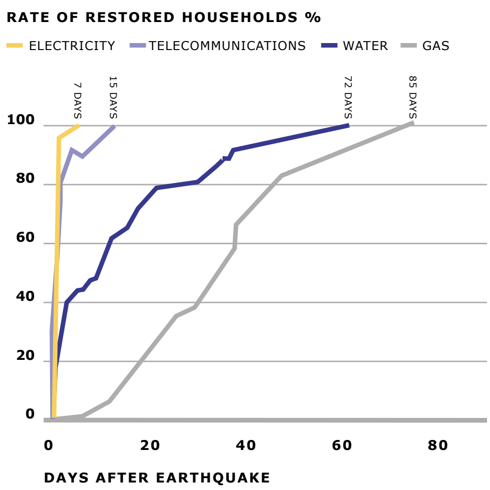
Damage to the distribution assets has been assessed relative to the shaking intensity measured on the Modified Mercalli (MM) scale. These range from minor damage (<1% of asset replacement value at shaking <MM8) to significant damage (≈15%) at MM10 (the maximum earthquake shaking intensity that UnitedNetworks assets are likely to experience).

Northern and Eastern regions are not anticipated to experience more than MM8 shaking on a one in five hundred year event with only minor damage as a result.

Central Region represents the greatest exposure. A one in five hundred year earthquake could exert MM10 shaking on the southern (Wellington) network. This is also the maximum credible earthquake event for this network. Damage in the region of 15% of replacement value is estimated for transformers and switchgear and 10% for other distribution assets. An earthquake of this magnitude would invoke a civil emergency and restoration of electricity to firstly essential services and then commercial and domestic consumers would be a national priority.

In 1995 Kobe experienced an earthquake with shaking intensities similar to those that would be expected in a Wellington Fault event.

RESTORATION OF SERVICES IN KOBE



Supply to Wellington may not be restored as quickly since Kobe had a much higher degree of network redundancy. However, supply restoration of electricity services is still likely to lead the restoration of other services.

8.4.2 Landslide

The risk of significant damage due to landslide in the Northern and Eastern Regions is considered relatively low. However, there is a significant risk of localised landslide in the steeper parts of the Central Region's southern and northern networks. Approximately 30% of the southern network urban asset and 10% of the Northern networks urban asset is located in areas of moderate risk. The rest of the urban assets are in low risk areas apart from those installed long the transport corridor between Ngauranga Gorge and Petone where the risk is high.

The four gas insulated 33kV cables connecting Transpower's Wilton substation to the Moore St and Terrace zone substation are installed in steep terrain and may be exposed to landslide damage.

8.4.3 Volcanic action

Volcanic action represents the greatest potential loss of all identified risks.

Northern Region – Takapuna, Devonport, Milford, Northcote and Glenfield representing about 15% of the Northern Region's distribution network, are situated within the Auckland Volcanic Field. This field is still considered active, although there is no basis on which to predict the time or approximate location of a future eruption.

Historic eruptions have displaced approximately three cubic kilometres of material per eruption. Most hazards would be confined to 1-4km from the vent and conceivably destroy all assets within 1-2km of the vent. Ash and lava flows may cause problems further afield and the corrosive effect of acidic products could spread over a wide area reducing the economic life of network assets that may otherwise appear undamaged.

A one in 10,000 year likelihood is estimated for an eruption on this field with resultant material damage of $70-80 million.

Eastern Region - The Taupo and Okataina volcanic centres pose the greatest potential volcanic hazards. Both are capable of eruptions exceeding 100 cubic kilometres. Eruptions of this size would bury much of the Eastern Region's Taupo and Rotorua networks. Likelihood of one in 20,000 years is calculated with material loss of $100-250 million.

Lesser scale eruptions (7 cubic kilometres) with higher frequency (one in 3,000 to 5,000 years) are also likely based on the geologic record. Such eruptions would incur lower loss, approximately $100 million material damage.

Central Region – There is no credible volcanic hazard threatening the Central Region distribution network.

8.4.4 Tsunami

Tsunami are large waves of volcanic or seismic origin which may occur as a consequence of both very distant or local events.

Low lying assets in Thames and along the Waihou River (including the Mikkelson Road zone substation at Te Aroha) could be inundated to various depths in tsunami flood waters resulting from a rupture of the northern section of the Kerepahi fault. However, the likelihood of such an event is low; one in 10,000 years.

Low lying assets along the Wellington and Petone foreshore (including Seaview substation) could be inundated in a seiche in Wellington Harbour caused by a local earthquake or large offshore Tsunami. The likelihood is difficult to predict, but less than one in 100 years is assumed.

Low lying distribution assets in Tauranga and Mt Maunganui could also be exposed to tsunami, however damage and disruption to UnitedNetworks assets is likely to be less than suggested in the previous scenarios for tsunami.

8.4.5 Flood

Distribution assets tend to fare reasonably well in flood events, especially if water velocities are low, (<0.5ms).

Recorded flood events affecting the Auckland area (including the Northern Region's network) have generally been localised in nature with rarely more than one major catchment experiencing appreciable flood damage at any one time.

With the exception of several small coastal settlements, the Eastern Region's assets are not located in recognised flood plains.

However, the Thames Valley network assets, near the lower reaches of the Waihou, Piako and Waitakaruru Rivers and in the lower lying reaches of the Hauraki Plains (where approximately 25% of the Valley network asset value is located) are exposed to flooding, especially in extreme events. Distribution transformers in these areas (apart from a few in Thames) are mostly pole mounted. Flood protection works will provide reliable protection for most assets from flood events up to one in 50 to 100 years.

The Hutt River presents a significant hazard to distribution assets in the Central Region. Flood protection works will provide reliable protection for most assets from flood events up to one in 50 to 100 years. The flood protection works may be overwhelmed in more extreme events causing widespread flooding through low lying areas near the river.

Wellington Regional Council flood hazard maps suggest that flood depths in excess of one metre could be expected in parts of the Lower Hutt CBD, Moera and parts of the Upper Hutt CBD during a one in 1,000 year event (equivalent to a 2,500 cumecs river flow). The replacement value of distribution assets in the flooded region (including five or six 33kV sub-transmission cables installed in bridges spanning the Hutt River) would be in the order of $30-40 million. 15-30% damage to these assets resulting in a property loss of $5-12 million is assumed due to the depth and relatively high velocity of the flood waters that would be experienced.

Flow rates in the Hutt River in the region of 3500-7000 cumecs are credible for the probable maximum flood (PMF). The assets at risk would be similar to those in the 1,000 year event however the extent of damage and time to recover would be significantly greater.

8.4.6 Wind

Occasional high wind and even small tornadoes can be expected particularly in the Northern Region. High winds with short gusts occasionally up to 200km/hr in some areas can be expected in the Coromandel Ranges and Rimutaka Ranges.

Rural line assets are more at risk of damage during high winds than urban line assets. Even so, they are designed to withstand high winds and most would be expected to fare reasonably well in extreme storm events. 1-2% damage to rural pole mounted assets in 500 year storm events as a result of unfavourable topographical features (accelerating local wind speeds) is assumed. Significant asset damage in a 500 year wind storm is not likely to occur in more than one UnitedNetworks Region at a time. Electricity disruption to most rural consumers would probably be reinstated within one to two weeks.

Even in maximum credible wind storms, wind forces would vary widely. A loss of 3-5% of poles and pole mounted assets in rural areas is assumed in a maximum credible wind storm. Electricity disruption to most rural consumers would probably be reinstated within one to four weeks depending on accessibility and availability of repair resources.

8.4.7 Malicious damage

Electricity transmission and distribution systems are vulnerable to malicious attacks. Previous attacks on Transpower pylons in the South Island highlight the vulnerability of rurally located assets to more determined (and potentially severe) attack. Terrorist bombings are not a recognised feature of New Zealand society but the potential for such attacks on infrastructure assets, particularly those whose damage is likely to be particularly news worthy (like electricity networks) does exist. The loss of more than one site at the same time would require an organised and coordinated attack. The probability of this occurring in the current social environment is probably remote but cannot be discounted.

In the Northern Region the Sunset Road, Birkdale, East Coast Road and Wairau Road zone substations are identified as more at risk from vandalism due to the socio-economic factors in those areas.

8.4.8 Transpower

UnitedNetworks level of exposure to risk is extended in respect that the power it conveys is also simultaneously carried over the Transpower network. Transpower face similar if not identical risks to UnitedNetworks.

Transpower has undertaken its own assessment of risk to UnitedNetworks grid supplies. UnitedNetworks maintains a watch on Transpower grid risks together with Transpower.

8.4.9 Regulatory compliance

UnitedNetworks operates in a regulatory environment that mandates codes of compliance for both outputs and processes. These include Environmental, Health and Safety, Resource Management Act, Privacy Act, Discrimination and Harassment and Information Disclosure. Specific regulatory compliance risks e.g. oil contamination, noise, PCB's are held in risk registers and monitored by the Risk Committee.

Occupational health and safety is addressed through application of the business health and safety plan and warranting of contractors operating on the network.

Public safety is addressed through application of the maintenance and replacement plan and benchmarking of maintenance practices. UnitedNetworks maintenance policies address environmental and human safety as an imperative. Despite this, there will always be some residual risk as the present inspection methods (of the electricity industry) are not capable of detecting all safety related failures prior to occurrence.

Specific risk areas are:

- Pole failures
- Conductor failures
- Exploding metal cable potheads
- Ground mount switchgear explosions

8.4.10 Construction and maintenance

Following the failure of the subtransmission cables to the Auckland CBD in 1998, a re-assessment of UnitedNetworks 33kV and 11kV cable ratings was undertaken particularly in regard to the measured thermal resistivity of cable bedding and back-fill material.

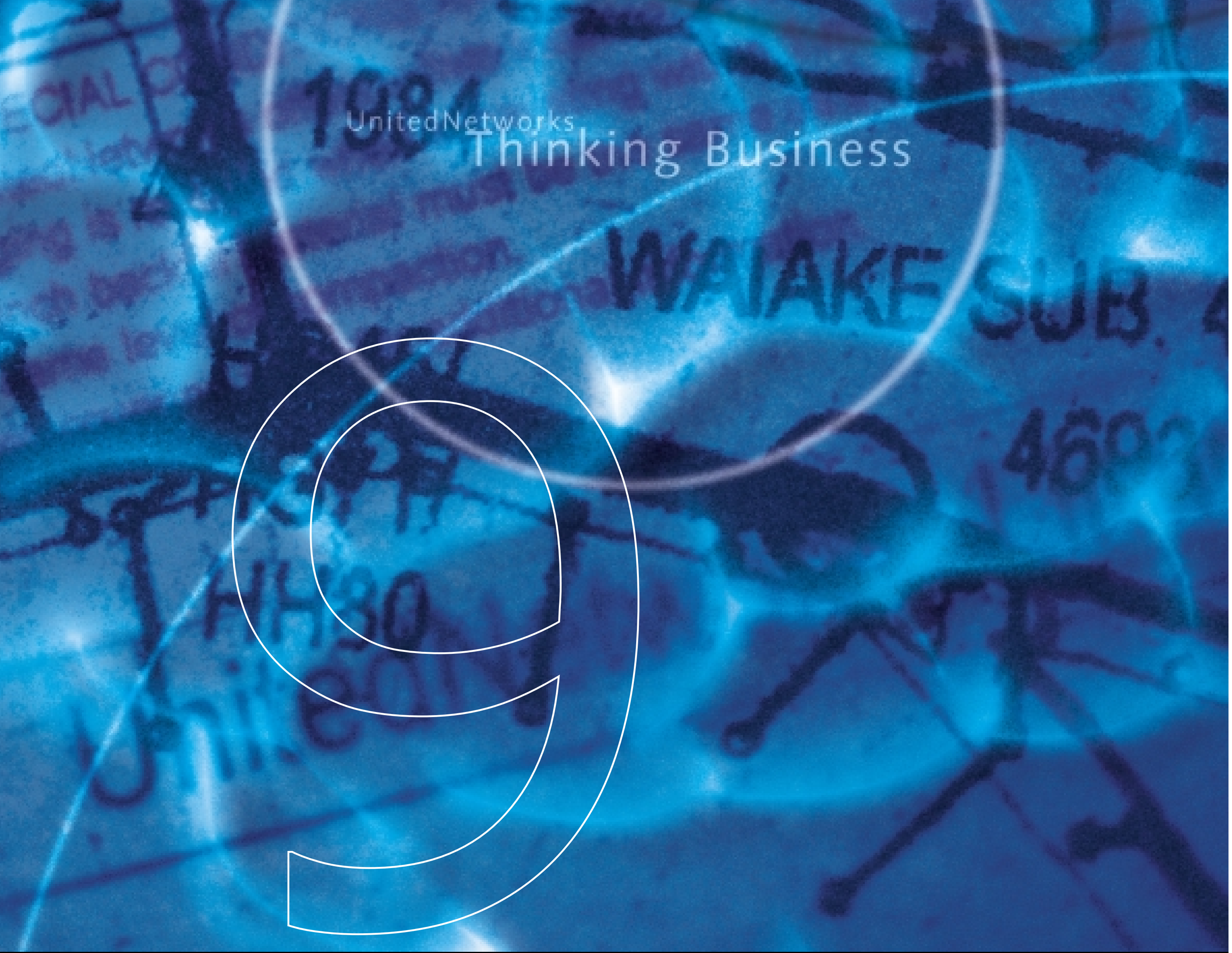
In the Northern Region, temperature sensors have been placed in cable trenches where cables group at route exits from a select number of zone substation servicing the Takapuna central business district. In the Central Region, testing of soil thermal resistivity has been undertaken on the most heavily loaded 11kV distribution cables and the 33kV subtransmission cables connecting Wilton point of supply to the Moore Street and Terrace zone substations.

Rot on wood poles often attacks from within the pole and from below the ground level. This makes detection of wooden poles with inadequate strength due to rotting both difficult and expensive.

Northern Region has mostly concrete poles and wood rot of poles is not a significant issue. Central Region has a mixture of wood and concrete poles. The wooden poles have been and are systematically tested for strength. Eastern Region has a known population of suspect wooden poles particularly in an area south of Rotorua. A program of testing pole assets is ongoing.

Fire/explosion as a material damage risk is limited to key assets which include the network control centers, UnitedNetworks regional offices and zone substations.

The Takapuna network control centre has a very high standard of fire protection installed. A reliable fire suppression system is also installed in the Haywards network control centre. Loss of SCADA systems is not expected to result in significant network disruptions.



PLAN IMPROVEMENT AND MONITORING

9.1	Benchmarking and performance measures	104
9.2	Improvement programme	104
9.2.1	Network information performance	105
9.2.2	Asset performance	105
9.2.3	Financial performance	106
9.3	Monitoring and review procedures	106

RETURN TO MAIN CONTENTS PAGE

9. PLAN IMPROVEMENT AND MONITORING

9.1 BENCHMARKING AND PERFORMANCE MEASURES

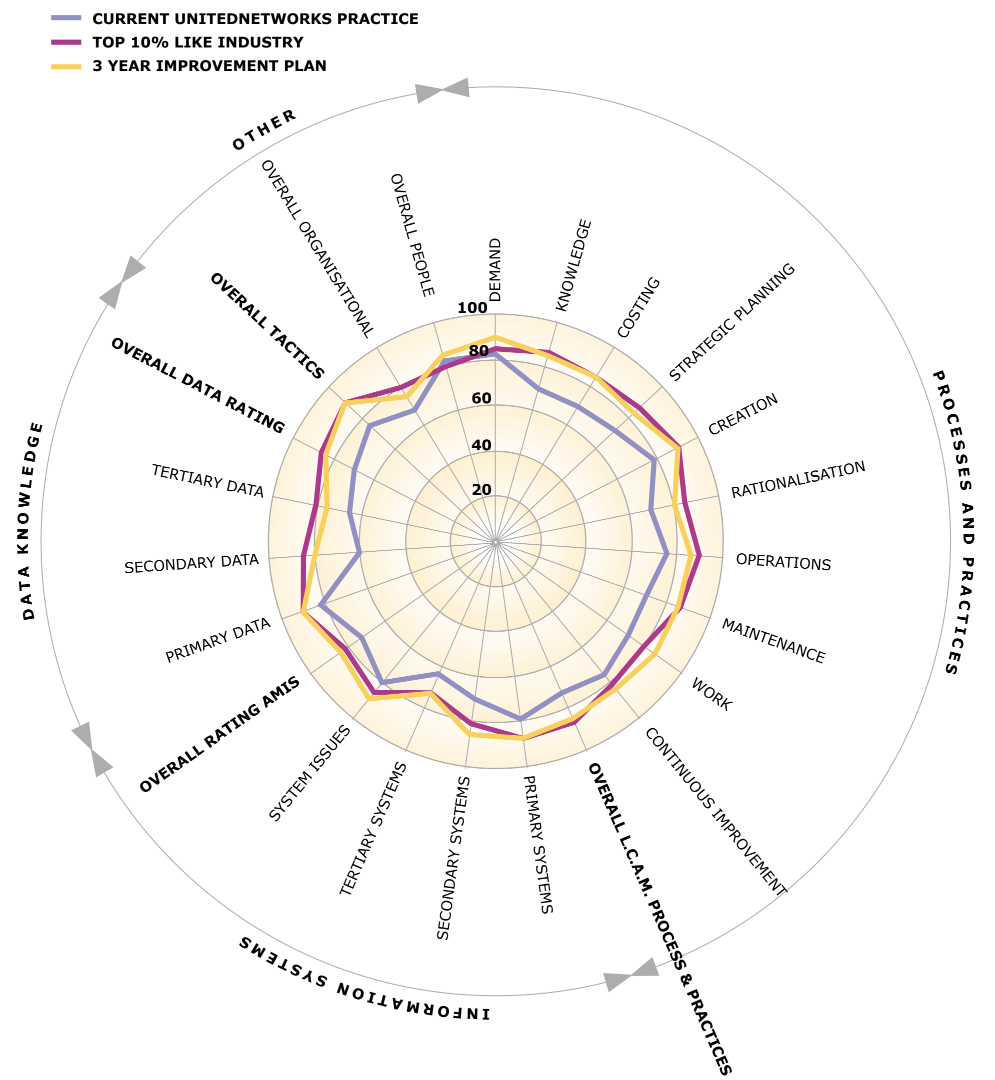
UnitedNetworks is committed to developing performance measures that evaluate the effectiveness of its asset management practices, systems and documentation. These measures make comparisons against other asset management companies and highlight those areas of weakness that require action.

9.2 IMPROVEMENT PROGRAMME

UnitedNetworks electrical asset management practices and systems have been reviewed externally by an independent expert during 2002. The scope of the review included:

- A review of the electrical Asset Management Plan
- On site discussions with staff in order to assess asset related processes/practices, data/knowledge and information systems.
- A gap analysis identifying UnitedNetworks current position in relation to other asset management companies.
- Identification of the criticality of each asset management activity with a recommended improvement strategy.

The following chart illustrates UnitedNetworks current asset management practice in comparison to the top 10% of like industries. The chart also illustrates target levels for the different asset management areas which UnitedNetworks has committed to achieve.



Overall during 2002 UnitedNetworks Total Asset Management Plan (TAMP) index was judged to be 85%. While significant improvements have occurred (TAMP of 78% in 2001) the gap analysis undertaken indicates that the following asset management areas are those where UnitedNetworks falls short of expectation, and which require attention in the short term:

1. Secondary data
2. Secondary systems
3. Costing
4. Maintenance processes
5. Maintenance knowledge

In general the review has indicated the need for UnitedNetworks to focus on maintenance and costing data/systems. The following sections outline the recent and current improvement plans.

9.2.1 Network information performance

During 2001 a GIS data enhancement project was undertaken to enhance the level of asset information stored in the GIS. The primary driver of this project was to be able to provide a reliable source of data for the regulatory valuation (ODV), but a number of other business processes and systems have benefited from this. In particular, data from the enhancement project was used to create a single asset database/register for all of UnitedNetworks electrical assets, which is located within a computerised maintenance management system (MMS).

The commonality of information between the GIS and Maximo means that the two systems are closely linked and processes are in place to track exceptions. The integration of these two systems from this point forward will initially be manual and paper based, however the intention is to move to electronic integration if this proves to be technically and economically feasible.

UnitedNetworks requires both of these systems in order to have a complete picture of the state of it’s electrical asset. The GIS gives the geospatial information and can demonstrate what the network looks like today, the MMS is required to provide the asset history as well as to link with other asset related systems.

By utilising the features and functionality of both systems UnitedNetworks planners and managers will have ready access to the tools and data required for effective decision-making.

Currently UnitedNetworks MMS is simply an asset register and the capture of asset condition and maintenance history is paper based. The computerised capture of this information will be addressed during 2002/2003.

During 2002 UnitedNetworks plans to begin a project of Enterprise Application Integration that will enable electronic integration between UnitedNetworks major information systems. The integration of these information systems will enable UnitedNetworks to develop strategic tools that combine information from various sources.

9.2.2 Asset performance

Improved asset performance analysis

In the future the functionality of UnitedNetworks MMS will be used to record fault and maintenance history for each asset. The ability to analyse this information by asset and consumer area will enable asset targeted maintenance and development programmes.

Asset maintenance philosophy review

It is UnitedNetworks intention to migrate towards advanced condition, performance and reliability centred maintenance management. As asset condition and maintenance history becomes more accessible (via a computerised MMS) it is planned to refine the current maintenance strategy.

Equipment specifications

A review of equipment specifications is underway, with the objective being to identify and analyse the ongoing procurement, installation and maintenance requirements.

9.2.3 Financial performance

The installation of a MMS, coupled with the existing GIS, will enable UnitedNetworks to track, monitor and understand asset expenditure in a much more efficient and visible manner. One initiative that occurred in 2001 was the development of asset replacement models that have enabled UnitedNetworks to improve its management of asset replacement expenditure.

The data source for the asset valuation (as at 31 March 2001) was for the first time almost entirely from the GIS system. A number of GIS analysis tools have been developed for the valuation and these will continue to be developed.

9.3 MONITORING AND REVIEW PROCEDURES

The Asset Management Plan is produced in the first quarter of each year, for internal planning purposes and for regulatory disclosure. It will be used to help prepare the budgets for the following year, and for negotiating with the field services contractor.

A draft of the Plan is issued to the Regions and the contractor for discussion and comments before being finalised. It is audited and reviewed by external consultants at regular intervals, to ensure that the Plan is clear, logical and contains no gaps.

Directory

Directors

D G Bacon

R P Perkins

P M Smith

K G Stamm

R W Stanic

D W Warnock

Chief Executive Officer

D W Warnock

Registered Office

44 Taharoto Road

Takapuna

Private Bag 102 977

North Shore Mail Centre

Auckland 1333

Telephone: 64 9 919 4000

Toll free: 0800 948 100

Facsimile: 64 9 919 4266

www.unitednetworks.co.nz

www.unc.co.nz

www.linelogix.co.nz

www.pureenergy.co.nz

Share Registry

Computershare

Level 2

159 Hurstmere Road

Takapuna

North Shore City

Private Bag 92119

Auckland 1020

Telephone: 64 9 488 8777

Facsimile: 64 9 488 8787

Auditors

Ernst & Young

41 Shortland Street

Auckland

Bankers

Bank of New Zealand

Level 4

125 Queen Street

PO Box 2139

Auckland

Legal Advisers

Chapman Tripp Sheffield Young

Level 35

ANZ Centre

23–29 Albert Street

Auckland

RETURN TO MAIN CONTENTS PAGE