Asset Management Plan

2001/2002

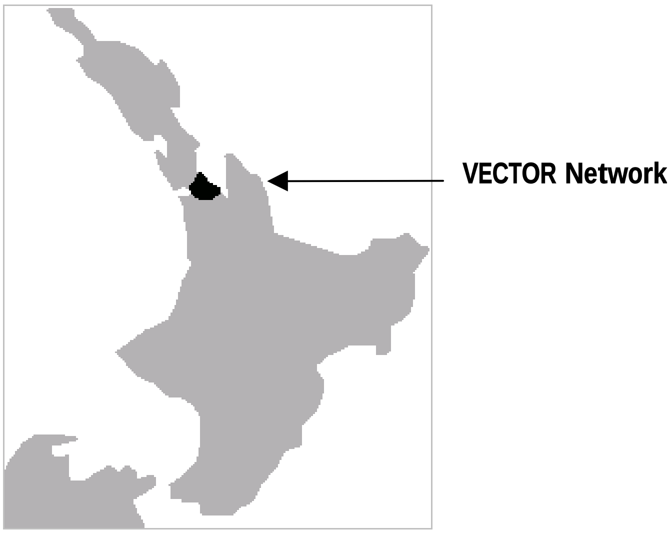
vector

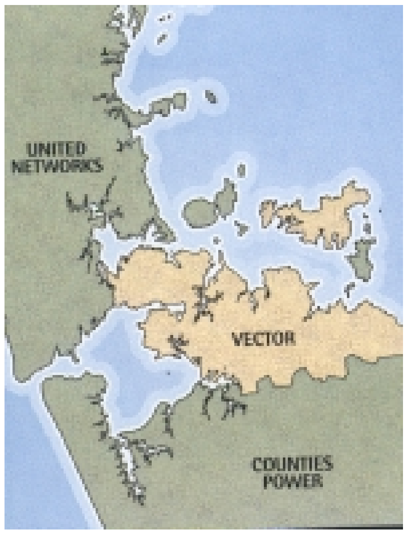
Auckland's Electricity Network

ASSET MANAGEMENT SUMMARY

This summary is provided to meet the mandatory disclosure requirements of Regulation 25 of the Electricity (Information Disclosure) Regulations 1999, as amended by the Electricity (Information Disclosure) Amendment Regulations 2000.

THE VECTOR NETWORK





VECTOR's network supplies more than one sixth of New Zealand's electricity demand. The distribution business covers the cities of Auckland, Manukau and part of Papakura, an area of approximately 900km^2. VECTOR has 260,000 customers, including approximately 220,000 residential customers and 50 of the country's top 200 industrial/commercial electricity consumers. Nearly 99% of the customers are located in the urban area.

NETWORK SUMMARY

Area Covered	894km^2
Customer Connections	260,000
Total Annual Energy Distributed	4,961GWh
Peak Demand	908MW
Supply Points from Transpower	8
Zone Substations	49
Distribution Substations	8,300
Transmission Cables	67km
Subtransmission Cables	391km
Subtransmission Lines	46km
HV Distribution Cables	1,630km
HV Distribution Lines	980km

PURPOSE OF THE ASSET MANAGEMENT PLAN

The purpose of the Asset Management Plan (AMP) is to describe how VECTOR will manage the assets and investment in its network in order to achieve the performance targets and strategic goals it has set.

VECTOR's AMP is provided to enable customers and other interested parties to identify VECTOR's performance targets, areas of business focus, forecast levels of maintenance expenditure and capital investment planned to manage its asset base. The plan also identifies our approach to network risk management and contingency planning.

VECTOR's approach to asset management is one which seeks to strike the appropriate balance between the needs and expectations of our customers, and the cost of providing the network service – this incorporates the risk and consequences of asset failure.

VECTOR's asset management approach is to:

- Ensure that the required standard service levels are met
- Provide a safe environment for operating personnel and the general public
- Avoid environmental damage as a result of failing equipment
- Preserve the required functionality, performance and value of assets to enable the continuation of a viable network business

DATE AND PLANNING PERIOD

The AMP has been developed as part of the Information Disclosure for 2001 and covers a period of ten years from 1 April 2001 until 31 March 2011.

The plan is a view going forward and does not commit VECTOR to any of the individual projects or initiatives set out in the plan. These may be modified to reflect changing operational, regulatory or customer requirements and must be approved through normal internal governance procedures.

The AMP is an evolving document, the review of which is an ongoing process within VECTOR as we gain better information on our customer expectations, asset capabilities and condition.

ASSET MANAGEMENT SYSTEMS AND INFORMATION

Central to VECTOR's goals of providing superior customer service are information systems. The systems adopted by VECTOR are designed to capture both critical asset information as well as customer feedback and expectations. These systems are fully integrated to support effective decision making both in terms of asset and customer management.

A key initiative this year is the implementation of a new SCADA/DMS system to assist in the management of the “real-time” network operation.

In addition to system development, VECTOR has invested heavily in staff training and has staff members involved in international technical working groups such as CIGRE and ESAA to ensure we actively participate in industry initiatives and advancements.

NETWORK AND ASSET DESCRIPTION

VECTOR's network can be viewed as three networks:

1. 110kV transmission network, which connects from the Transpower network to VECTOR bulk supply substations and also provides additional security for the Transpower transmission system north of VECTOR's network.

2. 33kV and 22kV subtransmission network, which connects between the Transpower grid exit points and VECTOR zone substations, each of which serves a particular geographic area with similar asset and customer characteristics.

3. 11kV and 6.6kV, and 400/230V distribution network linking our customers to our zone substations.

Each part of the network is designed, operated and maintained to achieve the levels of reliability set out in this AMP.

SERVICE LEVEL OBJECTIVES

Service for VECTOR is about understanding what our customers value and meeting these requirements cost effectively. VECTOR regularly conducts surveys with its customers to get feedback on what is important to them and how we can improve our service. The results are used as an input into VECTOR's business plans, asset planning and service provisions, thereby ensuring a central focus on customer needs.

As a result of our customer focus, VECTOR has moved away from the traditional "universal service" to focusing on providing a consistent level of service by area and customer type. Customer feedback has honed the focus of our service to be on reliability and power quality as shown below.

	Reliability		Quality
Customer Type	Potential Number of Faults Per Year	Maximum Restoration Time Per Fault (min)	Potential Number of Events Per Year Where Voltage Sags to Less Than 80% of Nominal Value
Commercial	Up to 3	Up to 120	Up to 20
Industrial	" 4	" 120	" 20
Residential	" 4	" 150	" 30
Rural	" 14	" 180	" 40

In addition to this, health and safety is a major focus for the business. VECTOR's policy is to:

> *"Create and maintain a safe and injury free working environment for our employees, our contractors, our suppliers and the public we serve."*

Our safety target for 2001/2002 is simply:

> *"No lost time injuries to any person working on our network."*

ASSET DEVELOPMENT AND MAINTENANCE PLANS

Ensuring the network meets the future demands of customer requirements, load growth, statutory requirements, environmental and safety issues, requires VECTOR to continually improve its asset management.

Our approach is to first optimise the use of existing assets where possible through automation, load management or other non-asset development solutions to defer major capital expenditure, so long as our reliability objectives are met and maintained.

To achieve this, VECTOR has moved away from traditional industry deterministic security standards to probabilistic standards that are founded on acceptable probabilities of loss of supply. When forecasts indicate that these new standards may not be met, a review is undertaken to determine an appropriate response through a range of options.

To enhance this process, VECTOR has invested heavily in systems and people to analyse and refine asset ratings and capability. This has enabled the ratings and utilisation of the assets to be increased and/or costs to be decreased whilst meeting service obligations.

Ensuring that asset maintenance, refurbishment and replacement programmes are value-based is also critical to VECTOR. Asset maintenance can be a significant proportion of the total lifecycle costs and VECTOR's approach is one of value-based maintenance to achieve the required reliability standards.

Asset maintenance plans are developed taking into account the variety of customer, environmental, operational performance and condition factors. Generic maintenance plans are developed for each asset type, but are applied based on performance requirements and criticality.

The underlying objective of the asset replacement programme is to identify opportunities where value can be gained through programmes of replacement rather than incurring ongoing remedial and preventative maintenance costs.

Our new standards represent the first steps down a new path in network asset management. Our continued focus on improved asset condition and network performance information will improve our decision making process. This in turn will enhance the ability for customers to evaluate their service requirements in terms of cost and performance – enabling a choice to either take their own measures to achieve the performance they require, or contract VECTOR to do so.

RISK ASSESSMENT

Risk is managed in VECTOR by a combination of:

- Reducing the probability of the failure, through the capital and maintenance work programme and enhanced working practices
- Reducing the impact of failure, through contingency and emergency plan development

Management of risk is undertaken by the risk committees, which direct the identification, analysis, prioritisation and treatment of risks across the business. VECTOR maintains a central risk register that documents the top 20 risks to the business and their response plans. This is reviewed on a monthly basis by the Executive Risk Management Committee and quarterly by the Board Risk Management Committee. The top 20 are chosen from individual risk registers maintained by each business unit.

VECTOR has a suite of contingency plans in place developed under the framework of risk reduction, readiness, response and recovery. Plans are in place to cope with storms, total loss of supply of a zone substation, Transpower grid exit point, the Control Room and Call Centre.

EVALUATION OF PERFORMANCE

Measurement and communication of performance measures is an integral part of VECTOR's management process. Physical performance is tracked through the measures of:

- Reliability
- Safety
- Customer satisfaction

All employees and contractors are accountable for achieving the performance targets. Our zone based contractors are incentivised through a contract bonus structure to achieve their targets whilst VECTOR employees have the performance measures embedded in their performance related pay scheme.

GLOSSARY OF TERMS

AAC	All Aluminium Conductor
AAAC	All Aluminium Alloy Conductor
ABC	Aerial Bundled Conductor
ABS	Air Break Switch
AMP	Asset Management Plan
ARC	Auckland Regional Council
CAIDI	Customer Average Interruption Duration Index
CBD	Central Business District (of Auckland)
CIGRE	Conference Internationale des Grands Reseaux Electriques (International Council for Large Electric Systems)
CSM	Customer Service Monitor
CCT	Covered Conductor Thick
CT	Current Transformer
Cu	Copper
DGA	Dissolved Gas Analysis
DMS	Distribution Management System
ESAA	Electricity Supply Association of Australia
GWh	Gigawatt hour
GIS	Geographical Information System
GIS	Gas Insulated Switchgear
HRC	High Rupturing Capacity fuse
HV	High Voltage
ICP	Installation Control Point
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronic Engineers
IED	Intelligent Electronic Data
IPC	Insulation Piercing Connector
km	Kilometre
kV	Kilovolt
kVA	Kilovolt Ampere
kW	Kilowatt
LTI	Lost Time Injuries
LTIFR	Lost Time Injury Frequency Rate
LV	Low Voltage
MEN	Multiple Earthed Neutral
MW	Megawatt
MVA	Mega Volt Ampere
n-1	Security standard
NICAD	Nickel Cadmium battery
Nilstat ITP	Protection relay
ODV	Optimised Deprival Value/Valuation
OSH	Occupational Safety and Health

PILC	Paper Insulated Lead Cable
PVC	Polyvinyl Chloride
RMU	Ring Main Unit
RTU	Remote Terminal Unit
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SAP	Systems Applications and Processes
SCADA	Supervisory Control and Data Acquisition system
SF_6	Sulphurhexafluoride
SREI	Safety Rules Electricity Industry
TLS	Transformer Load Simulator
TMS	Transformer Management System
V	Volt
VRLA	Voltage Regulated Lead Acid battery
VT	Voltage Transformer
XPLE	Cross Linked Polyethylene Cable

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1. INTRODUCTION

1.1. VECTOR ASSET MANAGEMENT OVERVIEW

The objective of the AMP is to describe how VECTOR will manage the assets and investment in its network in order to achieve the performance targets and strategic goals it has set.

To ensure that optimum efficiencies and benefits are realised from our asset base, VECTOR has refined its asset management philosophy. The focus is now based on greater utilisation of the existing assets achieved through higher performance. This is through enhanced value-based maintenance strategies, better real-time use of capacity, timely system upgrades and utilisation of advanced condition monitoring techniques and advanced technology. To ensure our asset management strategy is achieved, VECTOR has invested or is in the process of investing in the following:

- Transmission and subtransmission reinforcement to ensure the set security criteria can be met
- Advanced information and control systems for planning and operations
- Upgrades of the LV asset
- Continuation of the zone based maintenance approach where contractors are accountable and incentivised for achievement of performance measures

The asset planning process prioritises the programmes for maintenance and development to balance customer service and operational efficiency. Implicit in the asset planning process is an understanding and evaluation of the risks to operation and the consequences of failure. Also critical is the collection of information from which performance can be monitored and improvement targets set.

The AMP is the foundation document for the management of VECTOR's assets. From this document, customers and other interested parties will be able to identify VECTOR's performance targets, areas of business focus, forecast levels of maintenance expenditure and capital investment, and their rationale. The plan also identifies our approach to the management of network risks and our approach to contingency planning.

1.2. NETWORK SUMMARY

The VECTOR network supplies more than one sixth of New Zealand's electricity demand. The distribution business involves the operation and maintenance of a regional supply network that covers the cities of Auckland, Manukau and parts of Papakura - an area of approximately 900km^2. VECTOR has 260,000 customers, including approximately 220,000 residential customers and 50 of the country's top 200 industrial/commercial electricity consumers. Nearly 99% of the customers are located in the urban area.

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1.3. ASSET MANAGEMENT PHILOSOPHY

VECTOR's approach is designed to ensure a balance between the needs and expectations of our customers, and the cost of maintenance and replacement. This is balanced against the risk and consequences of asset failure.

VECTOR's approach to asset management is to:

- Ensure that the required standard service levels are met, including reliability of supply to customers
- Provide a safe environment for operating personnel and the general public
- Avoid environmental damage as a result of failing equipment
- Preserve the required functionality, performance and value of assets to enable the continuation of a viable network business

Assets must be operated and maintained to continue to meet performance standards cost effectively. Functionality and performance requirements are continually reviewed and revised to reflect the changing operational and customer requirements on the network.

In line with VECTOR's approach to a customer driven level of service provision, the asset management plans are continually developed from analysis of customer requirements, an assessment of the condition of the asset, the risk and consequences of asset failure and analysis of least cost solutions.

The way we develop, operate and maintain our assets is focused to ensure that we are achieving the standard service levels in an optimum, cost efficient way. The drivers and performance targets for network development, maintenance and system operation, are developed and linked to ensure the service standards are focused on and achieved, as shown in Figure 1.1.

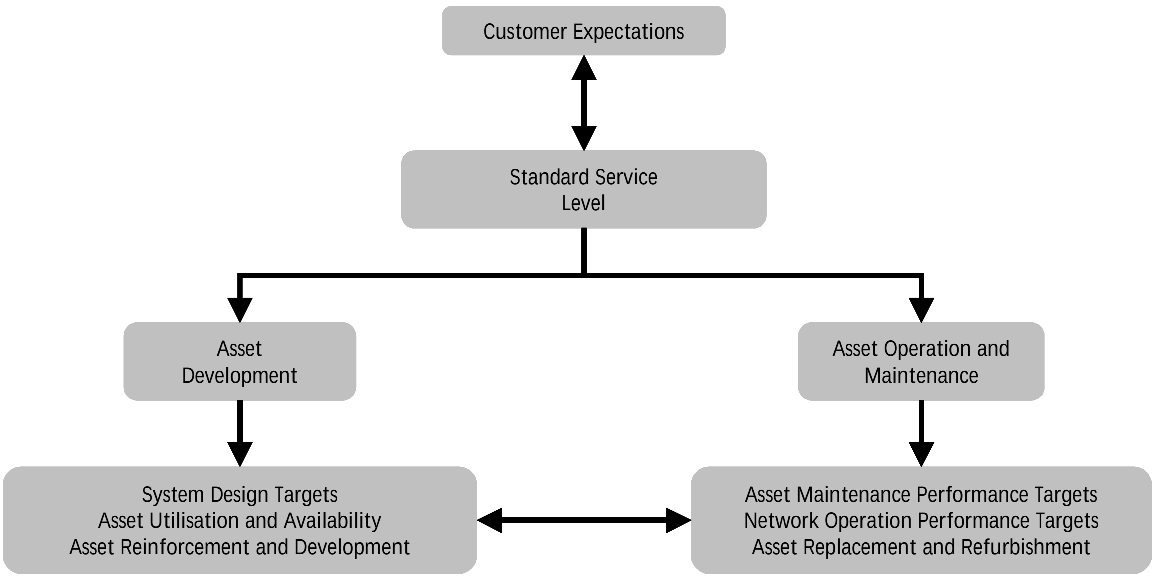


Figure 1.1 Asset Management Philosophy

1.4. ASSET MANAGEMENT PROCESS

VECTOR's Asset Management Process is shown in Figure 1.2.

1.4.1. INFLUENCERS

- ***Shareholders***
  VECTOR's customers elect the Auckland Energy Consumer Trust to represent their interests. The Trust is responsible for appointing the Board of Directors and agreeing the Statement of Corporate Intent.

- ***Customers***

  VECTOR manages the network to meet the needs of its customers - residential, commercial and industrial.

- ***Regulations***

  Statutory requirements impact on how VECTOR operates to meet its service delivery standards. The following statutes are of particular relevance to this AMP:

  The Electricity Act 1992
  Electricity Regulations 1997
  Electrical Codes of Practice 1993
  New Zealand Standard NZS3000 1999
  Australian/New Zealand Standard ANZS3000 2000
  Health and Safety in Employment Act 1992
  Resource Management Act 1991

  Other statutes apply to the business as a whole, but are peripheral to the asset management philosophy.

  The above statutes define how we operate, but the current light handed regulatory regime is also an influencer.

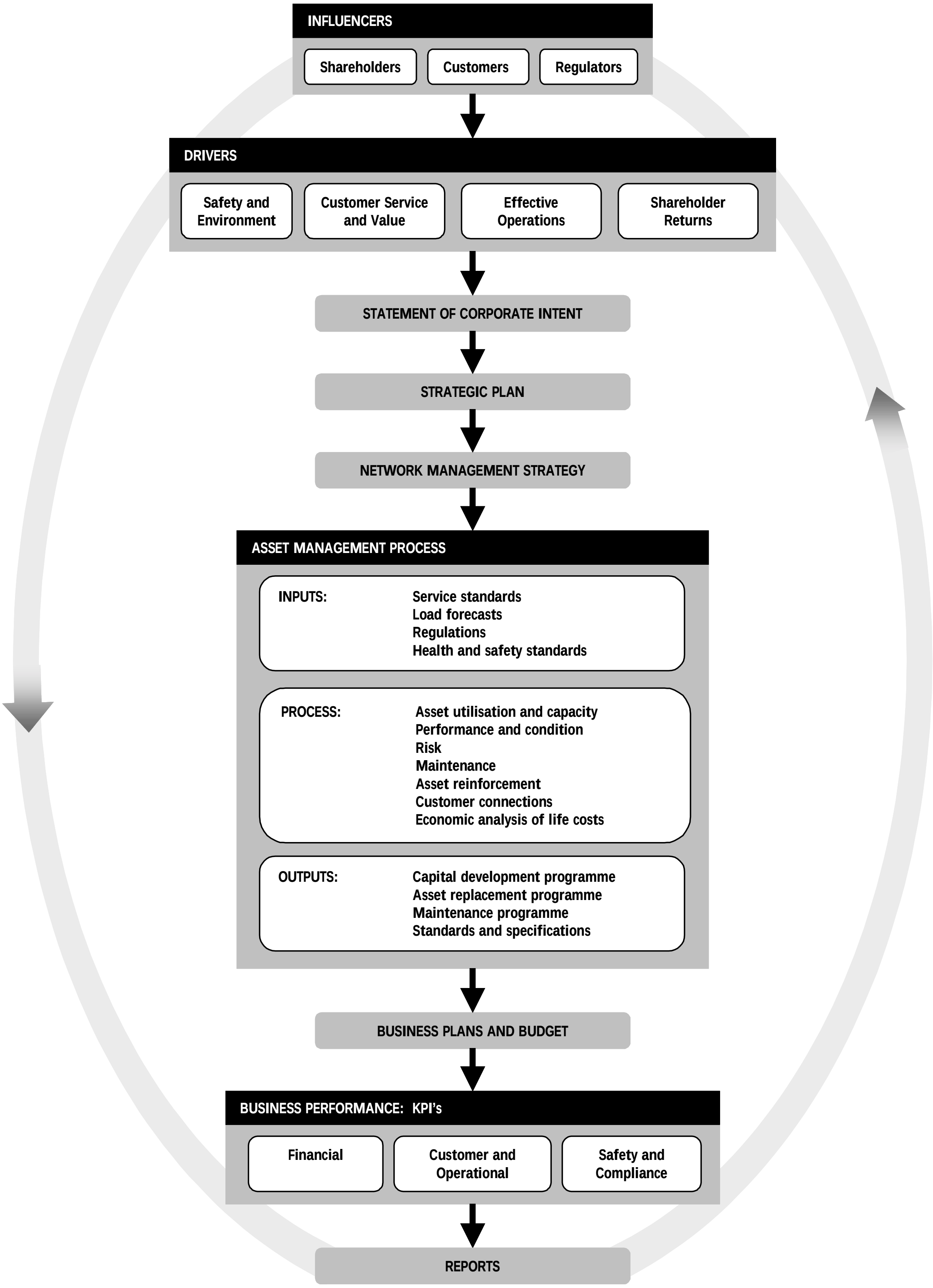


Figure 1.2 VECTOR's Asset Management Process

1.4.2. ASSET MANAGEMENT DRIVERS

- ***Customer Service and Value***
  VECTOR's objective is to deliver improved customer value by matching the performance of both its assets and contractors to the performance its customers expect and are willing to pay for.

- ***Effective Operation***
  VECTOR's objective is to manage the operation of its assets in such a way as to deliver the required performance at the lowest overall cost.

- ***Health and Safety and Environmental Responsibility***
  VECTOR will at all times ensure its employees, contractors and customers safety is not put at risk by the management of its assets. VECTOR will manage the network and act in an environmentally responsible manner and comply with all legal environmental requirements.

- ***Shareholder Returns***
  VECTOR's objective is to manage its assets to meet the shareholders' requirements for return on investment, preservation and enhancement of the value of the company, and community obligations.

1.5. RELATIONSHIP WITH BUSINESS PROCESSES

The AMP is directly influenced by a number of other policy documents and processes:

- ***Statement of Corporate Intent***
  This document defines the Directors' intentions and objectives for VECTOR for the financial year and is agreed with the shareholders. This encompasses planned business activities and objectives, values, and performance targets.

- ***Strategic and Business Plans***
  The five year plan, annual plans and key initiatives are established to support the achievement of performance targets.

- ***Network Management Strategy***
  This defines the approach and direction for network management in terms of network value, performance, revenue and customer expectations for service and quality.

- ***Performance Targets***
  Performance targets are established for the company as part of the long-term and annual planning rounds. These include customer service, network performance and financial targets. These are cascaded down to individual business units and contractors.

1.5.1. PLAN IMPLEMENTATION

The outputs from the asset planning process, which incorporates continual review of asset functionality requirements and customer feedback, are the operational, maintenance and capital work programmes.

- ***Asset Maintenance Plans/Schedules***
  For each customer area, asset or asset group, specific maintenance programmes are established annually, taking into account long-term strategic positioning.

- ***Asset Development***
  For each customer area, capital works programmes are developed to ensure service delivery.

- ***Equipment and Design Standards***
  Equipment and design specifications, based on the required functionality of the assets, are included in the Network Standards Manual. This manual is continually reviewed to ensure the standards are based on current performance and functionality requirements, and to take advantage of new working practices and technology, to ensure minimum asset lifecycle costs.

1.6. PLANNING PERIOD

This AMP covers a period of ten years from 1 April 2001 until 31 March 2011. The plan is a view going forward. It does not commit VECTOR to any of the individual projects or initiatives set out in the plan. These may be modified to reflect changing operational, regulatory or customer requirements and must be approved through normal internal governance procedures.

The AMP is an evolving document, the review of which is an ongoing process within VECTOR. VECTOR encourages and welcomes stakeholder comment on the plan.

1.7. RESPONSIBILITIES AND ACCOUNTABILITIES FOR ASSET MANAGEMENT

The responsibilities for asset management are outlined in Figure 1.3.

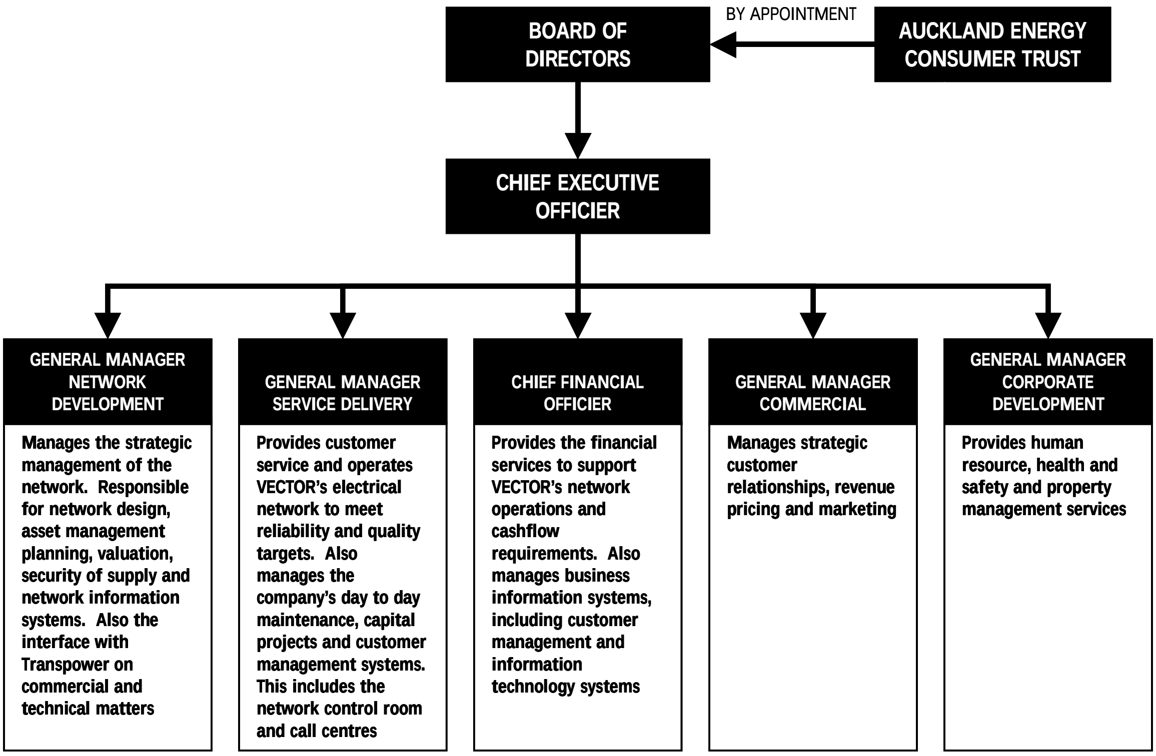


Figure 1.3 Asset Management Structure Chart

1.8. ASSET MANAGEMENT INFORMATION SYSTEMS

1.8.1. OVERVIEW

Increasing the level of information VECTOR holds on its assets and network, together with implementation of tools to support the effective use of this information, is an area of high focus for the company. The underlying objective is to base decisions on more refined information to optimise expenditure on asset maintenance, capital investment and asset performance. Specifically, the information and tools are required to support and refine the customer responsiveness, asset replacement, asset maintenance and network design philosophies detailed in this plan. The GIS is the central focus for asset information collected within VECTOR and information flows between the GIS and other corporate systems. Our zone based contractors are accountable for the provision of accurate, timely asset maintenance and fault data into the GIS, and are incentivised through the contract to provide this.

In addition to this, VECTOR is about to commence implementation of new systems to manage its "real-time" network operations. This includes a new SCADA (Supervisory Control and Data Acquisition) system to replace the existing system that has become out-dated and a DMS (Distribution Management System) to provide sophisticated tools to support network operational decision making.

1.8.2. OVERALL SYSTEMS ARCHITECTURE

The system architecture and links between systems are shown in Figure 1.4.

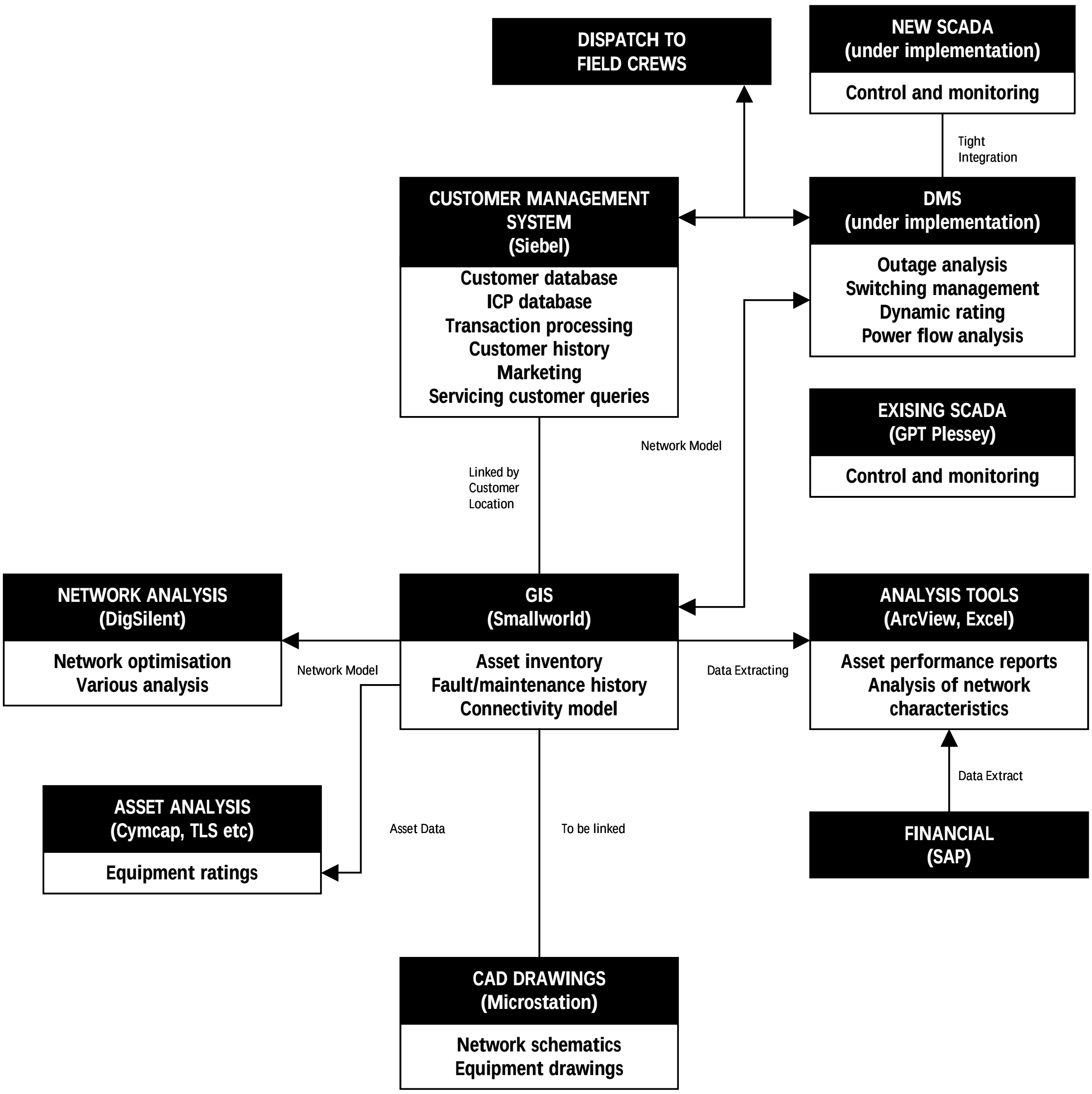


Figure 1.4 Systems Architecture

1.8.3. GIS SYSTEM

VECTOR has used GIS technology as the base of its network information systems for several years. The migration to the current "Smallworld" GIS system was completed in 1999.

The system provides a complete inventory of network assets, recording graphically the location of equipment together with key attribute data.

The emphasis over the past 12 months has been to improve data quality such that the GIS provides an accurate electrical connectivity model. As part of this, customer locations are also being mapped in the GIS and connected to the network. The project will be completed in mid-2001.

Currently, the GIS depicts the network in its geographically exact location. For some applications, a simplified "schematic" view of the network is preferable. The GIS will be extended in 2001 to support a dual geographic and schematic view of the network.

A project was initiated in October 2000, to evaluate the use of tools to allow GIS data to be updated electronically in the field by work crews. The scope of the project has included collection of fault history data and recording of simple network changes.

Various options of software, hardware and processes have been considered.

The project will potentially lead to rollout of technology which will significantly reduce data maintenance costs while improving data quality.

This trial will be complete by the end of June 2001. A decision on future directions will be made at this time.

1.8.4. ASSET PERFORMANCE ANALYSIS

Since May 2000, fault data has been recorded to an individual asset level in the GIS system. New tools have been implemented to support detailed analysis of potential asset performance problems on the network. This has allowed geographic areas of high concentrations of asset failures to be identified and the potential for asset maintenance programmes to address these evaluated.

Currently, details of asset component, cause, remedies and weather conditions are recorded for each fault. It is planned to increase the level of information recorded to include detailed root cause analysis reports.

The GIS system has also been recently further extended to support the recording of asset maintenance history and key test results. The collection, recording and analysis of this information are primarily the concern of VECTOR's zone based contractors who have their own information systems to support this. Electronic files of information are provided to VECTOR for loading into the GIS.

This will provide VECTOR with base details of the maintenance history of each of its assets. It will also allow monitoring of progress against contractors maintenance plans.

Standard asset performance reports are being developed which combine inventory, fault history, maintenance history and cost information. These reports will form the basis for incremental improvements to asset management decisions.

1.8.5. NETWORK ANALYSIS TOOLS

In 2000, VECTOR purchased a comprehensive network analysis system called DigSilent Powerfactory.

Over the past 12 months, work has been proceeding to model VECTOR's entire distribution network. Throughout this time, special models have been built to support analysis work for particular projects.

A process has been established to extract data from the GIS system and import it into DigSilent. This process will be further developed in the coming year to achieve direct integration.

The tools provide VECTOR with advanced analysis capability that will result in optimal design solutions to meet network capacity, network performance and power quality requirements.

1.8.6. SCADA/DMS (SUPERVISORY CONTROL AND DATA ACQUISITION/DISTRIBUTION MANAGEMENT SYSTEM)

VECTOR is implementing new systems to support the real-time management of its network.

This involves implementation of a new SCADA system that monitors the status of the network and supports remote operation of certain field devices. The current SCADA is old and at the end of its useful life.

In addition, a DMS system is being established which provides sophisticated tools to support network operational decision making. This will provide functions to support:

- Outage analysis and management to reduce fault durations
- Switching management to improve operational safety
- Dynamic rating of equipment to optimise asset utilisation by increasing allowable short-term loads on existing assets
- Power flow analysis to simulate proposed temporary configuration changes

The SCADA and DMS systems will be fully integrated. The system will also be tightly integrated with VECTOR's *Siebel* Customer Management System and *Smallworld* GIS System.

The SCADA system is planned to be implemented by early 2002 with the base DMS system operational by this date as well. The advanced DMS modules will be implemented mid-2002.

1.8.7. LINKS TO OPERATIONAL ACTIVITIES

In addition to the systems previously described which are used to manage VECTOR's assets and network, the following core systems are used:

- ICP database which VECTOR maintains as part of the customer information system. This is used to support the exchange of information with retailers as required for customer switching

- SAP which is used as the financial management system

2. NETWORK ASSETS

2.1. NETWORK OVERVIEW

The overall architecture of the network is shown in Figure 2.1.

The network can be considered as three networks – transmission, subtransmission and distribution. The 110kV transmission network connects the Transpower network to the VECTOR bulk supply substations for VECTOR supply, but also supports security on the Transpower transmission system north of the VECTOR supply area. The high voltage subtransmission network also connects the Transpower network at the grid exit points to zone substations, at 33kV or 22kV. Each substation serves a particular geographic area, with known asset and customer characteristics. At the substations the voltages are further stepped down to 11kV or 6.6kV. The distribution network then carries the electricity to distribution transformers, or for some commercial customers, directly to their premises. At the distribution transformers electricity is stepped down to 400/230V, for final delivery to customers.

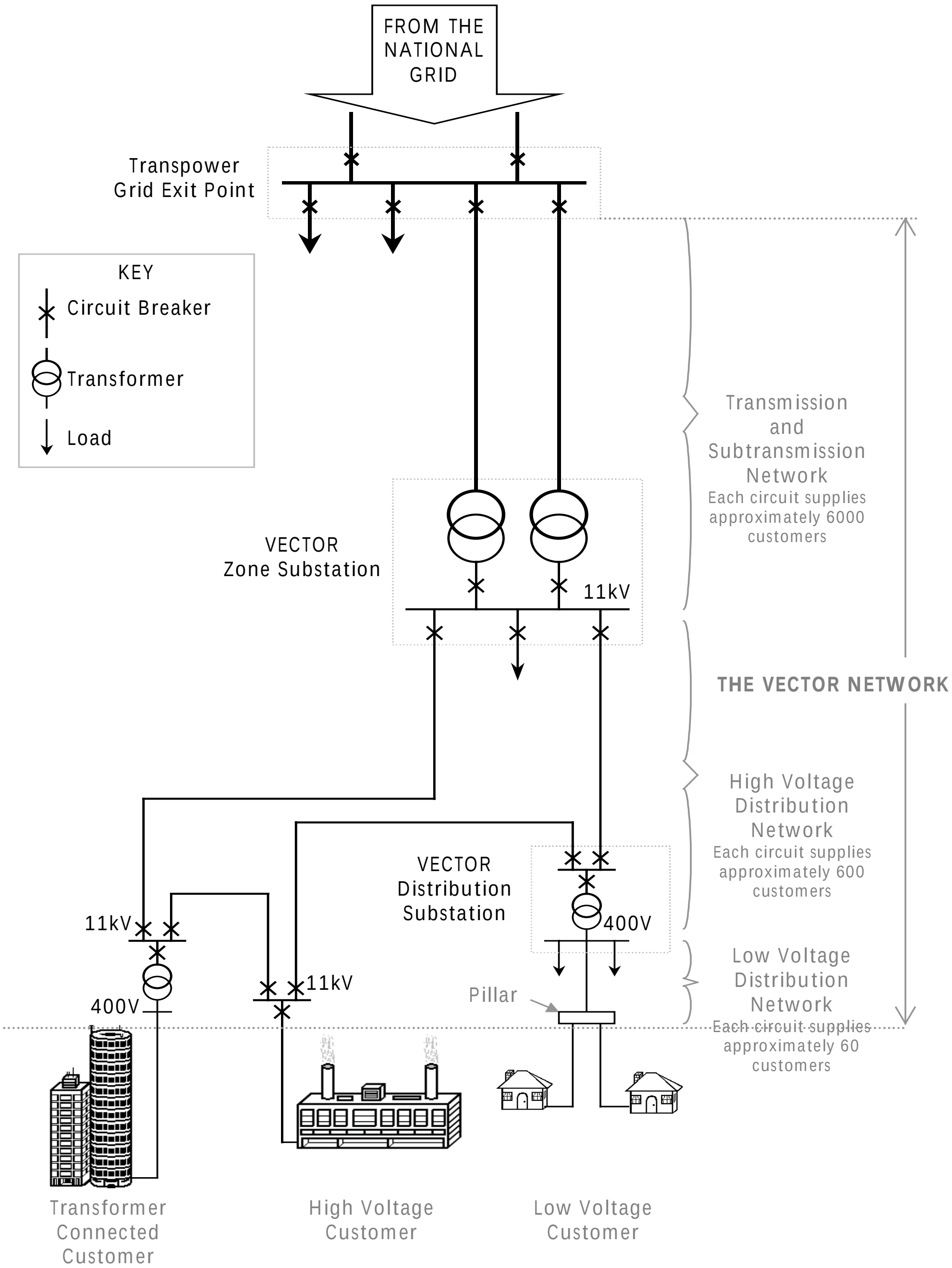


Figure 2.1   *Schematic of VECTOR's Network*

2.2. TRANSMISSION AND SUBTRANSMISSION NETWORK

The higher voltage transmission and subtransmission network is designed to transfer large amounts of electricity efficiently, and also provides additional security to the Transpower cross-isthmus network. The network transfers electricity from Transpower's network via eight grid exit points, to 49 zone substations. A zone substation typically supplies 6,000 customers. The subtransmission network consists of underground cables, except for supply to Maraetai, which is supplied by a combination of underground cable and overhead line.

At the zone substations, the subtransmission voltages are stepped down to 11kV (or 6.6kV) to supply the distribution network. The zone substations are all remotely controlled via the SCADA system, which allows remote operation to be carried out from the Control Room and returns load and equipment operation information.

2.3. TRANSMISSION AND SUBTRANSMISSION DESIGN

The transmission and subtransmission network has been developed essentially as a radial network, with two or three feeder transformers at each zone substation. There are no ties between zone substations at subtransmission level (other than in the CBD). The future development of the subtransmission system will be driven by the security and reliability standards, and may include single transformer stations, and more interconnections at subtransmission voltage.

Generally the load on a zone substation should not exceed 30MVA, in order to keep the number and size of 11kV feeders within practical bounds. In some cases where the load is relatively concentrated, the design maximum load can rise to 50MVA (eg, in the CBD, where land for new zone substations is expensive and difficult to obtain, or in heavily industrial areas).

If there is to be no loss of supply for a single subtransmission circuit fault, the allowable load on the station is limited to the sum of the short-term ratings of the remaining healthy circuits. VECTOR's new design philosophy permits the station load to be increased beyond this limit by accepting a small probability that in the event of a fault, load will have to be shed immediately while load transfers are carried out, with the proviso that all supply is restored within three hours. For the subtransmission security targets see Section 3.

2.4. DISTRIBUTION NETWORK

The function of the distribution network is to deliver electricity from the zone substations to customers. It includes a system of cables and overhead lines operating mainly at 11kV, with some 6.6kV, which distribute electricity from the zone substations to distribution substations. Typically 600 customers are supplied at the high voltage distribution level. At the distribution substations the electricity is then stepped down to 400V and delivered to customers either directly, or through a reticulation network of overhead lines and cables. Approximately 60 customers are supplied from each distribution substation, via the low voltage distribution network. For larger loads, electricity can also be delivered at 6.6kV or 11kV. Four main categories of customer connection are available and the final network connection type determined through consultation with the customer. The connection types are:

- Single phase low voltage
- Three phase low voltage
- Transformer connection
- High voltage connection

A number of customers are fed by dedicated substations, and take supply at 33kV or 11kV.

2.5. DISTRIBUTION DESIGN

The distribution system consists of interconnected radial circuits originating from zone substations. The design is based on the concept of availability of feeder backstopping capacity, according to the security standards. A distribution feeder fault may result in an outage, but supply should be able to be restored within two to three hours by switching operations on the distribution network. This system provides a very reliable means of electricity supply.

The distribution circuits are controlled by automatic circuit breakers at the zone substations. Oil switches and air break switches are installed at strategic locations on the circuits to provide operational flexibility. Consideration is being given to automating some of these switches to improve response time and provide better customer service. For the distribution security targets see Section 3.

There are 99 large customers who are connected to our network at high voltage. The ownership of the substations serving these customers varies from site to site, but generally VECTOR owns the incoming switchgear and any protection equipment associated with it. The customer usually owns the transformer(s), any outgoing switchgear and associated protection, and the building.

2.6. PROTECTION AND CONTROL

The VECTOR network is protected from the Transpower grid exit points to the customer supply point by a series of relays and fuses. The protection network has been designed to interrupt the supply immediately if excessive fault currents arise to ensure that the assets are not working out of normal operation ranges for significant periods and health and safety is not compromised.

It is VECTOR's strategy to install combined protection, control, metering and monitoring microprocessor devices in new substations and to upgrade the existing substations. Substation Intelligent Electronic Data (IED's) acquisition devices are integrated using industrially hardened substation PC based computers. The communication media between the substation IED's and the substation computers is fibre optic. The industry standard communication protocol IEC60870-5-103 is used for communication between the substation IED's and the substation computer. It is VECTOR's intent to migrate to and implement the emerging IEC61850 communication architecture.

Communication between the substation computers and the existing SCADA Masterstation uses proprietary master-slave protocol. Communication between the new SCADA Masterstation and the substation PC based computers will be an industry standard communication protocol.

VECTOR's communication network consists of fibre optic, copper pilot cables and radio. The major Transpower grid exit points are connected to VECTOR's Control Room by fibre optic. The existing copper pilot cable network is extensive and is currently used for analogue data transmission. VECTOR is planning to use the existing pilot cables for digital communication.

2.7. IMPROVEMENTS TO NETWORK DESIGN

VECTOR, after consultation with the shareholder, the Auckland Energy Consumer Trust, has initiated a 40 year programme to improve the company's overhead distribution lines. For most of the urban lines, this will include progressive undergrounding. The local councils require all new subdivisions to be reticulated underground and have done so since the 1960's. This, together with significant undergrounding of existing lines from 1980 (principally along major routes), means that VECTOR already has the highest level of undergrounding of any major electricity lines company in New Zealand.

For asset performance and reliability, there are significant benefits. The existing overhead network is old and is relatively expensive to maintain. Undergrounding and other improvements will enable the old assets to be replaced with new equipment that meets higher performance standards. The opportunity will also be taken to review the design and capacity of the network to ensure the asset base is optimised.

There will be significant safety, reliability and cost improvements from reduced vehicle impacts. Car versus poles remains one of the highest causes of power outages in the VECTOR overhead network. Maintenance costs for vegetation management will also reduce, as will the risk of outages due to tree damage in storms.

The programme will enhance community and property values. Streetlight design and layout will be improved, which will also enhance traffic and pedestrian safety. Property values will increase due to the removal of the poles, as will property security due to improved streetlighting.

VECTOR will be working closely with the three local councils and other utility providers in the VECTOR network area to co-ordinate works to ensure that disturbance for customers in any area should only occur once and also minimise the costs.

Planning for this major initiative is underway and work is likely to start in the summer of 2001/02. Initial focus will be on the arterial routes.

3. SERVICE STANDARDS

Traditionally, service standards have been set by the supply system capability rather than customer requirements. Conceptually, this is wrong, as the fundamental purpose of VECTOR's network is to distribute power reliably to our customers.

Service for VECTOR is about understanding what our customers' value and then meeting these requirements cost effectively. It encompasses providing our customers with a safe reliable supply of electricity, being responsive to faults, being accessible to customers, and providing accurate timely information.

VECTOR conducts a number of surveys to get feedback from our customers and how we can improve our service. VECTOR also conducts a regular Customer Service Monitor (CSM) every six months to ensure that we understand what our customers expect and what is important to them. The CSM asks a sample of our customers for their views and comments on the company covering their perception of VECTOR and their interface with us via the phone and serviceman. Using the results of these surveys, we can focus our business and service provision in the most appropriate way. The results are used as input into VECTOR's business plans and service provisions, ensuring a central focus on customer needs.

Our customer research has shown that different groups have different needs and tolerances of power fluctuations in terms of length and time of day. All research indicates that reliability in terms of fault frequency and duration of outages is important to customers, but with different levels of criticality.

For a number of commercial and industrial customers, feedback has indicated that power quality is, in many cases, as critical as outages. Power quality is the provision of supply within acceptable parameters such as voltage, frequency and waveform distortion. In the VECTOR network, we have a number of customers sensitive to voltage fluctuations, many of whom run continuous process operations with high costs associated with a disturbance or loss of supply.

Customer requirements and willingness to pay for varying service levels will ultimately drive performance. VECTOR has introduced a number of standard service levels against which we assess and measure our performance. The standards give VECTOR a basis for measuring performance and for determining the extent of asset maintenance, repair, refurbishment and acquisition. The standards also assist in establishing more defined customer expectations and therefore customer value.

Network performance at VECTOR is managed at three levels:

1. Reliability targets set for individual zones in terms of SAIFI and CAIDI (which in turn, give SAIDI, these measures are calculated as shown in Section 3.1).

2. The ability to handle extreme contingencies with the minimum impact to the customer, through risk mitigation. This is managed through our formal risk management process as in the "loss of substation" and similar scenarios.

3. Taking account of the standard service level targets.

3.1. RELIABILITY

Reliability reflects what the customer sees, as it is a measure of how often the power is off and for how long. Reliability is primarily a function of the original design and specification, equipment selection, maintenance practices and the operating regime. Reliability is generally measured by the industry standard measures of SAIDI, CAIDI and SAIFI.

$$\text{SAIDI} = \frac{\text{Sum of (Number of Interrupted Customers x Interruption Duration)}}{\text{Total Number of Connected Customers}}$$

$$\text{SAIFI} = \frac{\text{Sum of (Number of Interrupted Customers)}}{\text{Total Number of Connected Customers}}$$

$$\text{CAIDI} = \frac{\text{Sum of (Number of Interrupted Customers x Interruption Duration)}}{\text{Sum of (Number of Interrupted Customers)}}$$

The measures of SAIDI, SAIFI and CAIDI are used as they provide a consistent measure of performance across the network that can be compared on a year by year basis. VECTOR's reliability performance targets are disclosed in accordance with the Electricity (Information Disclosure) Regulations 1999 and as amended by the Electricity (Information Disclosure) Amendment Regulations 2000. Table 3.1 shows the actual reliability measures for the past five years and the target measures for 2001/02.

Measure	1997	1998	1999	2000	2001 Actual	2002 Target
SAIDI	124	153	82	59	49	47
SAIFI	2.2	1.7	1.3	1.1	0.99	0.95
CAIDI	56	89	65	52	49	49

Table 3.1 Actual and Target Reliability Measures

The major progress achieved over the last three years (in which successive network reliability targets have been set) is the outcome of targeted maintenance and enhancement of working practices through our zone based contractors. The weather patterns were a contributory factor to this success and must be taken into account when setting future targets to ensure they are realistic. Another factor that must be taken into account is the impact of outages on the Transpower network that are included in VECTOR's reliability statistics.

The following figures show actual progress on SAIDI, SAIFI and CAIDI over the last five years.

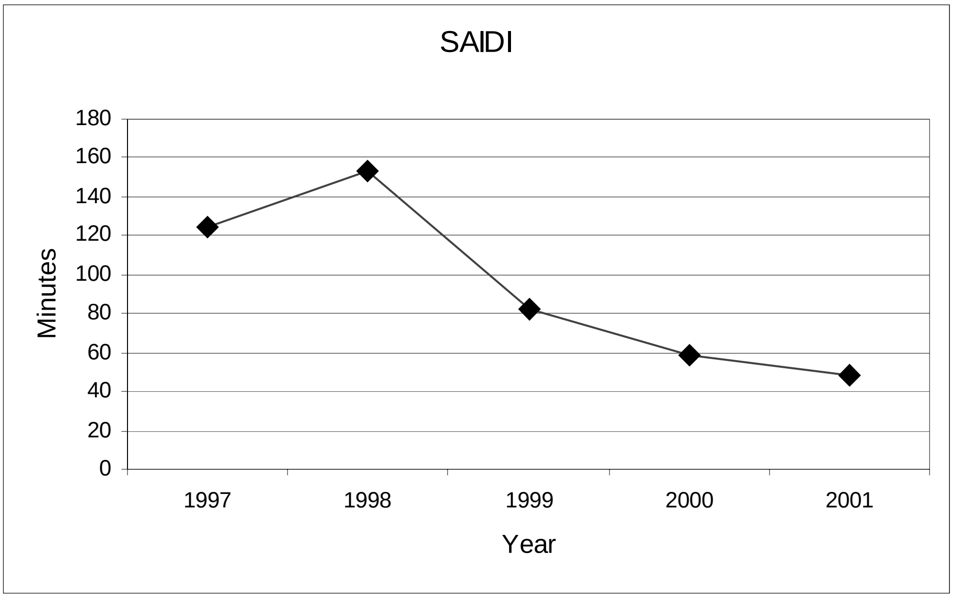


Figure 3.1 SAIDI Actuals (including Transpower outages)

Historically, the VECTOR network had never been below 100 SAIDI minutes per customer prior to 1999.

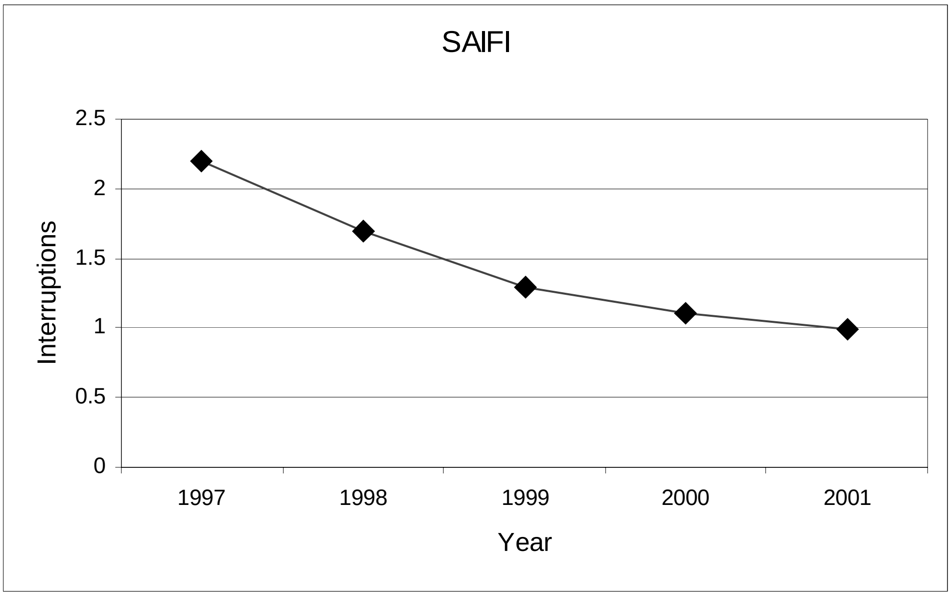


Figure 3.2 SAIFI Actuals (including Transpower outages)

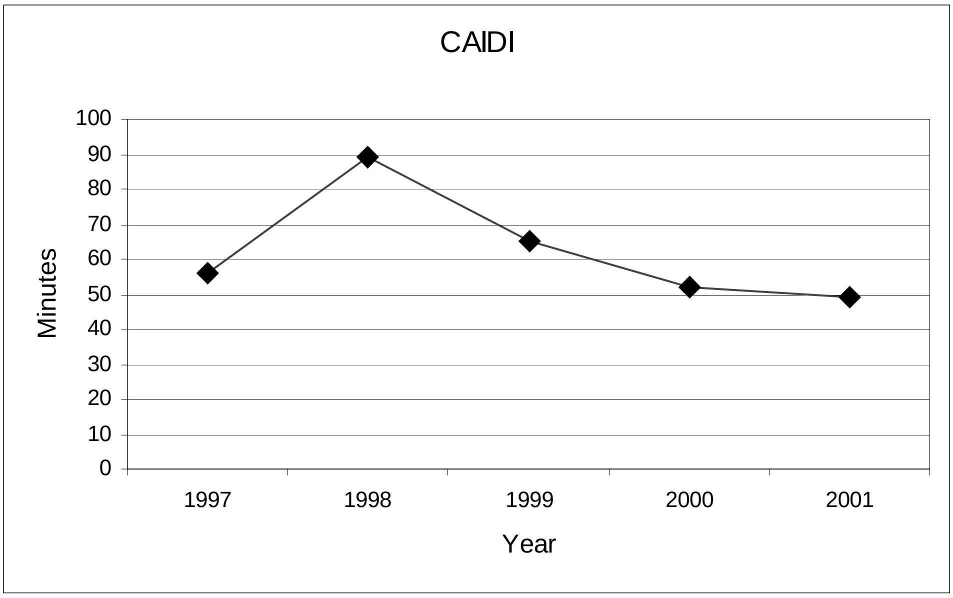


Figure 3.3 CAIDI Actuals (including Transpower outages)

As these reliability targets are system averages, they are limited in their practical use for understanding what areas or assets are causing reliability issues and whether effort is being targeted in the appropriate areas. As part of our customer focused approach to reliability, the performance targets have been split into the geographically based zones of commercial, industrial, residential and rural, to understand the trends. Figures 3.4 and 3.5 show progress in SAIFI and CAIDI over the last five years.

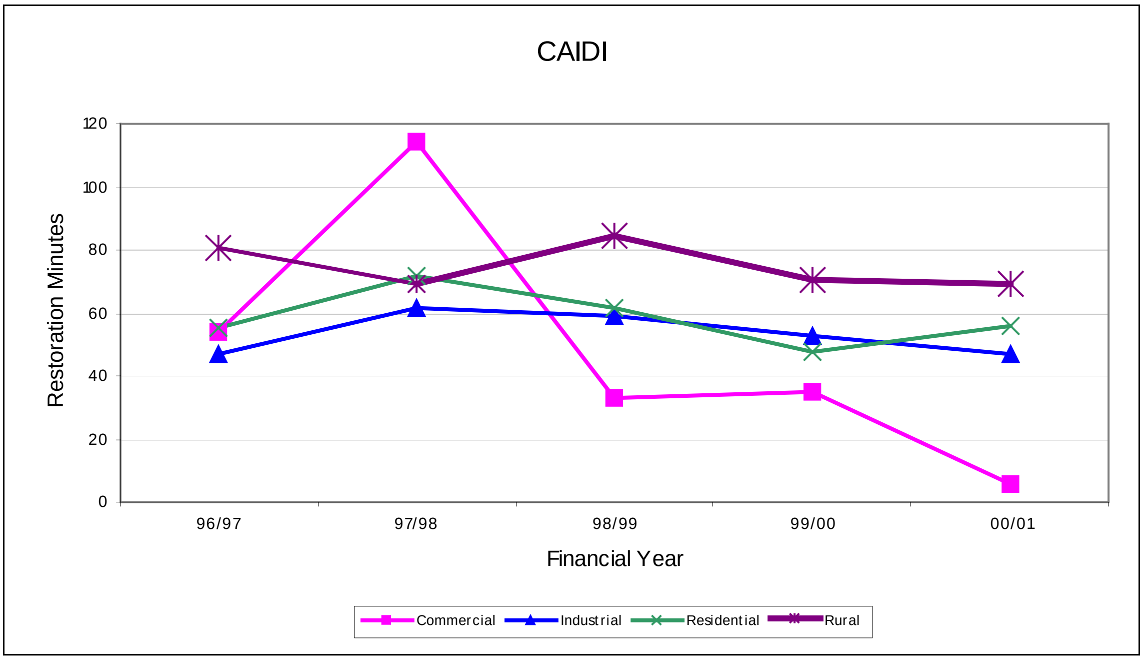


Figure 3.4 CAIDI by Different Customer Types (including Transpower outages)

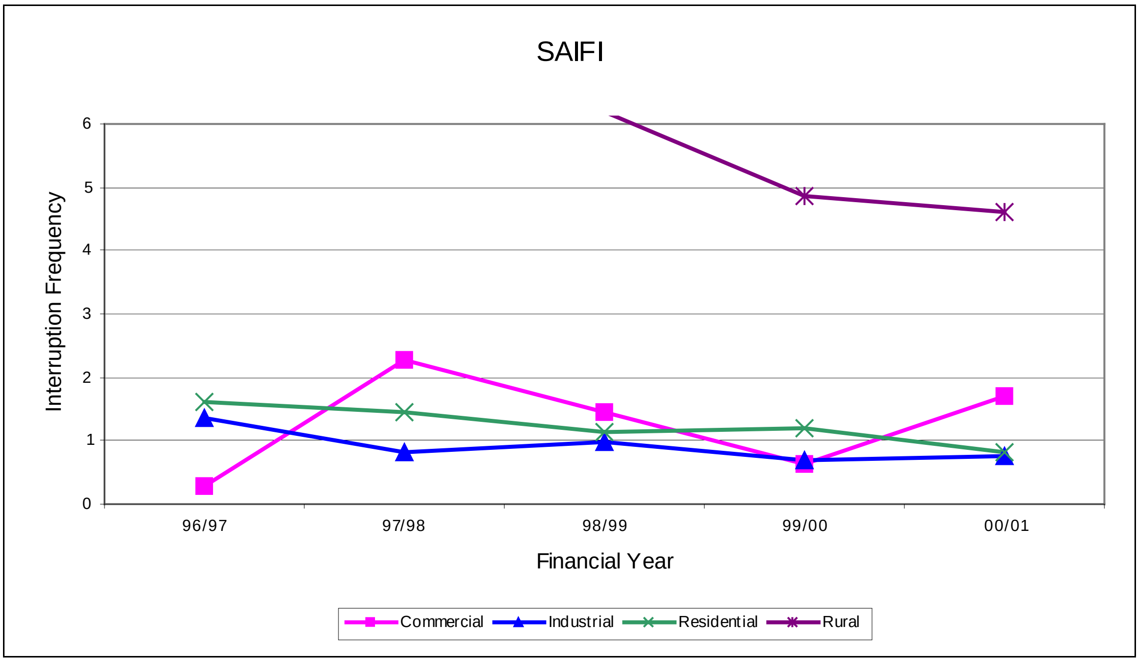


Figure 3.5 SAIFI by Different Customer Types (including Transpower outages)

As can be seen, progress has been on a general trend down, but with different degrees of reduction in each geographical area. To ensure that the reliability targets are in line with our customers requirements and expectations varying across the network, we have moved away from a universal standard of service, to specific outcome targets for different zone levels.

Our new philosophy requires a reliability-based assessment of the need for expenditure in the network. The risk of an outage occurring for customers in a given area will be calculated and assessed against the baseline level of service for that customer type. This will ensure that effort is directed to proactively highlight poorly performing areas and take specific corrective actions to enhance reliability. Customers will be able to contract for higher levels of reliability and quality where required.

3.2. NETWORK MANAGEMENT

The standard service level targets for our customers, as shown in Table 3.2 have been derived from this analysis of performance. The standard service levels give our customers a reasonable expectation of what level of service they will receive from VECTOR, dependant upon what region they live in. This is a significant shift from the previous policy, which focused on universal service to a standard level, to now being focused on providing a consistent level of service across individual customer types.

	Reliability		Quality
Customer Type	Potential Number of Faults Per Year	Maximum Restoration Time Per Fault (min)	Potential Number of Events Per Year Where Voltage Sags to Less Than 80% of Nominal Value
Commercial	Up to 3	Up to 120	Up to 20
Industrial	" 4	" 120	" 20
Residential	" 4	" 150	" 30
Rural	" 14	" 180	" 40

Table 3.2 Standard Service Levels: Reliability and Power Quality

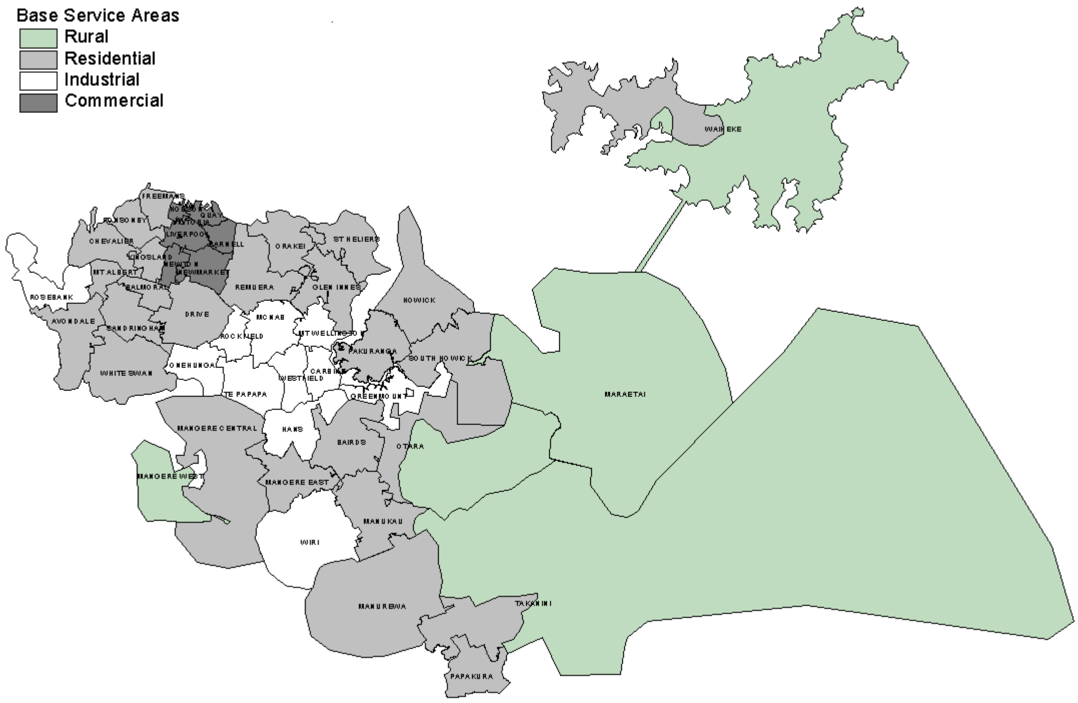


Figure 3.6 Customer Groups by Zone Substation

For network management purposes, VECTOR has translated the standard service levels into individual targets for the zone based contractors, based on the mix of customer types in their area (as shown in Figure 3.6). Currently these are at zonal level and reflect the predominant customer type within the zone. It is intended to move over time towards identifying customer types by feeder, following the full establishment of GIS connectivity.

Overall network SAIDI will be 45 minutes at the end of 2001/02 if the zone targets are achieved. The zone based contractors are incentivised under the performance nature of the contract to manage the operation and maintenance of the network to achieve the zone targets. To meet the targets, it is critical to understand what, if anything, is causing reliability problems in the zone.

The SAIFI fault frequency targets are analysed to understand if there is a particular asset or group of assets causing high fault frequencies, or a particular fault cause in an area. The results of the analysis can then be used to initiate revised preventative maintenance, asset refurbishment or replacement programmes, or other solutions if the fault cause is external, such as car versus pole or directional drilling.

The CAIDI fault duration targets are analysed to understand what is causing the high duration outages and what the potential solutions could be. The solutions could range from restructuring of the fault crew response, or automation, or installation of fault passage indicators, to assist efficient fault location.

The analysis of SAIFI and CAIDI for each zone is then reviewed and the optimum management plan to achieve the standard service level for that zone is established.

3.3. SYSTEM DESIGN SECURITY

Security is what provision is made for restoration and continuation of supply after there has been a failure in the network, and minimisation of the risk of extended outage. Whereas reliability is a function of design, operation and maintenance, the number and diversity of backup alternatives provided determines the level of security.

The traditional approach in the design and operation of electricity networks was to apply a deterministic security standard. The standards were basically n-1 for subtransmission – so that any one failure at that level caused no interruption of supply, and a limitation on (11kV) feeder loading so that switching could always be used to restore supply. These security standards were uniformly applied across the network, with little linkage to reliability targets and little customer consultation. It leads to inconsistent security levels across the network and poor asset utilisation, eventually leading to higher costs for a customer for a given level of security. This deterministic approach to security is now inappropriate practice for our maturing network.

VECTOR's response to the changing requirements for asset management has been the development of standards that are probabilistic rather that deterministic. When load forecasting indicates that the required standards will not be met, a response is required. This may be achieved through a number of options that include capital investment, improved fault response performance, reducing the frequency of faults or shifting load.

Application of probabilistic standards to achieve enhanced reliability and security requires a detailed knowledge of network performance and the ability to calculate the probability of a customer losing supply. The network performance data is now being collected on a routine basis by our zone based contractors and stored within the GIS. The detailed reliability assessments are carried out in a specialist module of the Powerfactory network modelling tool.

The updated standard service levels are set out in Tables 3.3 and 3.4. These have been developed on the basis of overseas practice in those utilities that have adopted this approach, together with consideration of the shape of the load profiles and the assessed impact of outages on the various types of customers. They provide for a security level equal to or greater than the minimal levels for our customers. The standards will be refined on an ongoing basis as our understanding of customers' requirements and in-depth knowledge of our network improves.

3.4. TRANSMISSION AND SUBTRANSMISSION RELIABILITY

Type of Zone Substation Load	Acceptable Probability of Loss of Supply in a Year Due to Subtransmission Events
CBD or predominantly industrial	0.5%
Mixed commercial/industrial and residential	2%
Predominantly residential	5%

Table 3.3 Transmission and Subtransmission Security

No customer will be without supply for longer than three hours following any single subtransmission fault.

3.5. DISTRIBUTION RELIABILITY

Type of Feeder Load	Acceptable Probability of Loss of Supply in a Year Due to a Backstopping Shortfall
CBD or predominantly industrial	0%
Mixed commercial/industrial and residential	2%
Predominantly residential	5%
Overhead spur up to 1MVA	100% (no backstop)
Underground spur up to 300kVA	100% (no backstop)

Table 3.4 Distribution Security

No customer will be without supply for longer than three hours following any single feeder fault (except for customers on spurs, where in some circumstances the repair time may exceed three hours).

The variation between areas is for two reasons:

1. The reliability requirements of CBD, industrial and commercial customers are higher than residential.

2. The load profiles in different areas vary; residential areas have peaks of typically less than three hours, so an outage which leads to an inability to supply all customers in a peak time, is basically self-correcting, but commercial and industrial areas have much longer peaks.

This approach will lead to more consistent levels of reliability and security across the network.

The new reliability and security standards represent the first steps down a new path in network asset management. With a true customer focus, we will establish baseline or customer-specified reliability standards for each feeder. This will drive capital investment decisions, maintenance and fault repair practices, long-term spares holding policy and emergency response plans. Our continued focus on improved asset condition and network performance information will improve the decision making process. We will be able to provide customers with reliability options and associated costs, allowing them to choose whether they will take their own measures to achieve the reliability they want, or contract VECTOR to do so.

3.6. POWER QUALITY

Over the last 18 months, we have installed 13 power quality monitors throughout the VECTOR network. These monitors have been sited at points in the network so we can gain a representative view of power quality on the VECTOR network for the first time and provide real-time feedback on conditions. The main causes of voltage sags and dips within the VECTOR network are faults and switching on the network. From these monitors we have been able to quantify the frequency and impact on customers of these events. This has enabled us to set power quality targets and incorporate them into our standard service levels for customers.

In 2001/02 we will expand the number of monitors throughout the network to further increase our base of information on power quality in the network. This will be done in two phases. The first will be to determine the quality of supply that we receive from Transpower. The second will be to install more monitors in areas of high concentrations of sensitive customers and closer to customers to provide information on the impact customer operations have on neighbouring customers. We also have mobile power quality meters that can be installed for specific customer queries or monitoring purposes.

4. NETWORK DEVELOPMENT

To ensure that the network efficiently meets the future needs in terms of customer requirements, load growth, statutory requirements, environmental and safety issues, VECTOR must ensure that investment is optimised. As part of the strategic planning process, it is critical to ensure that any investment is cost effective over the planning period and phased in at the optimum time. Risks, costs and benefits are reviewed and revised as new load growth and asset capacity, utilisation and capability information becomes available.

Our approach is to first optimise the use of existing assets and where possible through automation, load management or other non-asset development solutions, defer major capital expenditure, so long as our reliability objectives are met and maintained. Capital expenditure is mainly driven by growth and new connection, however compliance with regulations and safety issues and replacement of aging assets, contribute to the capital spend.

4.1. FORECAST GROWTH

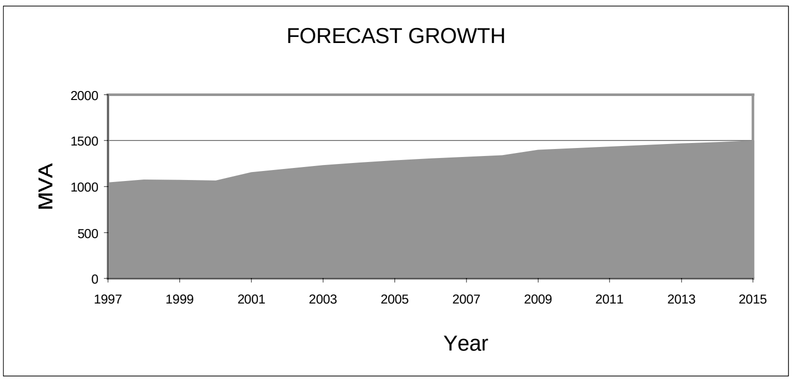


Figure 4.1 Forecast Peak Demand Growth Across the Network

The 15 year estimated forecast for VECTOR's total network shows an average growth rate of 1.9% per annum. VECTOR forecasts peak demand at the zones level based on data from the SCADA system at zone substation and 11/6.6kV feeders. The forecast is for a "normal" climate year, therefore the actual demand is adjusted for any climate extremes experienced. Peak demand is then forecast for the next 15 years. An underlying basic growth factor specific to the particular zone substation is applied, reflecting the expected impact of economic growth, population growth, available load for development, district plan changes etc. Individual commercial developments are accounted for where known. The forecasts are then adjusted to include block load transfers between zone substations, which are planned as a capital expenditure deferral strategy, and enable improved asset utilisation as well.

The maximum load on the system in 2000 was approximately 900MW, similar to 1999, mainly due to another year of very mild winter temperatures.

Demand is not consistent throughout the network, with some areas experiencing rapid growth due to new developments and others experiencing low or zero levels of growth as areas become fully developed or commerce and industry move away. The challenge for network development is to manage the maturing network at an economic level and to reach and maintain our standard service level agreements.

Short-term maximum demand in VECTOR's network is mainly influenced by climate, particularly the severity of winter. Medium-term demand is mainly driven by population growth with specific area growth being governed and regulated by regional council development and district plans, and also area specific commercial developments.

The load on VECTOR's network is primarily an urban load, consisting of:

- Residential load
- Small commercial loads, such as dairies and single shops or small blocks of shops
- Large commercial loads, including shopping malls and light industrial factories
- Large industrial loads, ranging from large factories to steel mills

Peak demands do not occur simultaneously. Advantage is taken of the diversity of load profiles when designing the network. Residential loads tend to peak in the evening, with a peak lasting two to three hours from 17:00 hours. Commercial loads tend to peak during the day with a peak lasting five or six hours. Peak demands are seasonal and area specific, with some areas peaking in winter and others in summer. The underlying trend for peak demands is moving towards a summer peak, particularly in commercial areas, and the network will have to be designed and operated to ensure performance is maintained under changing customer usage patterns.

Reinforcement and development projects are reviewed and planned for once the forecast loads exceed the security design criteria outlined in Section 3.

4.2. ALTERNATIVE SOLUTIONS TO MANAGING LOAD GROWTH AND NETWORK PERFORMANCE

VECTOR has a process of evaluating and, where appropriate, implementing alternatives to traditional investment in distribution assets to manage load growth and network performance.

Most alternative solutions such as automation and load management provide incremental increases in capacity from existing assets at a fraction of the cost of traditional, capital investment solutions, especially in low load growth areas. These solutions are an efficient way of deferring traditional investment and reduce the risk of large traditional investments becoming stranded.

However, determining the best cost investment entails a sophisticated analysis of technologies, trends in future demands, customer service requirements, and associated capital costs. Often data and information on this aspect are uncertain and difficult to quantify. In order to facilitate improved analysis and decision making, VECTOR is carrying out the following initiatives:

- The load flow and reliability models of DigSilent software are being used to compare the impact of alternative solutions on distribution capacity and customer service levels

- Research work on appropriate network reliability models are being performed in co-operation with Auckland University

- A new solutions group within VECTOR has been formed to keep track of new technology and where appropriate co-ordinate and fund trials of potential smart solutions

4.2.1. ALTERNATIVE SOLUTIONS IN PROGRESS

Alternative solutions currently being investigated and implemented are the following:

Remote Control and Automated Distribution Switchgear

- Switchgear on distribution feeders to specific customers requiring a higher level of reliability has been upgraded to reduce restoration times after feeder faults

- Switchgear at normal open points on distribution feeders between adjacent zone substations has been upgraded to allow reduced load transfer times after subtransmission faults. Reduced load transfer times allow the use of higher short-term overload ratings on subtransmission cables

- Real-time monitoring of assets eg, cable temperature monitoring

Load Management

- Load management has contributed significantly to increasing the VECTOR system load factor in recent times. During the previous winter period, energy distribution was up by 2.6% on the previous year, while the sum of supply point peaks was down by 3MW

- Interruptible loads, consisting of residential hot water cylinders, are controlled by means of a ripple injection system during peak load times in order to reduce peaks at the Transpower connection points, deferring investment in connection capacity

- The possibility of growing the portfolio of interruptible load specifically in localised constrained areas is currently being investigated. Potential growth possibilities are customer standby generation and thermal loads. These loads will be managed in a way that benefit VECTOR and the customer

- The current ripple control system is being rationalised and other load control management systems are being installed

4.2.2. FUTURE ALTERNATIVE SOLUTIONS

The following new technologies are not currently in extensive use but are expected to impact on the distribution network in the future. Therefore, the development of these and possible VECTOR participating strategies are currently being reviewed.

Distributed Generation

Different technologies are under development worldwide but in general all have the potential to have an impact on distribution asset performance, power quality and safety. As an alternative solution to traditional distribution investment, distributed generation could provide a viable capacity solution in constrained remote locations or distribution feeders with a peaky demand. It could also provide a solution for improved reliability.

Energy Storage Systems

Energy storage systems may in future provide solutions to distribution feeders or customers sites with peaky loads or improving power quality requirements.

4.3. ASSET DEVELOPMENT

A number of localised areas within the VECTOR network have been identified as approaching the point where VECTOR's supply reliability criteria cannot be maintained. Each issue and constraint is reviewed to determine the optimum operational and economic approach to addressing the problem and maintaining customer service by considering the following options:

- Increased asset utilisation, through advanced automation, dynamic ratings etc
- Load management (including demand side management)
- Level of acceptable risk
- Asset performance improvement
- Customer requirements and customer based solutions
- Capital investment

This results in a revised asset development programme in terms of the:

- Solution adopted to address the issue or constraint
- Timing of the solution
- Cost of the solution

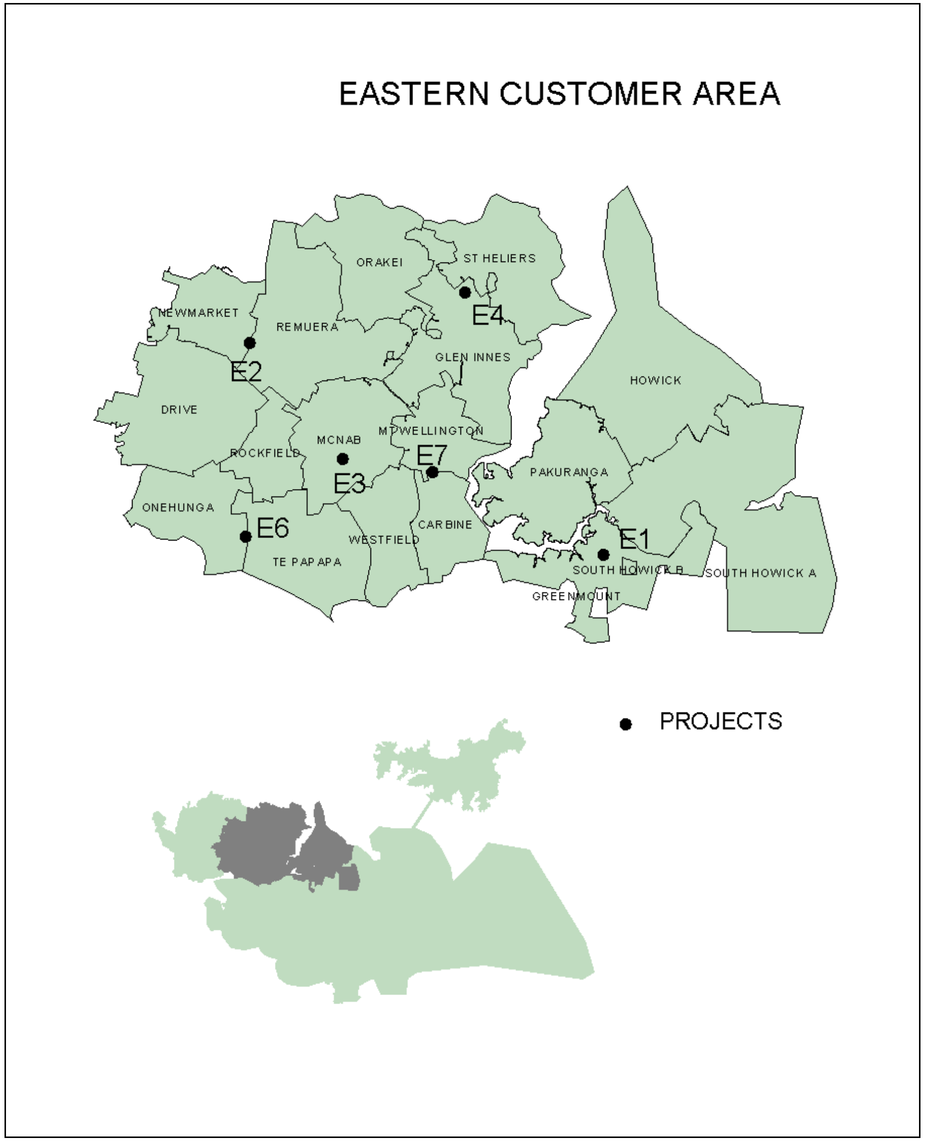
It is expected that by improving the utilisation of assets, VECTOR will be able to stage investments and defer or reduce capital expenditure. Detailed investigation of the options will occur before any new project is committed. Significant projects are summarised in this section, with their approximate cost range (ie, < $1million, between $1 and $3 million, and > $3 million). "Committed" status indicates that the project has an approved budget. The approximate area of each project is marked in the customer area maps.

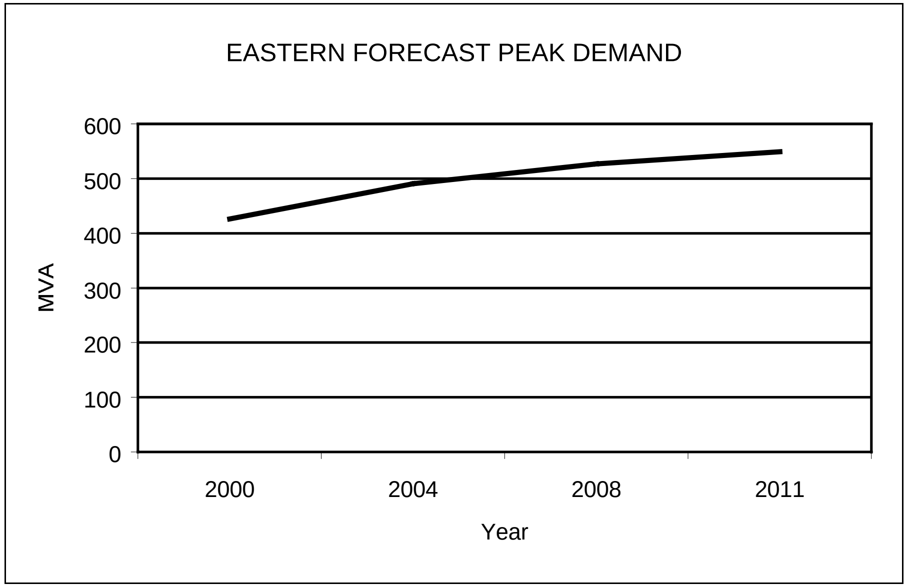
4.4. EASTERN CUSTOMER AREA

4.4.1. GROWTH IN THE EASTERN AREA

Residential growth is mainly focused in the eastern Manukau City area, with a high number of planned subdivisions. Residential growth elsewhere in the eastern area is expected to be low, with infill housing being the major form of development. Industrial and commercial development is expected to continue to be focused around East Tamaki and Westfield/Southdown, with small pockets of retail development in Mt Wellington and Botany Downs. Figure 4.2 shows the eastern customer area boundaries and forecast peak demands over the planning period.

Figure 4.2 Eastern Customer Area





4.4.2. ISSUES AND OPTIONS IN THE EASTERN AREA

E1: Botany Downs, Northpark and East Tamaki Areas

Project	*Greenmount reinforcement*
Driver	*Growth*
Timescale	*Complete early 2001*
Status	*Completed*

Last year's AMP flagged a forecast breach of reliability criteria and shortfall in supply capacity into the Botany Downs and East Tamaki areas, due to the high level of residential and commercial growth. The plan identified a project to install a third transformer, switchgear and feeder at Greenmount substation to address this issue, scheduled for completion in early 2001. This project was completed in January 2001.

E2: Newmarket and Remuera Area

Project	*Newmarket and Remuera upgrade*	
Driver	*Growth*	
Timescale	*June 2001*	
Status	*Committed*	*Estimated capital > $3 million*

As described in last year's AMP, condition monitoring indicated that the existing Newmarket and Remuera 22kV cables, approximately 60 years old, had reached the end of their useful life. The supply to Newmarket and Remuera did not meet VECTOR's reliability criteria.

The option selected to address this issue was to uprate both substations to 33kV. Remuera has been operating at 33kV, and Newmarket has had one cable operating at 33kV, since January 2000. Two additional 33kV circuits to Newmarket are currently being installed in the CBD tunnel. These were previously scheduled for commissioning in December 2000, but rescheduling of tunnel milestones has meant that they will now be commissioned in June 2001. The Newmarket load will continue to be managed using temporary transfers and contingency switching until this project is completed.

E3: Ellerslie, Penrose Area

Project	*McNab 11kV switchboard replacement*	
Driver	*Replacement*	
Timescale	*Within five years*	
Status	*Subject to condition monitoring*	*Estimated capital < $1 million*

The 11kV switchgear at McNab substation is 48 years old, and is nearing the end of its technical life. Condition monitoring using partial discharge testing has shown that, contrary to expectations, the equipment remains in satisfactory condition for continued operation. Regular testing will continue, and as soon as the results indicate that the condition is such that performance will deteriorate beyond minimal acceptable levels, the switchgear will be replaced. The options to address this issue are limited to replacement of the switchgear.

E3: Eastern Bays Area

Driver	*Growth*	
Timescale	*10 years*	
Status	*Proposal*	*Estimated capital > $3 million*

Demand increases, through infill housing development, and the development of the former Winstone's Quarry site (which will cease operations within 12-18 months) are forecast to result in constraints in the Eastern Bays area. Options to address the constraints are:

- Establish a new 33/11kV substation at the existing St Johns 33kV switching station. This would offload Orakei, St Heliers, Remuera and Mt Wellington substations, enabling contingency switching plans to be enhanced in the area
- Uprate Glen Innes substation to 33kV
- Increased asset utilisation by automated load transfer after a contingency

A review of the requirements has indicated that based on current demand forecasts, establishment of a zone substation at St Johns is now unlikely to proceed within the ten year planning horizon. Automated load transfer facilities will be installed as the need arises, to defer major capital expenditure. The uprating of Glen Innes to 33kV will be driven by the condition of the existing 22kV cables. Although these cables are approaching the end of their expected life, their performance does not indicate an imminent need for replacement.

E5: St Johns Protection Upgrade

Driver	*Performance*	
Timescale	*2001*	
Status	*Proposal*	*Estimated capital < $1 million*

The protection system at St Johns 33kV switching station needs to be upgraded. Failure of the unit protection of St Johns incoming 33kV feeders to clear a fault may lead to loss of supply to the whole St Johns substation.

The unit protection of St Johns 33kV incoming feeders utilise copper pilot cable for communication between the relays at each end of the feeder. The relays are of old electromechanical type and do not supervise the communication path. Any damage to the communication path or relay malfunction will not be alarmed to the Control Room, and any subsequent fault on the incoming feeder may lead to complete loss of supply to St Johns substation. The backup protection at St Johns is a non-directional, electromechanical relay and cannot provide fast clearance for faults on incoming cables.

The existing protection relays are to be replaced with modern microprocessor relays, which will provide fast operation and increased availability of the protection system.

E6: Onehunga and Te Papapa Area

Driver	*Growth*	
Timescale	*2008*	
Status	*Proposal*	*Estimated capital > $3 million*

Load growth in the Onehunga and Te Papapa areas has led to a review of the current network capacity and supply requirements. Options considered included:

- Reinforcement by uprating Onehunga to 33kV immediately. Works would be optimised by using a section of the new trench to install a duct for a future additional 33kV cable to Te Papapa. The increased capacity could then be used to defer an upgrade of Rockfield, which is currently scheduled in 2007
- Increased asset utilisation
- 11kV reinforcement to facilitate load transfer

Previous development plans indicated that Onehunga would be upgraded to 33kV in 2001/02. The alternative solution adopted was to install automated load transfer facilities on key Onehunga feeders, at an estimated cost of $300,000. This is scheduled for commissioning in June 2001, and will allow deferral of the major reinforcement of Onehunga/Te Papapa until around 2008.

E7: Mt Wellington, Carbine and Westfield Areas

Driver	*Replacement*	
Timescale	*2001/02*	
Status	*Proposal*	*Estimated capital $1–3 million*

Performance requirements and load growth have led to a review of the supply options in the Mt Wellington and Southdown areas. In addition, the performance of the existing Mt Wellington gas cables, which are 38 years old, has deteriorated to the point where replacement is required. Options under review include:

- Installation of one or more new cables
- Load transfer to the St Johns substation if/when commissioned
- Installation of capacitor banks at selected locations
- Increased asset utilisation
- Load management, asset performance analysis and risk evaluation

A comprehensive review of forecast demand growth and development options has concluded that Westfield development is best considered in conjunction with reinforcement of Te Papapa and Onehunga. Establishment of a 33kV switching station at Te Papapa, to supply Onehunga and Westfield, is a likely development path.

The only significant land areas available for development in the Mt Wellington/Carbine area is the Winstones Quarry site and the former armed forces storage sheds at Sylvia Park. The quarry is scheduled for development as a mixed residential/commercial area in the short to medium-term. The Sylvia Park site is a large block of land, but there are no definite plans for its commercial redevelopment at this stage.

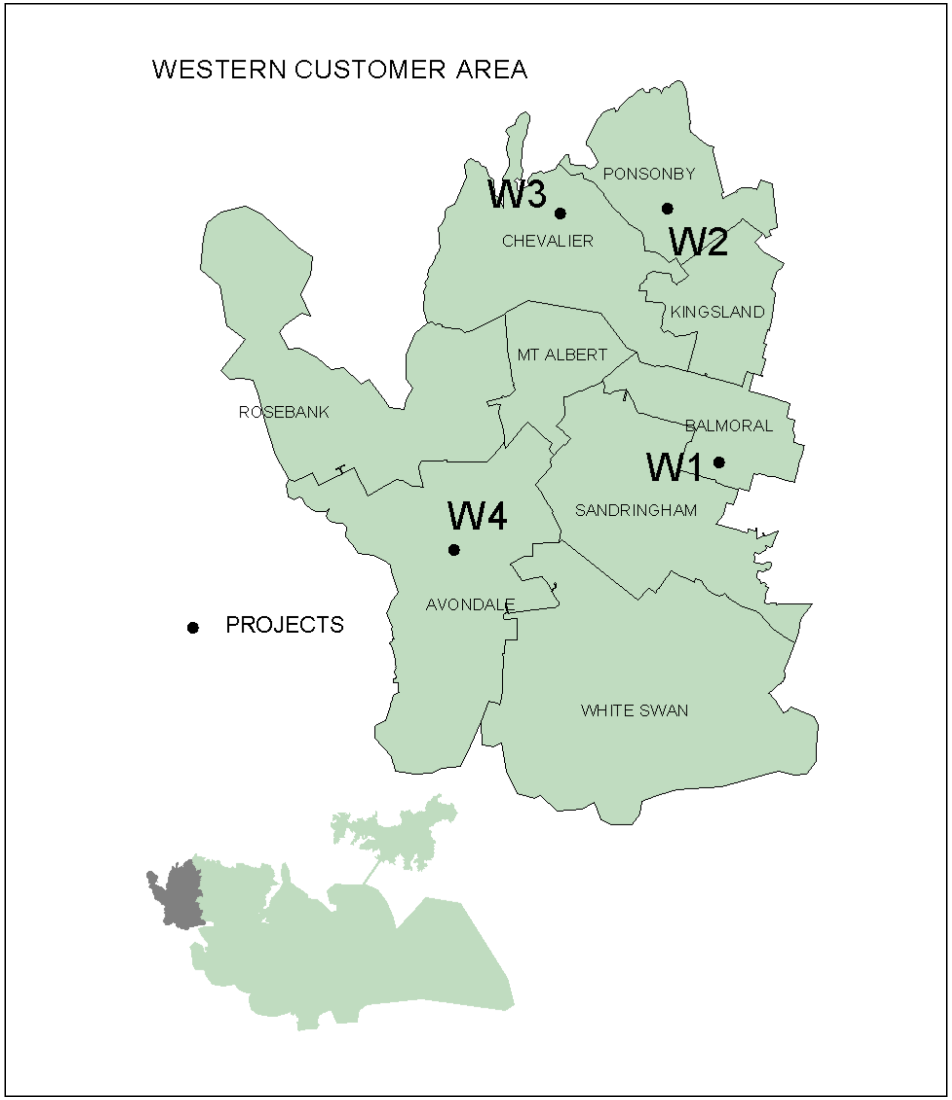
Options for replacement of the Mt Wellington 33kV cables have considered these possible future loads, but due to the uncertainty of their timing and the size of the eventual loads, options involving more investment than just replacement of the existing cables cannot be economically justified.

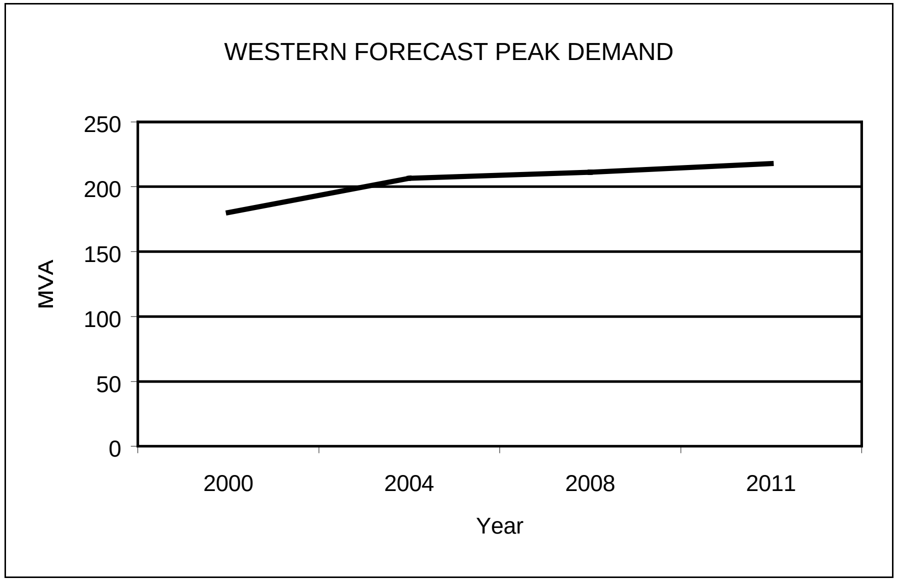
4.5. WESTERN CUSTOMER AREA

4.5.1. GROWTH IN THE WESTERN AREA

Residential growth in this area is expected to be low, with ongoing infill housing being the major form of development. Industrial and commercial development is expected to be focused around the Avondale area, with some isolated pockets of growth (eg, St Lukes). Figure 4.3 shows the western customer area boundaries and forecast peak demands over the planning period.

Figure 4.3 Western Customer Area





4.5.2. ISSUES AND OPTIONS IN THE WESTERN AREA

W1: Sandringham and Balmoral Area

Project	*Sandringham Balmoral upgrade*	
Driver	*Replacement and security of supply*	
Timescale	*2001*	
Status	*Committed*	*Estimated capital $1–3 million*

As outlined in last year's AMP, load growth and asset performance issues in the Sandringham/Balmoral area led to a requirement for supply options to be re-evaluated.

The option selected was a staged upgrade from 22kV to 33kV at Sandringham and Balmoral. Stage one involves installation of a 33kV rated switchboard at Sandringham, and termination of the existing 22kV Sandringham and Balmoral cables to it, to address the existing reliability criteria issues. The existing Balmoral 22kV switchboard will be replaced at the same time, due to unacceptable performance. This work was scheduled for 2001, and is currently on track for completion in June 2001.

W2: Ponsonby Area

Driver	*Replacement*	
Timescale	*2001/2002*	
Status	*Committed*	*Estimated capital < $1 million*

As outlined in last year's AMP, the Ponsonby transformers are 50 years old and reaching the end of their technical life. Condition assessments and high transformer losses indicated that refurbishment was not a viable option. Options reviewed included:

- Installation of surplus 22/11/6.6kV transformers (ex-Newton) at Ponsonby, following the completion of the Newton reinforcement project
- Replacement of existing transformers

The preferred option was installation of the surplus ex-Newton transformers in mid-2001. The dual ratio on these transformers would simplify the planned uprating of the Ponsonby distribution network from 6.6kV to 11kV in 2008, at which time it is expected that the 6.6kV network will no longer have sufficient capacity to deliver the required load.

A review of the Newton upgrade project in 2000 resulted in its cancellation, so the Newton transformers were no longer available for transfer to Ponsonby. However, two suitable 22/11/6.6kV 15MVA units were available from Hobson, where they have been replaced by new 110/22/11kV units as part of the inner Auckland upgrade project. These surplus units have now undergone a mid-life refurbishment, and will be recommissioned at Ponsonby by the end of June 2001. The oil containment facilities at Ponsonby will be upgraded at the same time.

W3: Ponsonby and Chevalier Areas

Driver	*Growth*	
Timescale	*2008*	
Status	*Proposal*	*Estimated capital $1–3 million*

As outlined in last year's AMP, Ponsonby and Chevalier will be the last remaining substations operating at 6.6kV. By 2008 the load on these substations is forecast to be at a level where continued operation of the distribution network at 6.6kV is no longer sustainable. The uprating will require new transformers to be purchased for Chevalier, unless suitable surplus transformers have become available from elsewhere in the network. A review of the demand forecasts in 2000 has confirmed the expected timeframe for this work as 2008.

W4: Avondale Area

Driver	*Replacement*	
Timescale	*2001/02*	
Status	*Committed*	*Estimated capital > $3 million*

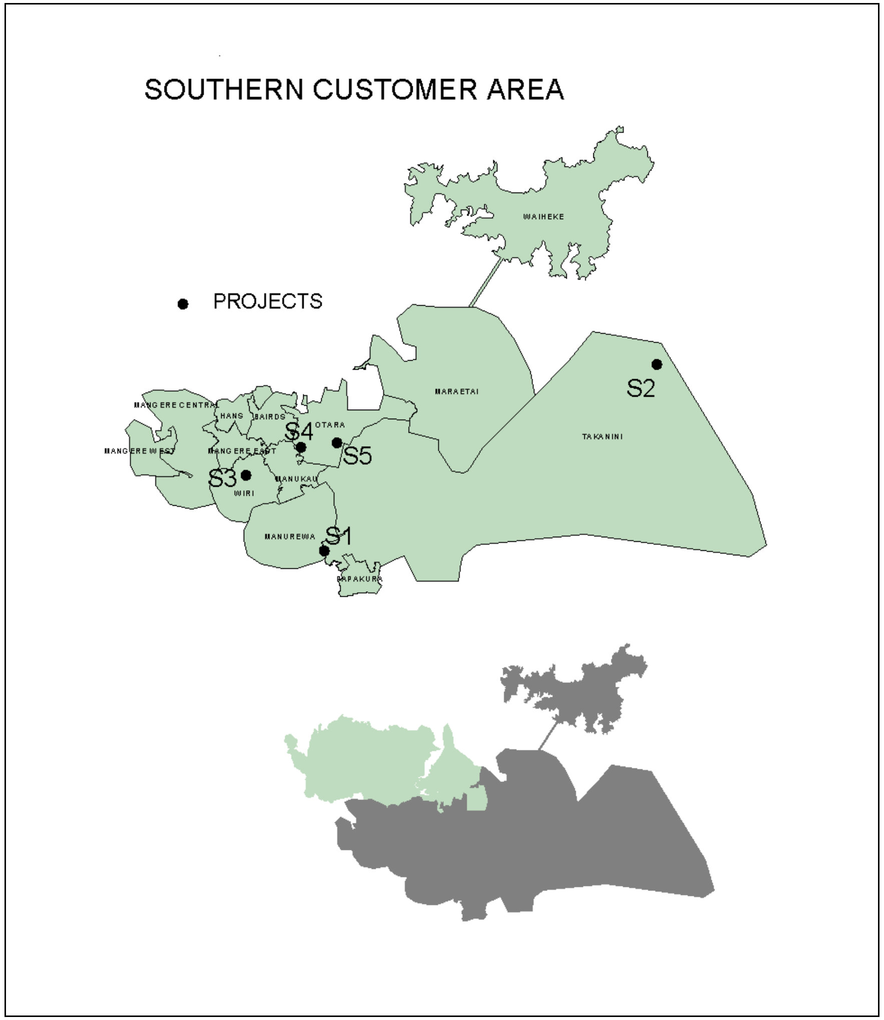
The performance of the 22kV gas-filled cables supplying Avondale substation has deteriorated to the point where replacement is justified.

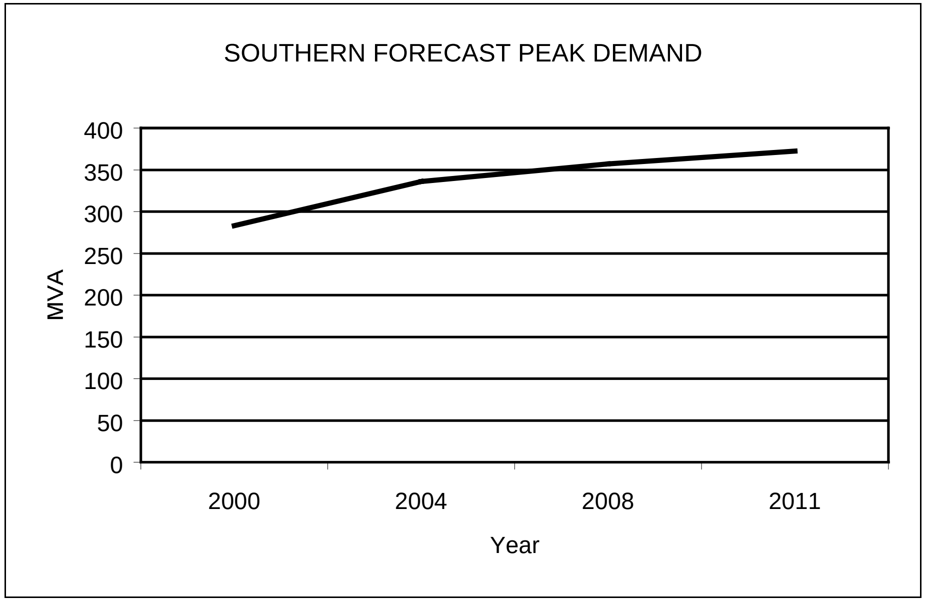
4.6. SOUTHERN CUSTOMER AREA

4.6.1. GROWTH IN THE SOUTHERN AREA

Residential demand is expected to increase in the Clendon/Wattle Downs and Takanini/Alfriston areas with a high number of subdivisions under construction and planned. Smaller residential growth is expected in the Maraetai area. Industrial and commercial growth is expected in the Wiri and Manukau areas, and in the vicinity of Auckland airport and the Watercare wastewater treatment plant. Figure 4.4 shows the southern customer area boundaries and forecast peak demands over the planning period.

Figure 4.4 Southern Customer Area





4.6.2. ISSUES AND OPTIONS IN THE SOUTHERN AREA

S1: Clendon Area

Driver	*Growth*
Timescale	*> 2010*
Status	*Proposal*

A review of forecast load growth in the Clendon/Wattle Downs area against the new reliability criteria has indicated that the new zone substation previously scheduled for commissioning in 2006 will not now be required within the ten year planning horizon. Selective 11kV feeder reinforcements and automated load transfer solutions will be used as and when required to achieve this deferral.

S2: Kawakawa Bay Area

Project	*Supply upgrade*	
Driver	*Performance*	
Timescale	*June 2001*	
Status	*Committed*	*Estimated capital $1-3 million*

The supply to the Clevedon and Kawakawa Bay area has historically had poor performance, with a high number of interruptions of long duration and problems with low voltage. This is being addressed by a combination of measures:

- Installation of a new, single transformer substation at Clevedon and subsequent relocation of 11kV voltage regulators
- Pole marking with reflectors
- Installation of an emergency backup connection to the Counties Power network

Commissioning of the Clevedon substation was planned for August 2000, but extensive delays (beyond VECTOR's control) in the resource consent process have meant that this is now expected to be completed in September 2001. The pole marking programme undertaken in 2000 has resulted in a significant reduction in the number of faults caused by vehicles hitting poles. Construction of the emergency tie to the Counties Power network will begin in March 2001, with final commissioning planned for June 2001.

S3: Wiri Area

Driver	*Replacement and Growth*	
Timescale	*> 2010*	
Status	*Proposal*	*Estimated capital > $3 million*

The capacity of the subtransmission network to Wiri has been confirmed by cable temperature monitoring. Contrary to the expectation outlined in last year's AMP, the capacity has been found to be adequate for the ten year planning period. The cable monitoring will continue, and if load growth is higher than expected, or the soil conditions deteriorate leading to cable derating, options available to address this issue include:

- Uprating of existing cables by remediation of hot spots
- Reinforcement of Wiri zone substation, by installation of two new 30MVA cables from Transpower Wiri
- Increased asset utilisation
- Load management, asset performance analysis and risk evaluation

Linked projects:

- Subtransmission special maintenance: cable temperature investigations
- Transpower Wiri grid exit point capacity upgrade

S4: Manukau/Otara Area

Driver	*Growth*	
Timescale	*2004*	
Status	*Proposal*	*Estimated capital $1–3 million*

Manukau and Otara will require reinforcement or changes to the operating regime by 2004 if the forecast load growth is realised. Options under review include:

- Installation at Manukau of additional 11kV switchgear and a third transformer and additional 33kV cable. Manukau can then be used to off load Otara
- Increased asset utilisation
- Load management, asset performance analysis and risk evaluation

Interim low cost measures to increase transformer ratings (eg, installation of fans and extra radiators), or automated load transfer facilities will be considered as options, which provide a worthwhile deferral of the reinforcement expenditure.

S5: Flat Bush Area

Driver	*Growth*	
Timescale	*2010*	
Status	*Proposal*	*Estimated capital > $3 million*

Updated load forecasts indicate that due to the high level of current and proposed subdivision development demand may exceed available capacity in the Flat Bush area by 2010. Options under review include:

- Capacity increase at Otara and Manukau
- Establishment of a new zone substation at Flat Bush
- Increased asset utilisation
- Load management, asset performance analysis and risk evaluation

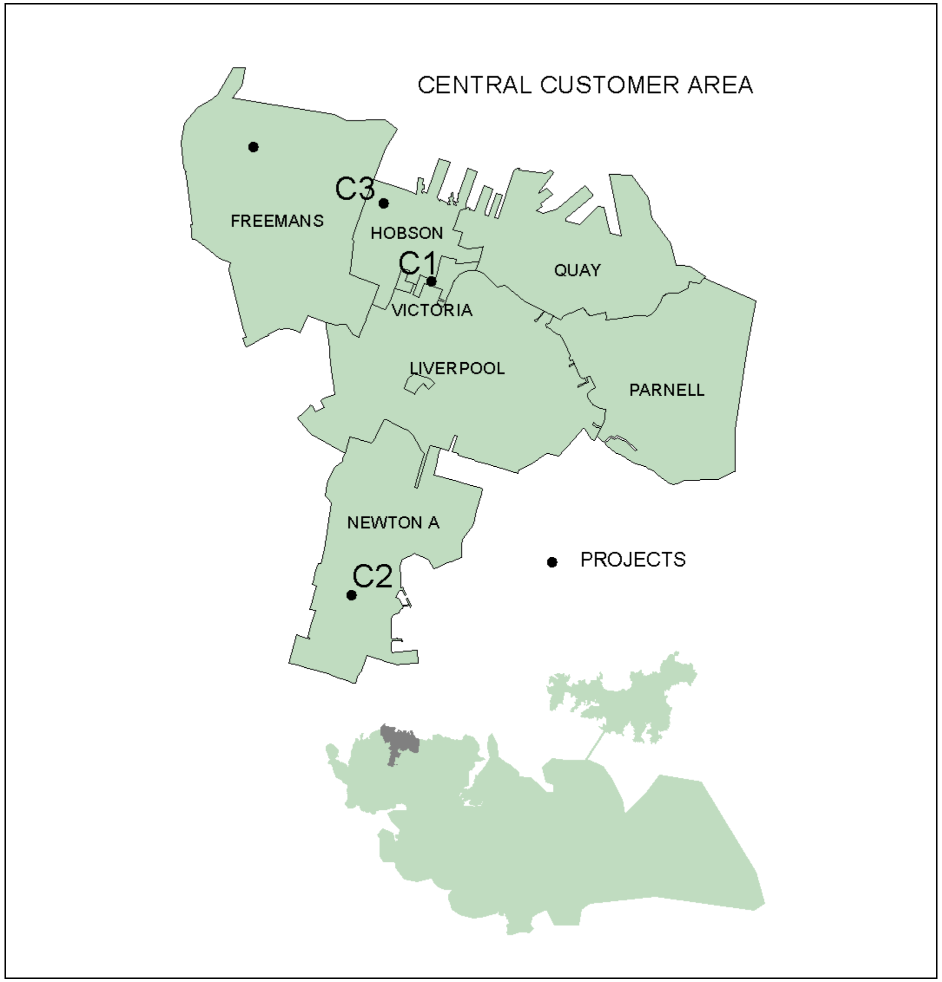
It is expected that establishment of a new zone substation can be deferred to beyond the ten year planning horizon by the introduction of automated load transfer facilities and selective 11kV feeder reinforcements as and when required.

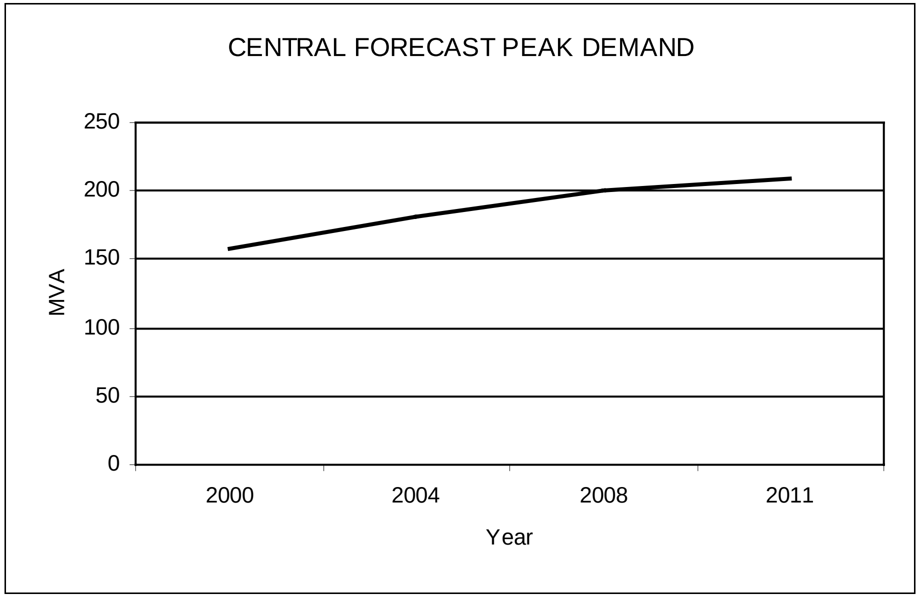
4.7. CENTRAL CUSTOMER AREA

4.7.1. GROWTH IN THE CENTRAL AREA

Residential demand is expected to increase in the central area with the development of new apartments and refurbishment of offices into apartments, although possibly at a slower rate than in recent years. Commercial and retail will continue to develop. Ongoing uncertainty about the Britomart development will have a significant effect on demand forecasts for the Downtown area. Redevelopment of the Auckland Hospital site currently underway will increase the demand on Liverpool substation, and will require reinforcement of the network.

Figure 4.5 *Central Customer Area*





4.7.2. ISSUES AND OPTIONS IN THE CENTRAL AREA

The completion of the current inner Auckland reinforcement project (CBD tunnel and associated high voltage equipment) has provided reliability and security of supply in the central area, and enabled the removal of the emergency overhead lines to be completed well before the Resource Management deadline of December 2001. CBD customers were consulted in 2000 to explain the current level of service provision, the potential future service levels, and their costs. The response from CBD customers was that they were unwilling to pay higher prices for electricity to provide a better level of reliability than was currently planned by VECTOR. Figure 4.5 shows the central customer area boundaries and forecast peak demands over the planning period.

C1: Central Area

Project	*CBD reinforcement*	
Driver	*Growth*	
Timescale	*2001*	
Status	*Committed*	*Estimated capital > $3 million*

The current inner Auckland reinforcement programme has been developed to ensure load growth is met and that areas are strategically linked to enable efficient contingency switching, with optimum utilisation of the existing assets. The completed programme included:

- Completion of the tunnel
- Installation of a new 110kV supply from Penrose to Liverpool
- Establishment of Hobson as a 110kV point of supply
- Upgrades to the switchgear at Liverpool and Hobson
- Installation of a new Roskill to Liverpool 110kV cable

4.7.3. RELATED AND LINKED CENTRAL AREA PROJECTS

C2: Newton Capacity Upgrade

Driver	*Growth*
Timescale	*December 2000*
Status	*Cancelled*

Last year's AMP outlined a committed project involving installation of new larger subtransmission transformers at Newton and replacement of the existing 22kV oil-filled cables with cables of larger capacity, to be completed by December 2000. A review of this project before construction started early in 2000 resulted in a recommendation to cancel the project, as completion of the Kingsland upgrading project, commitment to upgrading projects at Freemans

Bay and Newmarket, and the planned establishment of a new zone substation at Hobson West combined to remove the need for Newton reinforcement. Automated load transfer facilities will be established as and when necessary to defer indefinitely the need for reinforcement of Newton.

C3: Hobson West Substation

Driver	*Growth*	
Timescale	*2002/2003*	
Status	*Proposed*	*Estimated capital > $3 million*

Establishment of a new substation to supply increasing load on the western side of the CBD and off load existing substations at Hobson, Victoria and Liverpool was identified as a development option in last year's AMP. This has been confirmed as a solution, and a suitable substation site has been purchased. It was planned to commission the new substation in time for the summer peak of 2001/02, but some targeted 11kV feeder reinforcements have allowed this to be deferred until at least 2002/03, and possibly 2003/04 depending on load growth.

C4: Freemans Bay Area

Driver	*Growth*	
Timescale	*2001/2002*	
Status	*Committed*	*Estimated capital $1–3 million*

The proposed upgrading of Freemans Bay to 11kV operation was foreshadowed in last year's AMP. This project has been committed and is now under way. Completion is scheduled for February 2002.

Options for future reinforcement in the CBD include:

- Reinforcement of the Quay area. Planned works to install a third transformer to meet capacity have been deferred because of the original Britomart project cancellation and the installation of a second transformer at Parnell
- Installation of a fourth 110kV infeed to the CBD
- Installation of a third 110/22kV transformer at Hobson
- Increased asset utilisation
- Load management, asset performance analysis and risk evaluation
- The tunnel provides a greater level of security of supply for the cross-isthmus network and also provides a corridor for future upgrades to the cross-isthmus network

4.8. TRANSFORMER REDEPLOYMENT

To ensure optimum utilisation of existing assets, transformers are relocated when released if performance and condition criteria are met. The CBD, Freemans Bay, Ponsonby and Newmarket/Remuera reinforcement projects will release the following transformers:

- Hobson transformers to be relocated to Ponsonby
- Existing Ponsonby units to be scrapped
- Newmarket transformer to be relocated to Parnell
- Remuera transformer to be relocated to Parnell
- Parnell transformer to be relocated to Freemans Bay
- Freemans Bay units to be scrapped

4.9. TRANSPOWER SUPPLY POINTS

Transpower supplies the VECTOR network through eight grid exit points. Transpower and VECTOR liaise on works programmes to ensure priority and critical issues are addressed.

4.9.1. ISSUES AND OPTIONS AT THE GRID EXIT POINTS

Roskill and Penrose Grid Exit Points

Driver	*Rationalisation of feeders*
Timescale	*February 2000*
Status	*Completed*

Following switchgear replacements and transformer upgrades at Transpower's Penrose and Roskill grid exit points, alterations were required to VECTOR's cable terminations to maximise supply availability and operational flexibility.

Wiri Grid Exit Point

Driver	*Security of supply and performance*
Timescale	*2002*
Status	*Proposal*

An increase in transformer capacity at Wiri is required given that load growth in the area is expected to continue. VECTOR is working with Transpower to determine the most cost effective option to achieve this.

Mangere Grid Exit Point

Driver	*Security of supply and performance*
Timescale	*2001*
Status	*Proposal*

A high standard of protection is required to ensure security of supply to key customers. VECTOR is discussing with Transpower the possibility of installing an 110kV bus section circuit breaker and 110kV bus zone protection.

Pakuranga Grid Exit Point

Driver	*Security of supply and performance*
Timescale	*2002/3*
Status	*Proposal*

The existing transformer capacity at Pakuranga is marginal in terms of meeting the required reliability standard. Load growth in the area is high and is expected to continue. An increase in transformer capacity is required. VECTOR is working with Transpower to determine the most cost effective option to achieve this.

Hepburn Grid Exit Point

Driver	*Security of supply and performance*
Timescale	*2001/02*
Status	*Proposal*

The existing transformer capacity at Hepburn is insufficient to meet the Transpower reliability standard. The Hepburn grid exit point supplies VECTOR and UnitedNetworks. VECTOR will work with UnitedNetworks and Transpower to determine the most cost effective option for increasing transformer capacity.

Penrose Grid Exit Point

Driver	*Security of supply*
Timescale	*> 2006*
Status	*Discussion*

Concerns over security of supply at Transpower Penrose are currently being discussed with Transpower. One possible solution to the security problem is construction of a new 220kV line from Otahuhu to Penrose.

4.10. CUSTOMER INITIATED NETWORK DEVELOPMENTS

Customer driven capital expenditure is driven primarily through the growth of the city and with Auckland and Manukau cities being some of the fastest growing areas in New Zealand, VECTOR experiences a significant level of various activities.

- New subdivisions account for around 40% of customer activity, including reticulation and streetlighting for commercial and residential developments

- New service connections in areas where reticulation already exists or only requires moderate extension account for a further 20% of expenditure

- Customer substations are installed for commercial customers with loads unable to be supplied from the low voltage reticulation. They account for more expenditure than service connections but with only 2.5% of the number of jobs

The remainder of the expenditure is divided between:

- Cable relocations – mainly driven by council road widening projects
- Capacity changes – where transformer connected customers require an upgrade or downgrade in capacity
- Low voltage reinforcements – where a change in customer capacity requires an upsizing of the low voltage network

The demands from the customer led initiatives are included in the load forecasts and influence the timing and priority of capital works in the VECTOR network.

4.11. NETWORK PERFORMANCE PROJECTS

VECTOR has initiated a number of network wide projects to enhance its knowledge and control of the network.

Power Quality Metering

Driver	*Performance analysis*
Timescale	*Stage 1: Complete by March 2000*
	Stage 2: 2001/02
	Stage 3: 2001/02
Status	*Stage 1: Completed*
	Stage 2: Committed
	Stage 3: Proposal

Stage 1 of this programme has installed power quality metering at selected zone substations and selected points on the distribution network to provide information on the quality of supply and enable VECTOR to take a more proactive approach to improving quality of supply.

Stage 2 of this project is installation of power quality metering at the Transpower grid exit points, to enable analysis of the quality of supply we receive from Transpower.

Stage 3 of this project is to install more power quality monitors in areas of high concentrations of sensitive customers and closer to customers to provide information on the impact customer operations have on neighbouring customers.

Fibre Optic Cable Extensions

Driver	*Growth*
Timescale	*Ongoing*
Status	*Committed*

The fibre optic cables are used for operational communications, network control and protection signalling. It is proposed to extend VECTOR's fibre optic network backbone to connect all Transpower points of supply in VECTOR's area. The cable network was extended to the Transpower Pakuranga substation in 2000. As a part of the CBD tunnel project a 48 core fibre optic cable has been laid between VECTOR's Hobson, Liverpool and Transpower Penrose Substations.

Any new zone substation built will be connected to the Transpower point of supply via fibre optic cable. A cable has been laid between Transpower Pakuranga substation and the new zone substation at East Tamaki.

To minimise costs, use is also made of fibres installed by others across the network.

4.12. EXPENDITURE FORECAST

The capital expenditure plan that corresponds to the asset replacement, refurbishment and development projects is given in Table 4.1. These forecasts are based on known, current solutions only. Extensive analysis of alternate approaches, including load management, increased asset utilisation through advanced technology etc is expected to enable the forecast expenditure to be reduced.

- Compliance projects are projects where the main drivers are regulatory, environmental, health and safety etc

- Growth projects are projects where the main drivers relate to growth in demand

- Performance projects are projects where the main driver is replacement of assets that are failing to deliver their functional requirements

- Replacement projects are projects where the main driver is straight replacement of assets that are at the end of their useful life

- Cyclic replacement projects are projects where the main driver is economic efficiency, where the whole of life maintenance and remedial costs are higher than the replacement costs. Risk analysis is another main driver in this category

	01/02	02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11
Compliance	1	1	1	-	-	-	-	-	-	-
Growth	8	5	7	3	7	5	8	9	3	3
Performance	3	1	1	1	1	1	1	1	1	1
Replacement	13	1	4	1	1	4	13	6	1	6
Cyclic Replacement	7	7	5	5	5	4	4	4	4	4
Customer	14	12	13	13	14	15	15	16	17	18
TOTAL	46	27	31	23	28	29	41	36	26	32

Table 4.1 Forecast Capital Expenditure Budget ($ million)

5. ASSET MAINTENANCE

5.1. ASSET MAINTENANCE STRATEGY

VECTOR operates and manages a wide range of assets from 110kV power transformers to 230V service connections. Each asset is reviewed in terms of risk and criticality and the optimum maintenance strategies defined.

Ensuring that the asset maintenance, refurbishment and replacement programmes are value-based is the critical driver in VECTOR's asset management policy. Asset maintenance can be a significant proportion of the total lifecycle cost and VECTOR's approach is one of value-based maintenance.

The foundation for the asset maintenance plan is our customer service obligations, which are based on customer type and service expectations. The decisions on maintenance for each asset are based on the impact on the reliability targets eg, SAIFI and CAIDI, health and safety implications, reliability management and cost. Asset maintenance, refurbishment and replacement on the VECTOR network are designed to maintain the functionality of the asset and the operating capability of the network to meet these requirements. Preventative maintenance on VECTOR's network consists of the following:

- Routine asset inspections, condition assessments, servicing and testing of assets
- Evaluation of the results in terms of service delivery, performance expectations, risks etc
- Repair, refurbishment or replacement of assets when required

Asset maintenance criteria are documented in the zone based contractors maintenance instructions. These include the inspection, testing and condition assessment requirements for each asset. The maintenance instructions also include the actions to be taken based on the results of the tests and condition assessments.

The development of the asset maintenance plans takes into account the variety of customer, environmental, operational performance and condition factors. Generic maintenance actions are developed for each asset type, but can be applied differently based on asset performance requirements and criticality. Assets that are at a greater risk of a certain type of failure or have high utilisation or high risks associated with failure, can have enhanced preventative and condition based maintenance schedules. Similarly, areas with known asset problems or fault causes can have enhanced maintenance programmes implemented.

As a general rule, the timing for any replacement is based on condition and performance assessments made as the asset:

- Approaches the end of its useful life and is no longer suitable for its application, in terms of asset functionality or customer requirements
- When the asset presents an unacceptable risk for performance or to the operating and maintenance personnel
- For economic reasons if the whole of life maintenance or remedial costs are higher than the expected replacement costs

From the detailed inspections and condition assessments, it has been determined that the condition of certain assets means that replacement or refurbishment is necessary to maintain the functionality of the asset. In line with our approach to value-based maintenance, asset refurbishment or replacement programmes are now applied to address known condition or performance issues for certain groups of assets in a particular area or environment. This further refines our existing replacement strategy and will enable full analysis of the economic and life cycle benefits of individual assets against groups of asset replacement programmes.

The underlying objective is to identify opportunities to achieve where appropriate overall value through programmes of replacement rather than incurring remedial and ongoing preventative maintenance costs. It is recognised that asset types have a finite life and for some asset types there may be a point where fault rates or performance degradation start increasing at such a rate, that ongoing maintenance is uneconomic.

One of the major factors considered is whether an asset's condition is regularly monitored through inspection or testing, versus assets where it is not possible or practical to inspect. The relative cost of inspection when compared to the replacement cost is also a consideration. Where the cost of inspection is low, or there are low volumes of assets and the cost of replacement is high, replacement on an individual asset basis is most likely to be the approved method. For assets where condition inspection is not possible, or the costs of inspection are prohibitive, replacement will be driven by age or by fault rate analysis, and are more likely to be comprehensive than specific.

In line with the revised zonal reliability targets and to ensure asset management is value-based, all proposed repair, refurbishment and replacement work is assessed to ensure that the rationale fits with one or more of the following drivers:

- Safety and environmental issues
- To bring performance in line with customer performance targets
- Work will result in a cost saving
- Customer wants and is willing to pay for improved performance

No work proceeds without economic analysis to determine the most cost effective solution to achieve the required level of performance.

When the requirement arises for an asset to be replaced, the opportunity is taken to consider the justification for both an upgrade and/or capacity increase to meet future supply requirements and replacement with modern technology to ensure minimum asset lifecycle costs. VECTOR is continually reviewing equipment for use on the network in terms of whole of life costs, which include reliability, initial costs and ongoing maintenance and operational costs.

5.2. ASSET PROCESS

For any asset replacement or refurbishment decision the process outlined in Figure 5.1 is followed to ensure consistency and comparability of options.

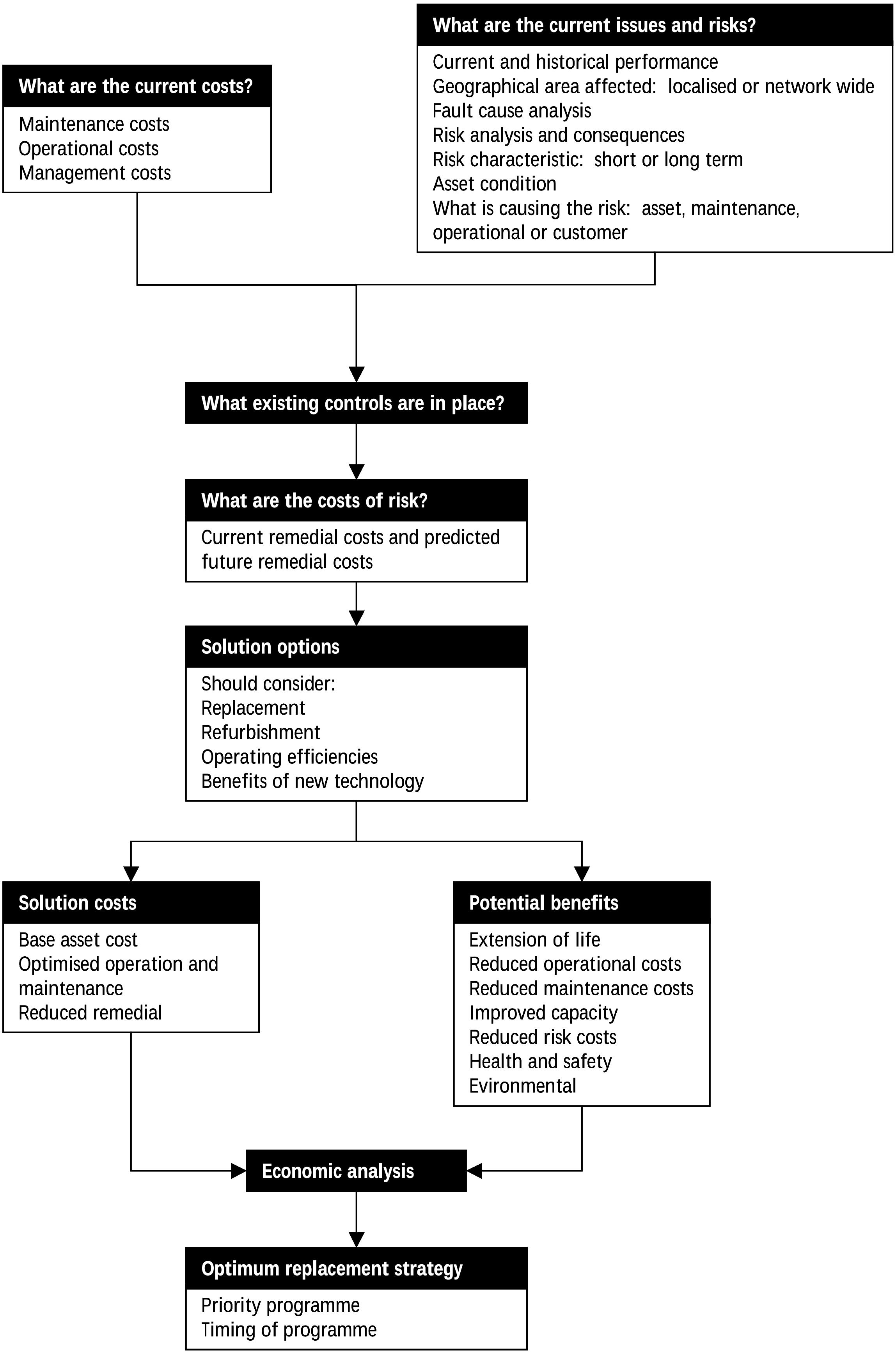


Figure 5.1 Asset Decision Process

5.3. ASSET MAINTENANCE BY ASSET TYPE

In this section the following terms are used:

Asset description
A brief description of the asset.

Asset performance and condition
Design capacity and current utilisation. Age profiles and condition based test investigations. Failure modes specific to the asset type where relevant. Improvements for reliability and safety made in 2000/01.

Asset maintenance
Brief description of the generic planned maintenance activities.

Asset issues and risks
Indication of asset specific risks, their impacts, current controls and planned actions.

Asset replacement
Major work that does not increase the capacity of the asset, but maintains the capacity and functionality of the asset at its lowest whole of life cost.

Asset creation for the major transmission and subtransmission assets
Part of the capital programme, where an asset is created or an existing asset is improved beyond its design capacity implemented in 2000/01 or planned for 2001/02.

Asset disposal for the major transmission and subtransmission assets
Assets decommissioned in 2000/01 or planned for decommissioning in 2001/02.

5.4. TRANSMISSION AND SUBTRANSMISSION CABLES AND LINES

5.4.1. ASSET DESCRIPTION

The subtransmission network consists of 504km of cables and lines rated at 110kV, 33kV and 22kV, the lengths and ages are shown in Table 5.1 and Figure 5.2.

Cable Type	110kV	33kV	22kV	Total Length (km)
Overhead		46		46
Underground Solid	29	98	100	227
Underground Gas	20	6	18	44
Underground Oil	37	125	25	187
TOTAL by Voltage	86	275	143	504

Table 5.1 Transmission and Subtransmission Cable Lengths and Voltages

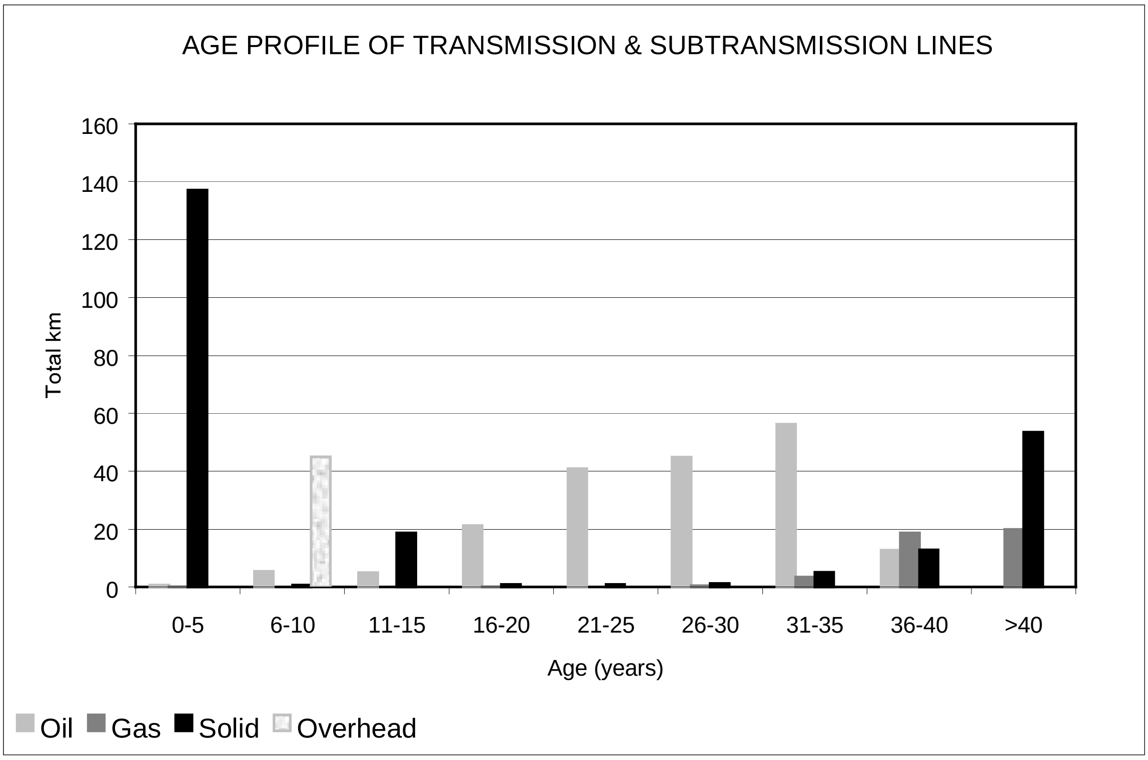


Figure 5.2 Age Profile of Transmission and Subtransmission Lines

5.4.2. ASSET PERFORMANCE AND CONDITION

Improvements for Reliability

Completion of the Inner Auckland Supply Upgrade: Transmission and Subtransmission

This project, carried out at an approximate total cost of $200 million, will provide increased supply capacity for future growth for inner city areas, including the CBD, Parnell, Newmarket, Newton and Freemans Bay, as well as benefit other suburbs. These major improvements will not only lift the reliability of supply in inner areas to a level better than many of the world's major cities, but will also have positive benefits for other parts of Auckland. This is due to the installation of new links and switching equipment as well as new HV cables connecting to the Transpower grid exit points, making the whole system much more "flexible".

The project works have included:

- The installation of a new high voltage (110,000 volt) cable from the national grid connection at Roskill to the inner area
- The building of a tunnel carrying two high voltage supply circuits from the national grid connection at Penrose to the CBD
- New 22,000 volt links around the inner city area
- A new 33,000 volt link via the tunnel, from the national grid connection at Penrose to Newmarket
- New high voltage substation equipment at Hobson Street and Liverpool Street substations
- Other extensive substation upgrading, including modern, new transformers and latest technology switchgear
- In addition, the supply to the Viaduct Harbour area has been boosted in the past two years to cope with the America's Cup activity and rapid business and residential expansion in that part of the city

The final element in the upgrading project, the 9.2km supply tunnel running underground from Penrose to Hobson Street, has just been completed and gone live.

Cable Ratings

A project was completed in 2000, which calculated new ratings for all subtransmission cables. Ratings were calculated for continuous, cyclic and short-term emergency loadings.

These ratings will be used as the basis for determining future network reinforcements. The ratings will also provide more accurate limits for network operations and will provide information to support consideration of short-term off load options in emergency situations. This will improve asset utilisation.

Further research is being conducted to improve the accuracy of the models. This includes comparing actual equipment temperatures with calculated values, and improved condition testing procedures for measurement of soil thermal resistivity.

The longer-term intent is to calculate ratings for key equipment dynamically as part of VECTOR's real-time network management system. This will be pursued concurrently with the new SCADA/DMS implementation.

Temperature Investigations

Temperature investigations continue as part of asset development investigations. Three temperature monitoring points were installed on the Wiri cable this year as part of the cable rating analysis. Further temperature investigations will be carried out in line with the cable rating analysis.

5.4.3. MAJOR FAULT CAUSES

Figure 5.3 shows the major fault causes impacting on the transmission and subtransmission cable and line assets.

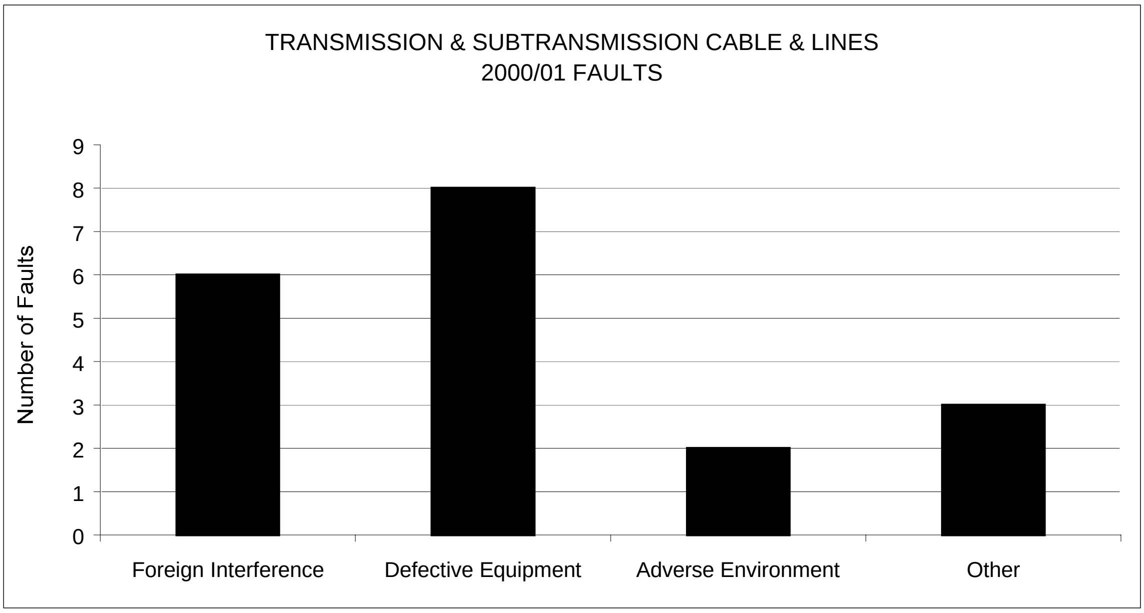


Figure 5.3 Transmission and Subtransmission Major Fault Causes

Foreign interference continues to be a problem, tree interference has been contained by proactive vegetation management, but directional drilling is becoming a bigger fault cause. Cable joints are the primary cause of the defective equipment faults. VECTOR has been proactive in developing methodologies to assess the risk, see Section 5.4.5.

5.4.4. ASSET MAINTENANCE

- Weekly route patrols, with enhanced frequency in parts of the CBD to identify any potential problems
- Proactive work with external contractors to prevent third party damage
- Annual cable termination inspections and thermographics
- Serving tests

5.4.5. ASSET ISSUES AND RISKS

The following issues, their current controls and required actions have been identified for transmission and subtransmission cable and line assets and are detailed in Table 5.2.

Issue Description	Issue Impact	Current Controls	Action
Increase in directional drilling across network leading to third party damage	Reliability	Regular route patrols to identify works in the vicinity of cables Free cable location service and obstruction plans for contractors and the public DialB4Udig campaign launched in 2000	OSH and VECTOR working proactively with external contractors to ensure correct process for cable location is followed
Oil leaks from cables	Reliability Environmental	Continuous monitoring of pressures to identify problem areas Development of maps with ARC to highlight sensitive areas	Continuation of serving test and repair programmes to pick up smaller leaks
Potential thermomechanical movement of cores in joints	Security	Development of x-ray technique to assess condition of joint in situ without destroying the integrity of the joint	Method proved successful and will be used on other suspect joints
High gas use in cables at Mt Wellington and Avondale	Reliability	Continuous monitoring of pressures and repair of leaks	Replacement plans as detailed in Section 3

Table 5.2 Transmission and Subtransmission Cables: Asset Issues and Risks

5.4.6. ASSET REPLACEMENT

Cables

The various cables have varying design lives but the main criteria for transmission and subtransmission cable replacement is based on an assessment of the risk of loss of functionality, analysis of failure rates and costs and condition tests. Condition and performance are used as the main guideline for replacement. The oil and gas cables have continuous pressure monitoring via the SCADA system, with alarms to give early warnings of low pressures.

Mt Wellington and Avondale Gas Cables

The Mt Wellington and Avondale cables were installed in 1963 and have been suffering from increased gas leaks. The leaks are along the length of the cable as well as the joints making spot repairs difficult and costly. Investigations have established that the rubber hessian serving has deteriorated allowing moisture to penetrate the reinforcing tapes causing corrosion. The annual remedial costs for gas replacement and repairs are high and increasing. The reliability standards for these cables cannot be fully guaranteed as it is impossible to predict when a leak will occur and it can take up to a month to repair the cable once a leak has been detected. The cables have been programmed for replacement in 2001/02. See Section 3 for options and investment details.

5.4.7. ASSET CREATION

- 110kV cables in CBD
- 33kV cables in Newmarket

5.4.8. ASSET DISPOSAL

The 22kV Newmarket cables will be retired in 2001. Sections may be used for 11kV network reinforcement.

The Avondale and Mt Wellington gas cables will be written off in 2001/02.

5.5. TRANSMISSION AND SUBTRANSMISSION TRANSFORMERS

5.5.1. ASSET DESCRIPTION

VECTOR owns 120 transformers, two of which are at Lichfield, which lies outside of VECTOR's main Auckland supply network. The subtransmission transformers range in rating from 12MVA to 60MVA. The age profile of the subtransmission transformers is shown in Figure 5.4.

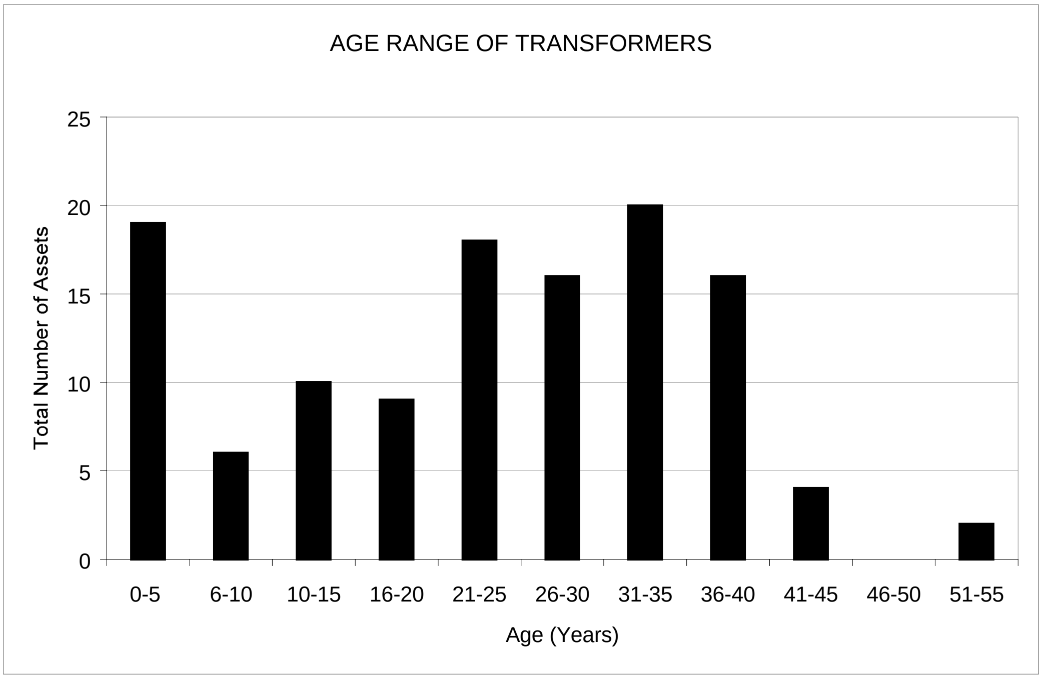


Figure 5.4 Subtransmission Transformers Age Profile

The transformers have an average age of 23 years. The ODV design life of a transformer is 45 years, but if the transformer is not subject to abnormal operating conditions and is well maintained, the design life can be extended.

5.5.2. ASSET PERFORMANCE AND CONDITION

Improvements for Reliability

Transformer Ratings

A project was completed in 2000, which calculated new ratings for all transformers and determined which circuits were transformer limited and which were cable limited. Ratings were calculated for continuous, cyclic and short-term emergency loadings.

These ratings will be used as the basis for determining future network reinforcements.

The ratings will also provide more accurate limits for network operations and will provide information to support consideration of short-term off load options in emergency situations. This will improve asset utilisation.

Transformer overloading capabilities were calculated using Transformer Load Simulator (TLS) software. The software is based on the recommendations of IEC60354 (Loading Guide for Oil Immersed Transformers). The maximum allowable transformer winding hot spot temperature was calculated by assessing moisture content in the winding paper insulation of the transformers with measured moisture content in the transformer insulating oil.

Further work is planned to more accurately assess moisture content in the transformer winding paper insulation and its limitation on overloading the transformers.

The longer-term intent is to calculate ratings for key equipment dynamically as part of VECTOR's real-time network management system.

Transformer Thermal Protection and Voltage Regulation

All new transformers and refurbished transformers have been equipped with a microprocessor based Transformer Management System (TMS). The TMS replaces conventional transformer thermal and voltage regulating equipment. The TMS enables real-time monitoring of the power transformers and using the calculations based on IEC60354 enables short-term emergency loading of the transformers. This allows the utilisation of the transformers to be increased safely. The replacement schedule will continue as planned in line with transformer purchase and refurbishment.

5.5.3. MAINTENANCE

Routine condition monitoring of transformer components using non-invasive methods. Each transformer is subject to monthly visual checks for moisture, oil levels and leaks and fan operation.

On an annual basis, DGA tests for transformer and tap changers are carried out, along with alarm tests, bucholz relay tests and thermal and ultrasonic imaging of terminations and connection.

Transformers and tap changers are scheduled for minor and major maintenance on a two and eight year cycle.

Eight transformers are scheduled for refurbishment in 2001/02, based on DGA results. Any transformers scheduled for movement to another site are refurbished as part of the move where their condition and assessed remaining useful life make this worthwhile.

5.5.4. ASSET ISSUES AND RISKS

The following issues, their current controls and required actions have been identified for transformers and are detailed in Table 5.3.

Issue Description	Issue Impact	Current Controls	Action
Moisture ingress into compound filled transformer end boxes	Security of supply Performance Health and safety	Sample of boxes selected for detailed inspection of the compound and gaskets	Gaskets will be replaced on opening. Results will determine if inspection of all assets is necessary
Corrosion of transformer leading to potential oil leaks	Performance Environmental	Programmed repair of corroded transformers	Any transformers scheduled for disposal or refurbishment are excluded from repairs
Moisture and acidity levels impacting on transformer utilisation	Performance	DGA tests and standard oil tests Transformer rating review	

Table 5.3 Transformers: Asset Issues and Risks

5.5.5. ASSET REPLACEMENT

Transformer replacement is based on condition. Transformers or components that have deteriorated beyond acceptable parameters are taken out of service for a detailed inspection of moisture levels, the core and windings. The investigation gives an indication of life expectancy of the transformer and a decision is made on refurbishment or replacement based on the functionality and performance requirements of the asset.

5.5.6. ASSET CREATION

Hobson:	T3 and T4	110/22/11kV	65/40/25MVA
Greenmount:	T3	33/11kV	20MVA
East Tamaki:	T1 and T2	33/11kV	20MVA
Newmarket:	T2	33/11kV	20MVA
Freemans Bay:	T1	22/11kV	20MVA

5.5.7. ASSET DISPOSAL

Ponsonby 1 and 2
Freemans 1 and 2

5.6. TRANSMISSION AND SUBTRANSMISSION SWITCHGEAR

5.6.1. ASSET DESCRIPTION

VECTOR own and operate 846 subtransmission circuit breakers, rated at 110kV, 33kV, 22kV, 11kV and 6.6kV. The circuit breakers are oil, vacuum, SF_6 and Gas Insulated Switchgear (GIS), with an average age of 23.5 years. Figures 5.5 and 5.6 show the age profile and breakdown of circuit breakers by type.

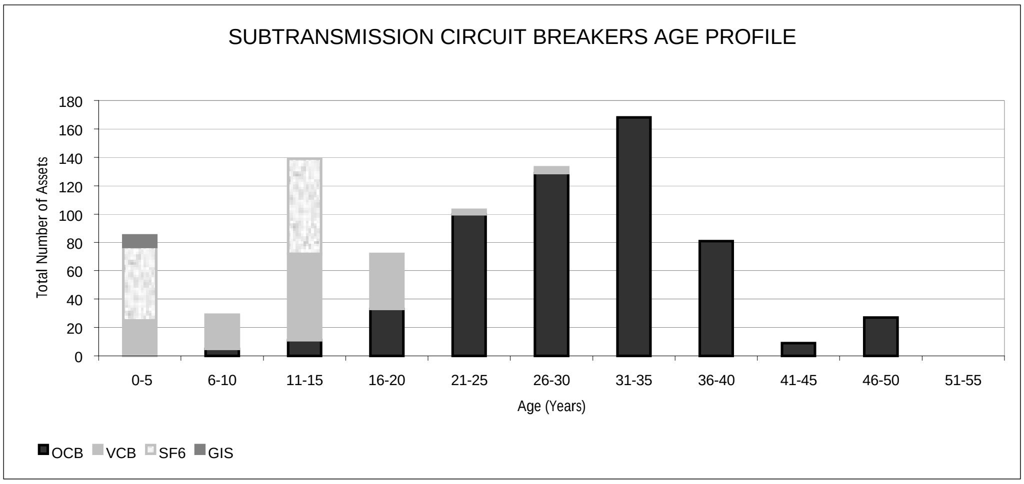


Figure 5.5 Subtransmission Circuit Breakers Age Profile

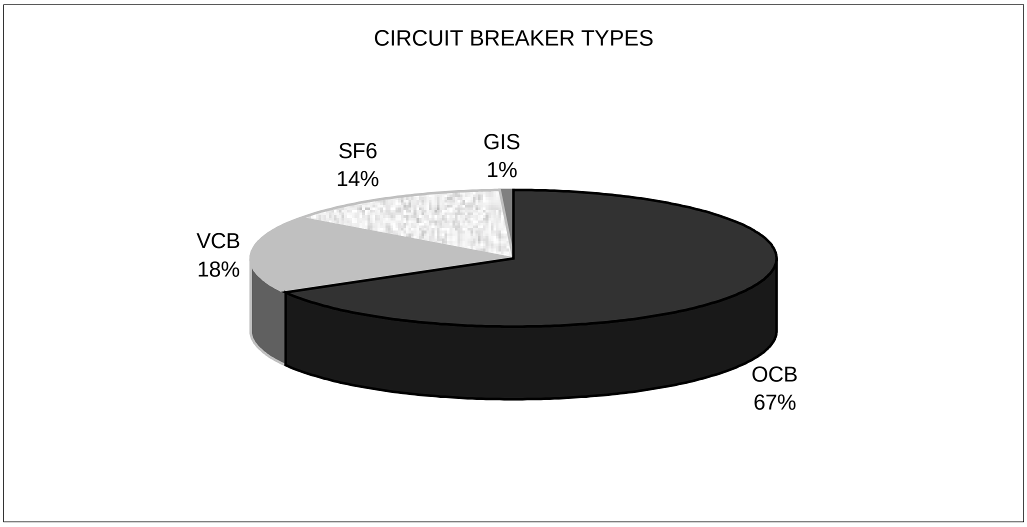


Figure 5.6 Subtransmission Circuit Breakers by Type

5.6.2. ASSET PERFORMANCE AND CONDITION

The condition of the circuit breakers is generally good with no condition problems identified through maintenance or operation.

5.6.3. IMPROVEMENTS FOR RELIABILITY

Partial discharge surveys and monitoring tests were carried out in five locations where switchgear was over 40 years old and had compound filled busbars. All breakers tested in 2000 were found to be in functional condition and no replacements were necessary.

5.6.4. MAJOR FAULT CAUSES

There were no major faults associated with the circuit breaker assets last year.

5.6.5. MAINTENANCE

- All switchgear is visually inspected on a monthly basis for leaks and general condition
- Major maintenance on the switchgear including inspection and performance testing of the circuit breakers and testing of the protection relays and systems on an eight year cycle
- Non-invasive partial discharge location and monitoring have been introduced into routine preventative maintenance this year as a routine condition assessment technique following last year's successful trials.

5.6.6. ASSET ISSUES AND RISKS

The following issues, their current controls and required actions have been identified for the switchgear assets and are detailed in Table 5.4.

Issue Description	Issue Impact	Current Controls	Action
Potential problems identified by suppliers with discharge	Reliability		Programme of partial discharge monitoring planned for 2001/02 over a range of switchgear ages and manufacturers to identify any potential problems

Table 5.4 Subtransmission Circuit Breakers: Asset Issues and Risks

5.6.7. ASSET REPLACEMENT

Switchgear is replaced on an as failed basis or when condition monitoring indicates that replacement will be more economic than refurbishment or repair.

5.6.8. ASSET CREATION

Hobson:	22kV (20 panels)
Liverpool:	110kV (1 bay)
Sandringham:	33kV (9 panels)
Balmoral:	22kV (2 RMU's)

5.6.9. ASSET DISPOSAL

Balmoral: 22kV

5.7. ZONE SUBSTATION BUILDINGS

5.7.1. ASSET DESCRIPTION

There are 49 zone substations and six ripple only substations in the greater Auckland area.

5.7.2. ASSET PERFORMANCE AND CONDITION

The buildings and grounds are in functional condition. Any minor issues are dealt with as routine repairs.

Improvements for Reliability and Safety

Zone Substation Revitalisation

The zone substation revitalisation projects identified in the previous AMP are progressing, but have been delayed due to the discovery, and need for removal of asbestos (underway) in the zone substation ceilings as detailed in the Asset Issues and Risk section.

Buildings

In 1999 a review was undertaken of all VECTOR's substations and identified that many of the zone substations required a "face lift". Items of work identified included repairs to roofing, guttering, cracked concrete walls, damaged doors or building exterior, painting of buildings, fencing and access issues.

Work has been undertaken for the high priority substations, with work planned to continue during 2001/02. In addition, options for enhancing security access to buildings will be evaluated during the coming year.

Earthing System Upgrade

Zone substation earthing systems are routinely tested to assess the integrity of the system. The earthing system at 40 zone substations has been assessed, with only minor items identified as needing rectification. These items have either been attended to, or are covered in the scope of existing projects. The remaining nine zone substations will be assessed and any necessary remedial actions undertaken over next two years.

Oil Containment

Oil containment is required to comply with the Resource Management Act that does not allow stormwater containing contaminants (oil) to be released to the environment. The programme to bund transformer bays at zone substations has been in progress for the past four years, with about 50% of the zone substations now completed.

All new substations have roofs over the transformer bays and have specifically designed oil containment bunds. Existing substations are being upgraded by the installation of a combination of roofs and oil plate separators, depending on which option is more effective at a particular site.

The program will continue over the next two years.

Seismic Upgrade

Seismic upgrades are required to ensure that electrical equipment in VECTOR's zone substations can withstand a design earthquake and remain serviceable following such an event.

This project commenced in 1996 and the work has now been completed at 30 zone substations. All remaining sites have been inspected and design work completed. The defects identified have been predominately the holding down arrangements of control panels and power transformers. Installation/remedial work is required at 18 sites and will be completed this financial year.

Fire Protection

Fire protection equipment installed at various CBD substations was upgraded during the last financial year.

5.7.3. ASSET MAINTENANCE

All zone substations and grounds and ripple injection spaces are maintained with regard to access security, condition and safety. The routine inspections include the building and other assets such as lighting, fire systems, fans, heaters and safety equipment.

5.7.4. ASSET ISSUES AND RISKS

The following issues, their current controls and required actions have been identified for the zone substation assets and are detailed in Table 5.5.

Issue Description	Issue Impact	Current Controls	Action
Asbestos in zone substation ceilings	Health and safety	Advise staff and contractors of issue and PPE requirements	Asbestos removal project underway. All high and medium risk sites to be completed by January 2002

Table 5.5 Zone Substation Buildings: Asset Issues and Risks

5.8. PROTECTION AND CONTROL: RELAYS

5.8.1. ASSET DESCRIPTION

VECTOR operates over 1,000 relays at the zone substations and Transpower grid exit points. 68% of the relays are electromechanical, 18% solid state and 14% numerical.

5.8.2. ASSET PERFORMANCE AND CONDITION

Improvements for Reliability

An audit of all relays and associated equipment (VT's and CT's) was completed in 2000 to evaluate the condition of the asset population, and with the exception of the known problems with the Nilstat ITP relays the condition was found to be good.

5.8.3. MAINTENANCE

Electromechanical relays are tested on a four year basis.

Solid state relays of the Nilstat ITP type are tested an annual basis, to monitor the condition prior to replacement.

Numerical relays are equipped with self-monitoring facilities. Experience has shown that not all protection relay faults can be detected by the self-monitoring functions; therefore VECTOR has adopted the recommendations on testing numerical protection relays from the CIGRE Study Committee 34 Power System Protection and Local Control.

5.8.4. ASSET ISSUES AND RISKS

No new issues or risks for the relay assets were identified from the audit.

5.8.5. ASSET REPLACEMENT

Individual replacement of relays is based on as failed and asset replacement programmes are based on condition.

The condition and performance monitoring of the solid state Nilstat ITP relays, which were installed on the network between 1985 and 1993, has shown that these relays are not performing as expected, although not yet adversely affecting operations. A programme to replace these relays with numerical relays has been set up and all relays will be replaced by 2004/05. Annual checks will monitor the condition of these relays.

5.9. PROTECTION AND CONTROL: BATTERIES

5.9.1. ASSET DESCRIPTION

VECTOR has battery banks at all zone substations and some HV customer substations to provide tripping and closing supply to the circuit breakers. Batteries also provide standby power supplies for the relays, SCADA, metering and communication equipment.

5.9.2. ASSET PERFORMANCE AND CONDITION

Improvements for Reliability and Safety

The existing NICAD batteries are at or near the end of their technical life and these are currently being replaced with the industry standard Valve Regulated Lead Acid (VRLA) batteries. The VECTOR standard has now been changed to the VRLA batteries, as they remove the environmental risks associated with the NICAD batteries and are also a more cost effective asset.

All batteries that provide standby power supply to SCADA, metering and communication equipment have been replaced. The majority of substation protection and control batteries and associated chargers have been replaced in 2000/01.

5.9.3. MAINTENANCE

Maintenance for the VRLA batteries is based on the recommendations of IEEE–1188 (IEEE Recommended Practice for Maintenance, Testing and Replacement of Valve Regulated Lead Acid Batteries for Stationary Applications).

5.9.4. ASSET ISSUES AND RISKS

No issues or risks for the relay assets were identified from the audit.

5.9.5. ASSET REPLACEMENT

Batteries are replaced when failed or based on condition. The remaining zone substation batteries will be replaced in 2001.

5.10. COMMUNICATIONS AND CONTROL: SCADA

5.10.1. ASSET DESCRIPTION

The existing SCADA system consists of three sub systems, the main SCADA system, the ripple control RTU's at the grid exit points and the grid exit point metering system.

5.10.2. ASSET PERFORMANCE AND CONDITION

The SCADA system is meeting the current performance and functional requirements. The Control Room computer systems are reliable and have full back up should the main system fail. The equipment however is obsolete and a replacement programme is underway.

5.10.3. MAINTENANCE

The main SCADA system is self-diagnostic in terms of failure being immediately apparent in the Control Room. The SCADA RTU's do not have full back up and maintenance is based on failure.

The ripple injection units have full back up and maintenance is predominantly on failure. Operational tests for the load shed scheme also indicate potential issues. A long-term strategy for ripple control is under development.

The bulk metering system is monitored for failure through the Control Room. The meters are calibrated for accuracy.

5.10.4. ASSET ISSUES AND RISKS

The SCADA equipment is obsolete and a replacement programme is underway.

5.10.5. ASSET REPLACEMENT

The existing meters will be replaced in 2001 with modern equipment having power quality monitoring functionality in addition to the basic demand metering functions.

5.11. 11KV AND 400V OVERHEAD NETWORK

5.11.1. ASSET DESCRIPTION

The overhead system consists of 980km of 11kV line and 2,200km of 400V line. Over 55,000 poles support the overhead distribution network, of which 20% are wooden and 80% concrete. Conductors vary across the overhead network, but are predominantly Cu and AAC. AAAC has recently been trailed and proved successful and will be considered for use on any future conductor replacement and line reinforcements. ABC and CCT are used in areas susceptible to tree damage, where the trees cannot be cut or removed due to resource consent and council restrictions.

5.11.2. ASSET CONDITION AND PERFORMANCE

The condition of the overhead distribution network is adequate. The majority of the overhead assets are old and were installed prior to 1965, when the undergrounding programme started.

Improvements for Reliability

Overhead Service Fuses
230V service fuses are currently one of the highest failing assets in the network, with associated high remedial costs, although failure rates are low in terms of the total asset population.

All new service fuse or replacement fuse holders use IPC technology for connections and contain HRC fuses. Re-wireable fuses are now not installed on the network and have been removed from the approved equipment standards. A selective replacement programme for fuse holders is scheduled for investigation in 2001/02. This will tackle areas with high concentrated failure rates and high remedial costs.

Connectors
Failed connectors also account for a high number of faults on the network, over a nine month period there were at least 250 faults caused by failed connectors.

All connectors installed on the network must meet defined performance and functionality requirements as stated in the VECTOR standards. All connectors must be fault rated and where possible should include the ability to provide a consistent application, with no potential for human error during installation. The connectors should have no reliance on components that may work loose over time. Only Ampact fired wedge connectors are approved for use on the HV network, and Ampact and IPC connectors are the approved connector on tap offs and the LV system.

Pole Reflector Programme

The trial of pole reflectors has proved very effective. The number of car versus poles has reduced on all feeders this year, but there has been a much higher drop on those feeders with reflectors installed. Because car versus poles remain one of the highest fault causes in the overhead network, a further 5,000 poles will be painted and have reflectors installed in 2001/02. Any roads with HV or HV/LV lines that have had a strike rate of two or more over the last two years will be painted and have reflectors installed. The success of the trial expansion will be monitored, to enable a full cost benefit review.

Fault Passage Indicators

A programme is underway to install overhead fault passage indicators in areas of the network where fault location is difficult and time consuming. A total of 30 single phase units were installed in ten locations in 2000/01 and another 45 single phase units will be installed in 2001/02 targeted in those areas where CAIDI caused by difficulties in fault location is a problem. VECTOR have now standardised on the Bardin fault passage indicator because of their superior reliability and functionality. These fault passage indicators have the ability to send fault signals back to the Control Room, making fault location more efficient and faster.

Live Line Work

From 1994/95 VECTOR has been performing all work live line where practical. The planned shutdowns for 2000/01 equated to 0.5 SAIDI minutes.

5.11.3. MAJOR FAULT CAUSES (HV & LV)

The predominant cause of overhead faults on the HV/LV network is equipment related. As shown in Figures 5.7 and 5.8, a large proportion of these fault calls are caused through operational issues not defective equipment. In this case the main issue is pole fuses operating either through a failure of the fuse, or the fuse operating correctly to protect an overload situation at the supply point. Opportunities to undertake mass replacement of fuses in areas where there are high problems with defective (aged) equipment will be identified.

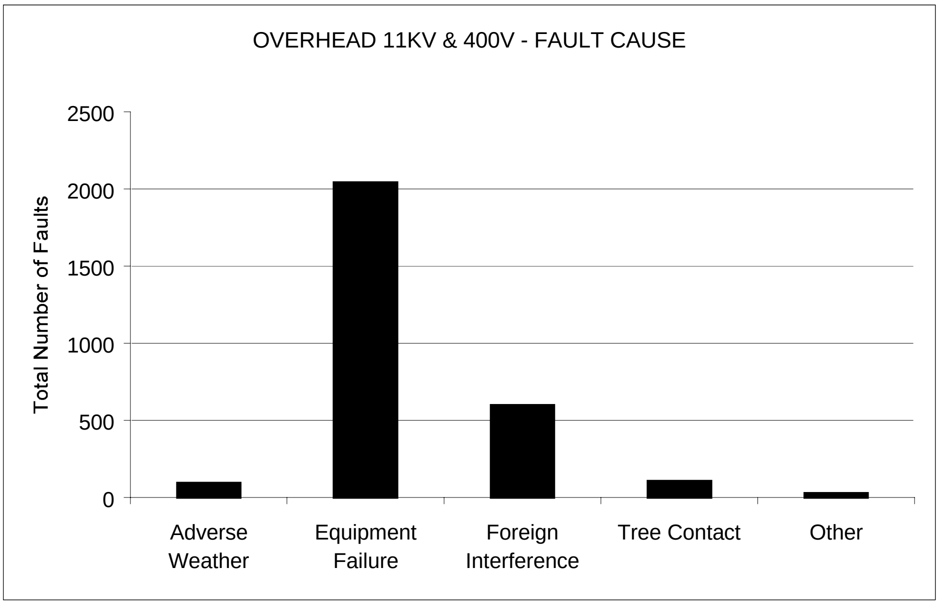


Figure 5.7 Overhead Fault Causes

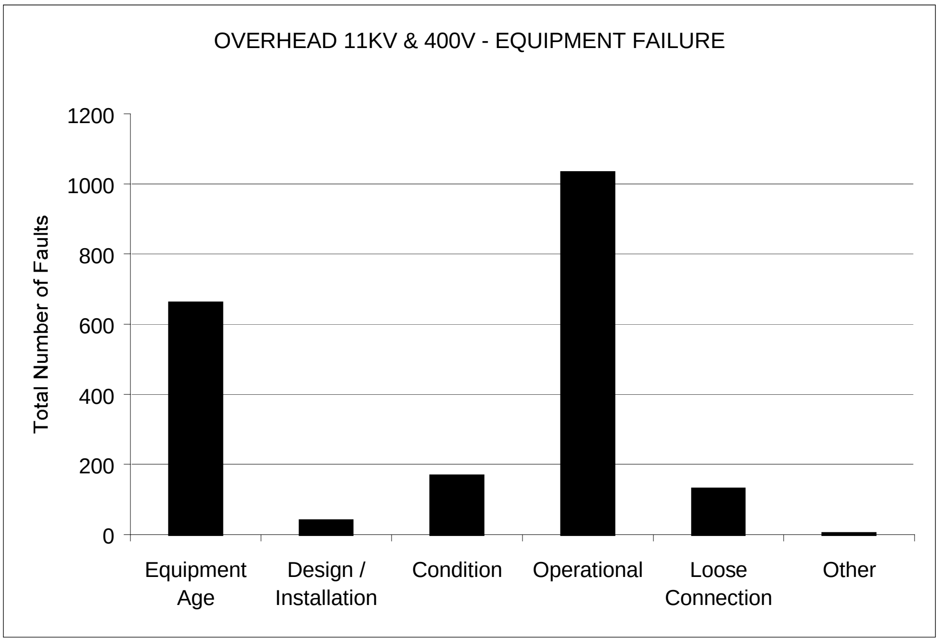


Figure 5.8 Overhead Equipment Failures

There has also been a problem with pole and cross arm failures due to asset age. There are planned accelerations of inspection programmes in key areas for these assets in the 2001/02 year to address this.

The other principal problem for the overhead network is foreign interference as shown in Figure 5.9.

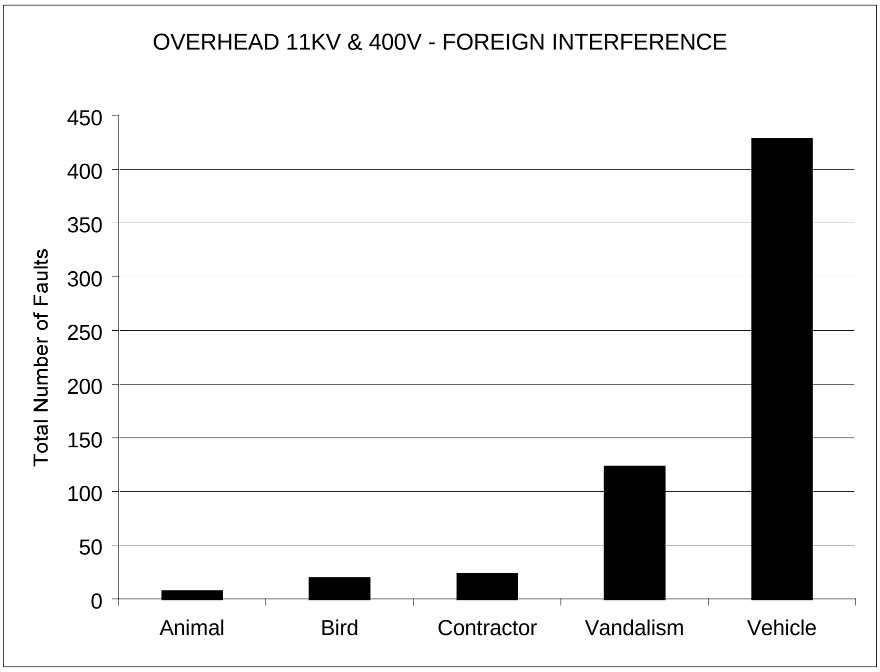


Figure 5.9 Overhead Fault Cause by Foreign Interference Type

As can be seen from the graph above, car versus pole incidents are the main cause. The expansion of the programme to install pole reflectors is designed to target this problem. The vandalism item predominantly relates to graffiti.

5.11.4. MAINTENANCE

- Annual visual line patrol of poles and hardware and five yearly condition assessment of wooden poles
- Proactive vegetation management and local council vegetation management agreements
- Three yearly earth bank testing
- Annual thermographics of lines
- Three yearly ABS inspection and operation

5.11.5. ASSET ISSUES AND RISKS

The following issues, their current controls and required actions have been identified for the 110kV and 400V overhead assets and are detailed in Table 5.6.

Issue Description	Issue Impact	Current Controls	Action
Failure of connector on transformer neutrals leading to potential return currents via the house earth	Health and safety Reliability	Zone based contractors made aware of the potential risks	Replacement programme scheduled for 2001/02 to replace all transformer neutral connectors with Ampact fired wedge connectors
Availability and cost of wooden transformer poles	Security in terms of availability of materials for replacement	New design using a double concrete pole structure offered as an alternative	
ABS not functioning as expected and failing either when tested or operated. This is thought to be due in part to problems with the cement used in the porcelain insulator reacting with the porcelain and cracking the insulator	Reliability	Zone based contractors made aware of the problem and reviewed as part of the three yearly inspection programme	ABS replacement plan being evaluated in terms of optimum locations, manual versus automatic and best technology
ABS U bolt connectors – weak point on asset leading to failures	Reliability	New paddle lug and Ampact connector design approved for use on the network	Will be implemented in line with the ABS replacement programme
Potential for flash burns when opening fuse termination boxes	Health and safety	Contractors advised of risk	Programme to identify, monitor condition and label all fuse termination boxes

Table 5.6 Overhead Distribution: Asset Issues and Risks

5.11.6. ASSET REPLACEMENT

Poles

The replacement criteria for a pole is that red tagged poles, as defined in SREI, Appendix G, are replaced when found. Yellow tags are re-inspected within 12 months. Areas with a high volume of red and yellow tags are evaluated for replacement of wider areas or feeders.

280 poles were replaced in 2000/01, as they did not meet the required standards and performance expectations. Condition assessments across the network have tagged a further 420 poles yellow which are scheduled for checking in 2001/02.

Cross Arms and Hardware

Pole cross arms and hardware are replaced to meet the current equipment standards when poles are replaced and as individual items when condition indicates this is the best option. Cross arms for replacement will be reviewed and scheduled for 2001/02 if justifiable based on condition or economic to replace.

Connectors and Fuses

Connectors and fuses are not inspected as part of the preventative programme, fault rates are analysed in terms of numbers and costs to determine if area wide replacement will be economic and justifiable.

Lines

The lines are inspected on an annual basis and replacement is based on condition assessments and analysis of fault history. Some small area re-conductoring is planned in 2001/02 to replace the existing line with CCT or ABC in areas where tree damage is frequent and there are restrictions on tree cutting.

Air Break Switches (ABS)

ABS are replaced based on performance and analysis of fault operations. A review is underway to evaluate the most economic way forward for ABS. The review will identify the optimum locations for ABS on the network, identify the benefits of automated ABS and look at new technology to ensure any replacements or refurbishments meet VECTOR's standards for performance and functionality.

5.11.7. ASSET CREATION

In 2000/01 approximately $2.2 million worth of 11kV feeder reinforcement projects were committed, to address capacity shortfalls or breaches in the reliability standards. A similar volume of projects is expected in 2001/02.

5.12. 11KV AND 400V UNDERGROUND DISTRIBUTION NETWORK

5.12.1. ASSET DESCRIPTION

The underground distribution network consists of 1,500km of HV cable and 2,600km of LV cable. HV cable types are predominantly PILC, with XPLE now standard for new cables. LV cables are predominantly PILC and PVC insulated cables.

5.12.2. ASSET CONDITION

Improvements for Safety

Cable Covers for Cables Mounted on Poles

The old wooden cable covers did not afford adequate protection for accidental knocks by cars or lawn mowers. VECTOR has worked with local manufacturers to design a new plastic cable cover that offers good impact resistance. The cable cover can be attached to wooden poles or to concrete through a specially designed bracket. A programme to install cable covers is underway and will be continued in 2001/02.

5.12.3. FAULT DATA AND CAUSES (HV & LV)

Damage to pillars is the main cause of faults to the underground network, as shown in Figure 5.10. Principally the problem relates to vehicle or deliberate damage to the equipment, as shown in Figure 5.11 and 5.12. Where ongoing problems are encountered, pillars are relocated. Longer-term, VECTOR is evaluating the use of underground pits, rather than surface mounted pillars.

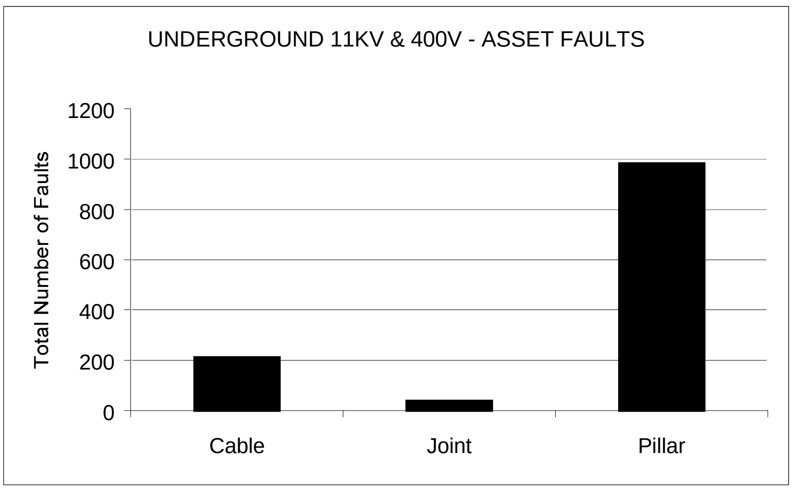


Figure 5.10 Underground Asset Faults

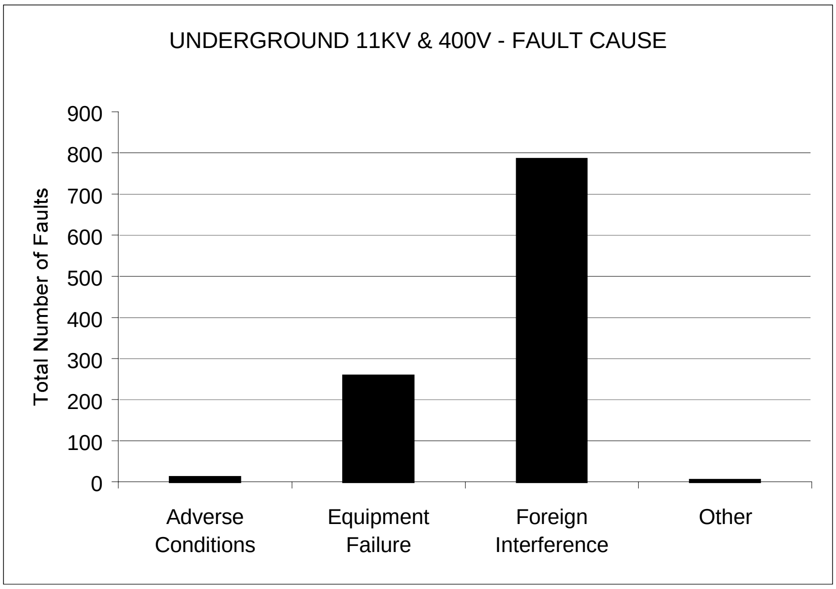


Figure 5.11 Underground Fault Causes

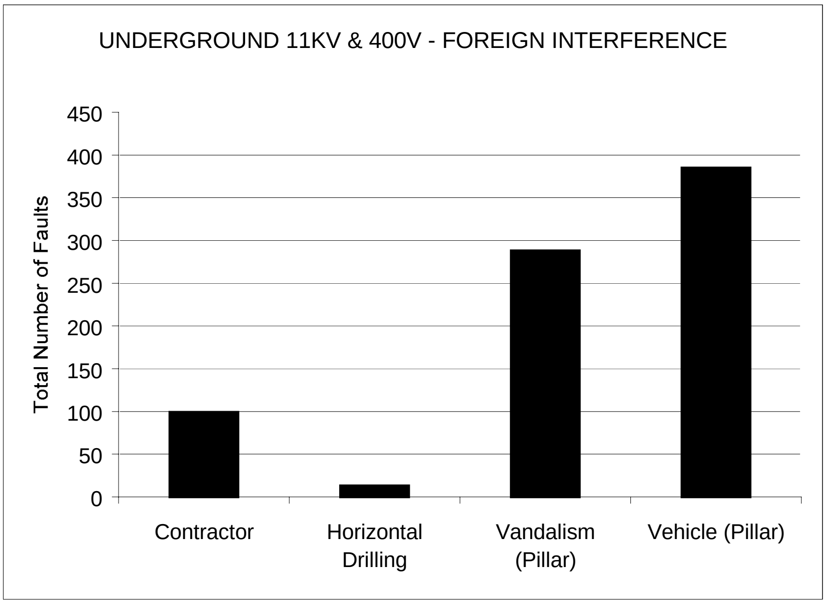


Figure 5.12 Underground Faults by Foreign Interference

There also continues to be a high level of problems caused by contractors damaging cables while digging. VECTOR will continue to pursue opportunities to increase awareness of the issue with contractors and to ensure that its information provision and cable location services are readily accessible.

5.12.4. MAINTENANCE

- Maintenance for both 11kV and 400V cables is reactive, based on faults
- Annual visual inspection of pillars, plus a sample check on pillar internals

5.12.5. ASSET ISSUES AND RISKS

The following issues, their current controls and required actions have been identified for the 11kV and 400V underground assets and are detailed in Table 5.7.

Issue Description	Issue Impact	Current Controls	Action
Third party damage through digging and thrust boring	Reliability	Free cable location service and obstruction plans for contractors and the public DialB4Udig campaign launched in 2000	OSH and VECTOR working proactively with contractors to ensure correct process for cable location is followed
Failure of house fuse boards leading to potential damage	Health and safety Reliability	Zone based contractors made aware of risk	Planned replacement programme of house fuses scheduled to start in 2001
Failure of fault passage indicators due to age and environmental conditions	Reliability	Control Room and zone based contractors made aware of risk	Replacement programme scheduled for review of older Horseman style fault passage indicators and implementation in 2001/02
Pillar security	Health and safety	Revised design for pillar covers now available from manufacturers	Move towards installation of underground pits instead of pillars for new subdivisions and high hit pillar sites
Height of link pillars	Resource management compliance	Height restrictions for new pillars imposed by local councils in 2001	Evaluation of pillars used elsewhere in Australia and New Zealand. Working with New Zealand manufacturers and zone based contractors to design the optimum pillar for the functionality required

Table 5.7 Underground Distribution: Asset Issues and Risks

5.12.6. ASSET REPLACEMENT

Cable Terminations

The inspection programme for cable terminations is limited to a visual check for compound leaks. Acoustics and thermographics have recently been trialed as an alternative condition assessment methodology, but have not proved satisfactory. Replacement is therefore driven by the visual inspections and analysis of fault rates.

In 2000 there were 24 pole termination failures, which contributed 2.7 SAIDI minutes to the overall network total. A further 26 terminations were replaced in 2000 under preventative maintenance as it was found that these terminations were leaking compound which is thought to be a failure cause.

In the last 12 months it has been necessary to replace over 11% of the termination assets either because of failure or pending failure. Due to the high failure rate of the terminations, their expected remaining asset life and future remedial costs, a replacement programme for terminations is scheduled to start in 2001. The priority for the replacement programme will be based on standard service levels.

Cables

Cable replacement is based on a combination of fault rate analysis and the tests performed following fault repairs.

Service Fuses

Service fuses installed between the late 1960's and 1984 were mounted on the wall of the customer's property. Previous replacement was on an as failed basis. From a review of fault causes, it has been identified that there is a risk of connection failure, which could lead to possible damage of the customer's property. To remove this risk, VECTOR is planning to replace the asset population of approximately 22,000 with fully insulated fuses and connectors with insulation piercing connector technology over the next three years.

Fault Passage Indicators

Individual asset replacement based on failure, and review of the older style fault passage indicators will highlight the need and benefits of a network wide replacement programme.

Pillars

Pillars are replaced based on fault, normally through foreign interference. VECTOR is currently reviewing the way it connects LV customers to our network. We are looking at underground pits, pillars and improved fusing to come up with the best solution in terms of safety to the public, costs, customer reliability, improved functionality and performance.

5.13. DISTRIBUTION TRANSFORMERS

5.13.1. ASSET DESCRIPTION

VECTOR owns and operates 7,900 distribution transformers of which 5,500 are ground mounted and 2,400 are pole mounted. The ground mounted are metal or fibreglass ground mounted packages, open enclosures or fully enclosed within other buildings. The transformers are generally rated between 30 and 1,000kVA, although there are a small number rated at 1.5kVA, 7.5kVA and 10kVA. Figure 5.13 shows the age profile of the distribution transformer assets.

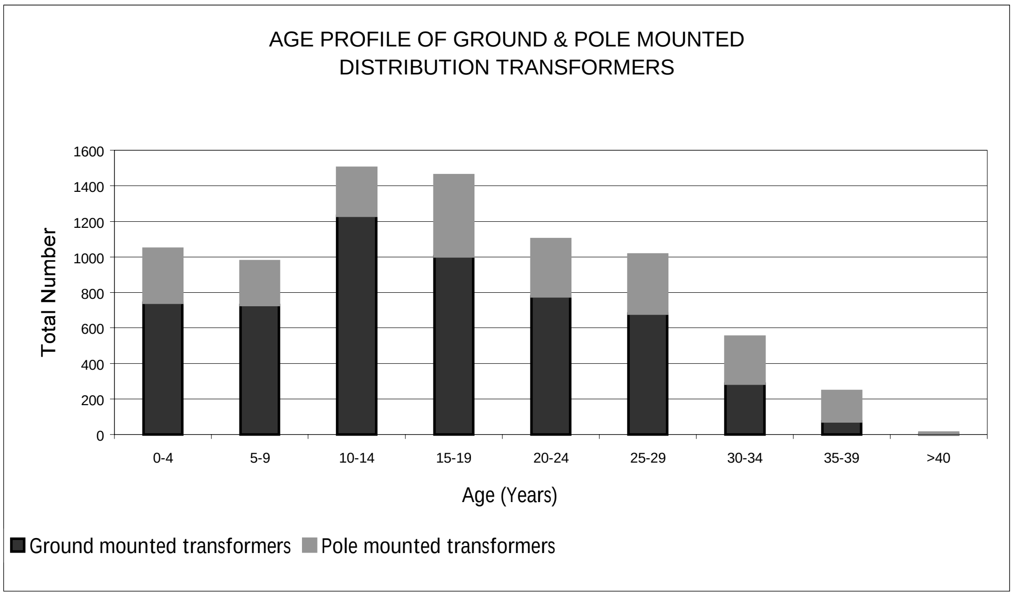


Figure 5.13 Distribution Transformers Age Profile

5.13.2. ASSET CONDITION

The condition of the transformer asset is generally good.

Improvements for Safety

As identified in last year's AMP, there was an issue with exposed bushings in some ground mounted sites. A bushing cover was designed and a survey of all sites has been completed and all exposed bushings covered.

5.13.3. MAJOR FAULT CAUSES

Detailed in Section 5.15.

5.13.4. MAINTENANCE

- Visual transformer inspection on a three year cycle
- Load records on a three year cycle
- Earthing resistance tests on a three year cycle, including MEN resistance, individual bank resistance and step and touch potential

5.13.5. ASSET ISSUES AND RISKS

No asset risks have been identified, with the exception of the transformer neutral connection, as described in Section 5.11.5.

5.13.6. ASSET REPLACEMENT

Transformers are replaced on an as failed basis. There are no plans to proactively replace transformers due to age or condition in 2001/02. Any failed transformers are returned to the VECTOR facility management contractor for investigation of failure and a decision is made on the cost benefits of repair, refurbishment, replacement or scrapping of the asset.

5.14. DISTRIBUTION SWITCHGEAR

5.14.1. ASSET DESCRIPTION

VECTOR owns and operates over 8,300 ground mounted switchgear units. The switchgear is of varying ages and manufacturers.

5.14.2. ASSET CONDITION

The switchgear is currently meeting performance and functionality requirements. Detailed inspection, maintenance and testing of a sample of the 11kV switchgear asset base is planned for 2001/02 to determine the internal condition of the asset and identify any issues that may stop the asset performing and lead to a change in the preventative maintenance schedule or a replacement programme if necessary.

5.14.3. MAINTENANCE

- Visual inspection on a three year cycle
- Full inspection and test programme schedule to commence in 2001/02 to evaluate condition

5.14.4. ASSET ISSUES AND RISKS

The following issues, their current controls and required actions have been identified for the distribution switchgear assets and are detailed in Table 5.8.

Issue Description	Issue Impact	Current Controls	Action
Potential failure in 11kV switchgear causing explosions	Health and safety Reliability	Preventative maintenance checks	Detailed inspection and testing programme scheduled for commencement in 2001/02

Table 5.8 Distribution Switchgear: Asset Issues and Risks

5.14.5. ASSET REPLACEMENT

Switchgear replacement is based on condition and availability of components for repair. Any failed switchgear units are returned to the VECTOR facility management contractor for investigation of failure and a decision is made on the cost benefits of repair, refurbishment, replacement or scrapping of the asset.

5.15. DISTRIBUTION SUBSTATIONS

5.15.1. ASSET DESCRIPTION

VECTOR own and operate over 8,300 distribution substations. The substations are maintained with regard to security, condition and safety.

5.15.2. ASSET CONDITION

The condition of the substations is good.

Improvements for Safety

As described in last year's AMP, exposed LV frames were a potential hazard in a number of ground mounted substations. A frame cover has been designed and a survey of all sites has been completed and all exposed frames covered.

5.15.3. MAJOR FAULT CAUSES

Remedial maintenance at distribution substations can be divided into problems associated with the substation enclosure and with the internal equipment, as shown in Figure 5.14.

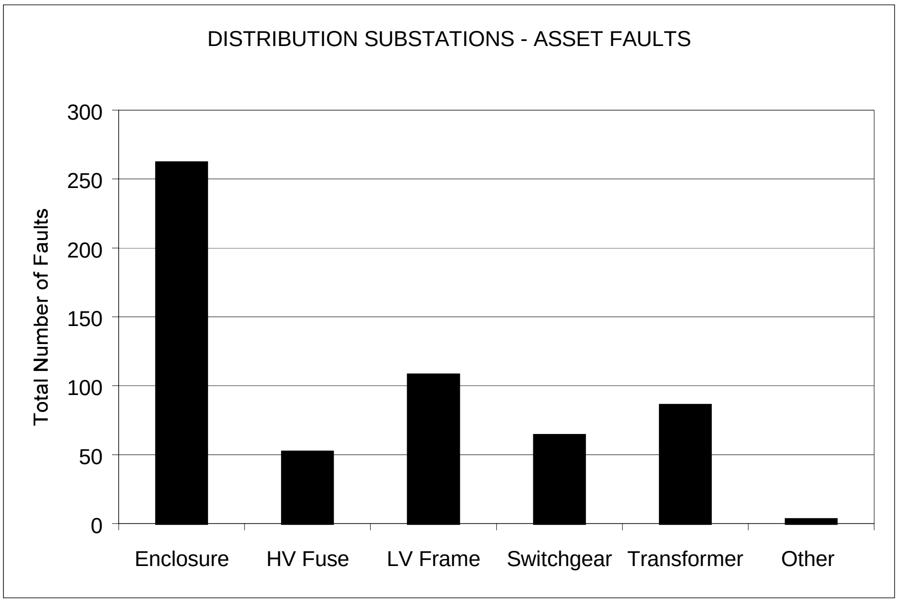


Figure 5.14 Distribution Substation Asset Faults

Vandalism is the main issue with the substation structure as shown in Figure 5.15. Damage includes graffiti and broken equipment. VECTOR will continue to work with councils and the police in endeavouring to reduce the problem.

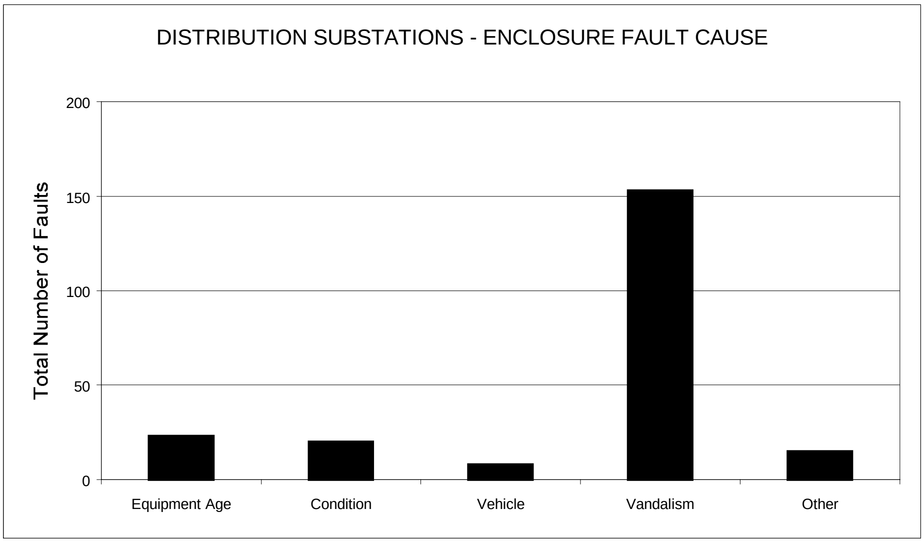


Figure 5.15 Enclosure Fault Cause

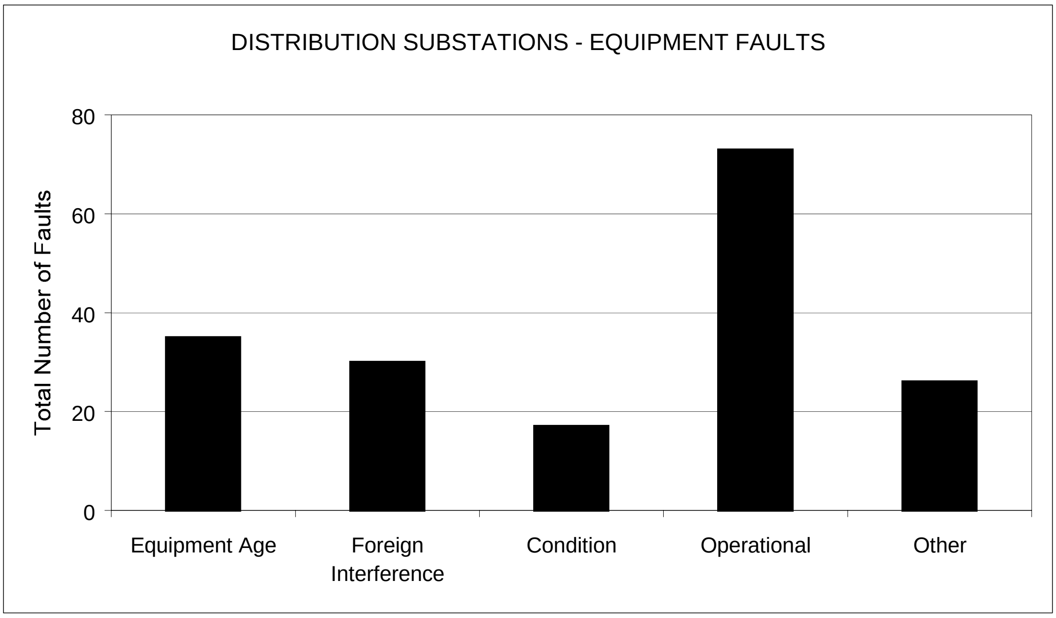


Figure 5.16 Distribution Substation Equipment Faults

Faults on switchgear, transformers and LV frames at distribution substations are attributable to a wide number of causes, as shown in Figure 5.16. More detailed information on fault events will be collected to improve the understanding of root causes.

5.15.4. MAINTENANCE

Visual checks on a three year cycle. Checks include vegetation management, cleaning, weatherproofing etc.

5.15.5. ASSET ISSUES AND RISKS

The following issues, their current controls and required actions have been identified for the distribution substation assets and are detailed in Table 5.9.

Issue Description	Issue Impact	Current Controls	Action
Concern over the volume of litter being deposited in open enclosures making access hazardous	Health and safety	Contractors made aware of risks	Preventative inspections accelerated in open enclosure sites and the cost benefits of alternatives being reviewed

Table 5.9 Distribution Substations: Asset Issues and Risks

5.15.6. ASSET REPLACEMENT

Distribution substation replacement is on an as failed basis.

5.16. LIGHTING

5.16.1. ASSET DESCRIPTION

The relevant local council is generally the owner of the lighting hardware where the distribution network is underground. In areas where the distribution network is overhead, the local councils will generally use VECTOR's poles as supports for streetlights. In all cases VECTOR owns the cables up to the point of isolation and the relays or photocells. The local council is responsible for the maintenance of the lighting asset.

5.16.2. ASSET CONDITION

Improvements for Safety

Light poles are classified as an "electrical installation" under the electricity regulations, which means they carry specific legal requirements in terms of earthing, protection and isolation devices. Although VECTOR does not own the streetlight assets, we have been proactive in the development of a new streetlight board that improves safety through the reduction of stray voltages. VECTOR is also encouraging the councils to improve the maintenance on the streetlights.

5.17. FORECAST MAINTENANCE EXPENDITURE

Table 5.10 shows forecast operational maintenance expenditure over the planning period.

	01/02	02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11
Maintenance expenditure	15	15	13	13	10	10	10	10	10	10

Table 5.10 Forecast Maintenance Expenditure ($ million)

6. RISK MANAGEMENT

Asset risk in VECTOR is an integral part of the asset management process. Asset risks, the consequences of failure, current controls to manage this, and required actions are all understood and evaluated as part of the asset function and performance analysis. Any risks associated with the assets or operation of the network are evaluated, prioritised and dealt with as part of the asset maintenance, refurbishment and replacement programmes. The acceptable level of risk will differ depending upon the level of risk our customers are willing to accept and the circumstances and the environment in which the risk will occur. As part of the risk analysis, very low probability events with high impact are analysed, such as total loss of a zone substation. From this analysis contingency plans are developed. Risk is managed in VECTOR by a combination of:

- Reducing the probability of the failure, through the capital and maintenance work programme and enhanced working practices

- Reducing the impact of failure, through contingency and emergency plan development

The capital and maintenance asset risk management strategies are outlined in the Asset Maintenance and Development sections. VECTOR's contingency and emergency planning is based around procedures for restoring power in the event of a fault occurring on the network, and are detailed in Section 6.5.

6.1. RISK ACCOUNTABILITY AND AUTHORITY

6.1.1. VECTOR BOARD

The Board endorses the risk context under which VECTOR operates. A Board Risk Committee meets regularly, reviewing the risk register and risk methodologies at least quarterly.

6.1.2. EXECUTIVE RISK MANAGEMENT COMMITTEE

The Executive Risk Management Committee oversees and monitors implementation of appropriate and consistent risk management in each business unit, and across the company as a whole, by:

- Developing and maintaining, for the Board's review and approval, a risk management policy for VECTOR consistent with the company's objectives
- Overseeing and monitoring the implementation of risk management across VECTOR to ensure that it is in compliance with the risk management policy

6.1.3. RISK COMMITTEE

The Risk Committee is a small inter-functional team, which evaluates any identified risks in a consistent manner, assigns priorities and actions, and monitors progress. The Risk Committee meets regularly to:

- Assess all new risks identified, assign priority and actions to the risks and record them in the risk register
- Define accountabilities for the risk management programme
- Review priority and actions for entries on the active register
- Monitor progress on actions assigned against entries in the register
- Report on new high priority entries and progress on resolution of existing high priority entries
- Create a company risk profile

6.1.4. ALL EMPLOYEES

All staff and contractors are responsible for reporting any identified risks that come to their notice. Each functional area within VECTOR has a risk register on which risks, solutions and accountabilities are listed. Some of these risks are dealt with at an operational level and others have their profile raised and become part of the overall VECTOR risk register for action.

6.2. RISK MANAGEMENT PROCESS

The risk management process for VECTOR is now in the process of evolving to one of focusing on and analysing critical and catastrophic type events. The output of this is an understanding of the consequences of failure of critical and catastrophic events, valuing the impact of the event and defining response plans. (Ordinary risks, the consequences of which can be relatively easily "absorbed" by VECTOR or the customer are managed in the normal line of business).

The risk management process adopted by VECTOR is shown in Figure 6.1.

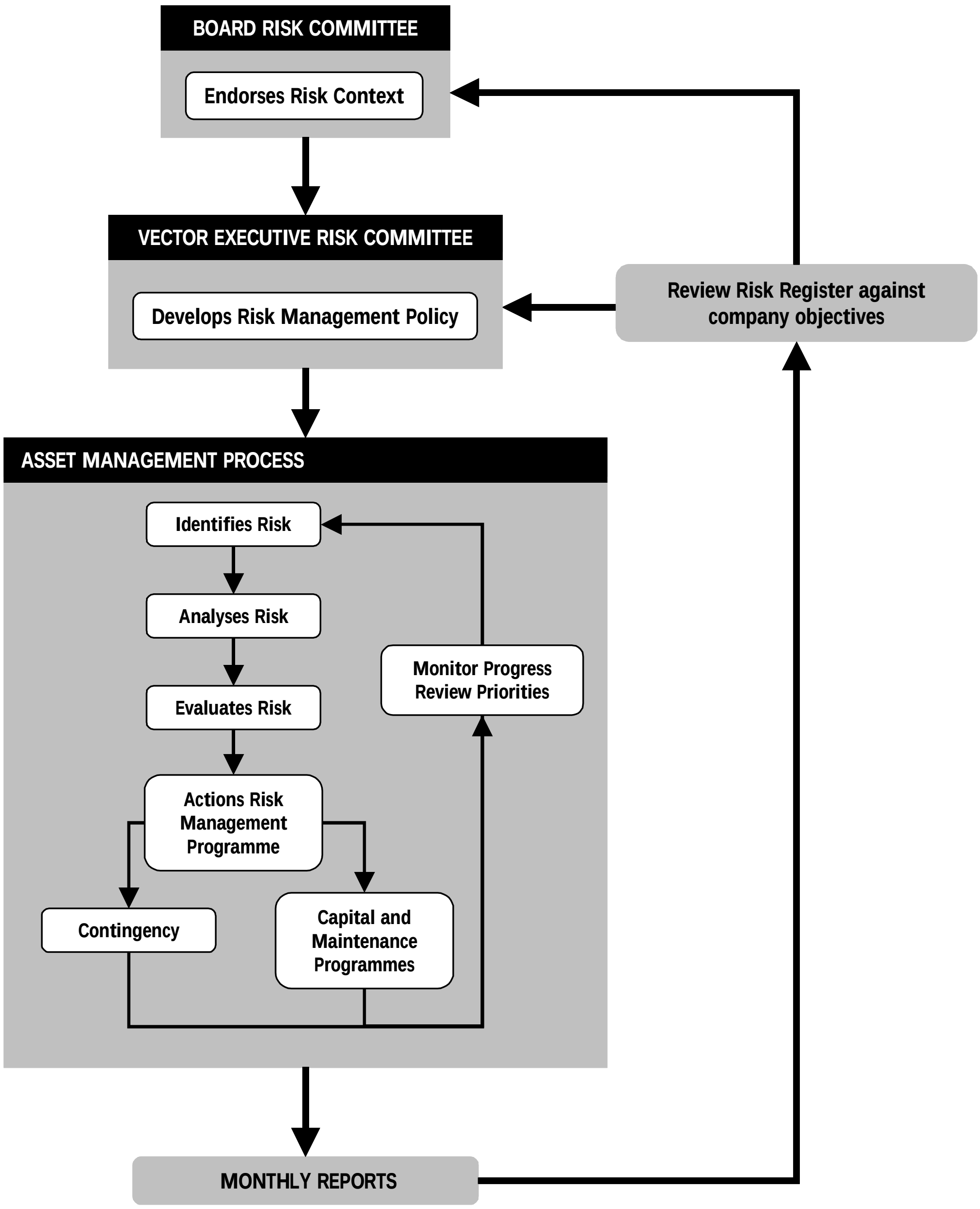


Figure 6.1 VECTOR's Risk Management Process

VECTOR's risk management policy is defined to ensure that:

- All risks to the business are identified and understood and works prioritised to mitigate risk with a top 20 risk register being maintained and tracked at Board level
- Practices that could cause disruption to service and operations, injury to people or the environment, or significant financial loss are understood, documented and mitigated
- The business is protected by suitable insurance polices, or contingency plans, wherever necessary

6.3. RISK IDENTIFICATION AND ANALYSIS

All risks are assigned a risk level based on the likelihood and consequence of the risk. Risk is determined using VECTOR's risk prioritisation matrix, shown in Figure 6.2.

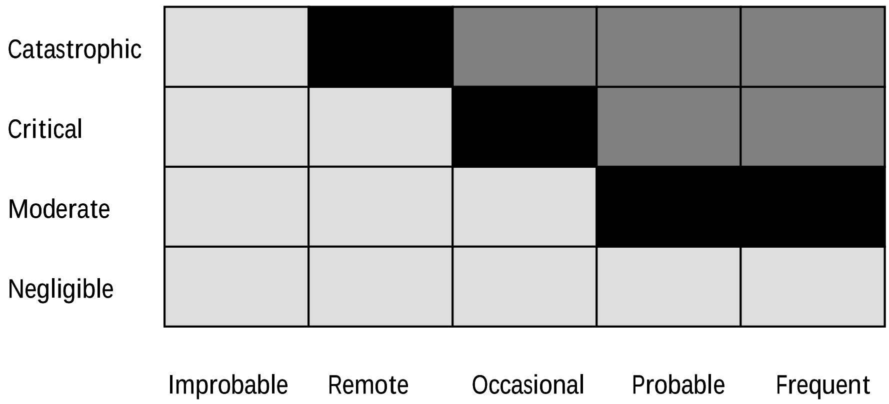


Figure 6.2 VECTOR's Risk Prioritisation Matrix

Catastrophic risk includes loss of life, extended loss of supply, or financial loss of a magnitude sufficient to impact on the company.

HIGH: These risks require immediate review and continuous monitoring to ensure the "due care" test is met. If measures cannot be implemented to control the risk, actions are required to reduce the inherent nature of the risk.

MODERATE: These risks require less rigorous ongoing control, but require continuous monitoring to ensure they do not become a high risk.

LOW: These risks require tracking on a periodic basis, to ensure they remain a low risk.

All catastrophic risks are assessed in terms of contingency planning, irrespective of their probability.

6.4. RISK MANAGEMENT PROGRAMME

VECTOR maintains a risk register, which is formally updated on a monthly basis for presentation to the Executive Risk Management Committee, and quarterly to the Board Risk Committee. The risk register documents the top 20 risks to the business and their response plans.

6.5. CONTINGENCY PLANS

6.5.1. SWITCHING

For all major feeders, the network is designed to allow reconfiguration by switching so that power can be fed through an alternative path if there is a failure or a need to shift load. For the CBD, this switching is carried out remotely through the SCADA system.

In the event of failure of a minor feeder, Control Room operators undertake network analysis and instruct field crews to undertake manual switching to restore power to as many customers as possible (while the fault is repaired), especially to critical customers.

6.5.2. CRITICAL SPARES

A stock of spares is maintained for critical components of the network so that fault repair is not hindered by the lack of availability of required parts. Whenever construction of a new part of the network is undertaken, an evaluation is made of the spares that will be retained to support repair of any key equipment installed.

6.5.3. DISASTER ANALYSIS

Plans are developed, as part of the overall management of the network, which consider the actions that would be taken in the event of a major failure of part of the network. Such plans consider switching options and the rapid construction of temporary lines.

If there is specific concern regarding a risk to the network, detailed contingency plans are developed, which include detailed design of the required temporary lines and the securing of materials required to allow immediate construction.

6.5.4. DISASTER PREPAREDNESS

Following the initial Lifelines project, VECTOR is now a member of the Auckland Lifelines Group. This group is looking at all aspects of being prepared in the event of a natural disaster and undertaking detailed investigations and developing cross utility contingency plans.

A disaster recovery plan has been prepared for the Control Room. This is to ensure that the Control Room can still operate after a natural disaster.

6.5.5. HEALTH AND SAFETY

This has been a major focus for the business during the past year, with safety a core value of the company, not to be compromised for any reason.

VECTOR's policy is to:

> *"Create and maintain a safe and injury free work environment for our employees, our contractors, our suppliers and the public we serve."*

To support the VECTOR safety policy a set of Safety Guiding Principles have been adopted by the company and their contractors. They reflect the principles of other world-class companies, and define the ultimate responsibility of management to lead and implement the safety process, while at the same time recognising each individual's responsibility to work safely.

- Everyone is responsible for safety
- We look out for each other
- Safety will be planned into our work
- All injuries are preventable
- Management is accountable for preventing injuries
- Employees must be trained to work safely

The development of the VECTOR Safe Work Practices, which define the essentials necessary to maintain an injury free environment, were also developed and introduced during the year. These practices reflect the basic approach necessary for VECTOR to identify and eliminate accident causes.

All contractors working for the company are required, as a minimum, to comply with these Safe Work Practices whilst carrying out any work on the network. Contractors are also required to report all employee accidents/incidents and near misses to VECTOR together with their relevant investigations and intended corrective actions. The zone based contractors are incentivised through the contract bonus structure to achieve the VECTOR safety targets.

Our progress on health and safety is shown in Figure 6.3, which shows an excellent achievement of zero Lost Time Injuries (LTI's) over the last five months of the year. LTI's in the first half of the year were mainly made up of accidents in the tunnel and do not reflect normal network operations.

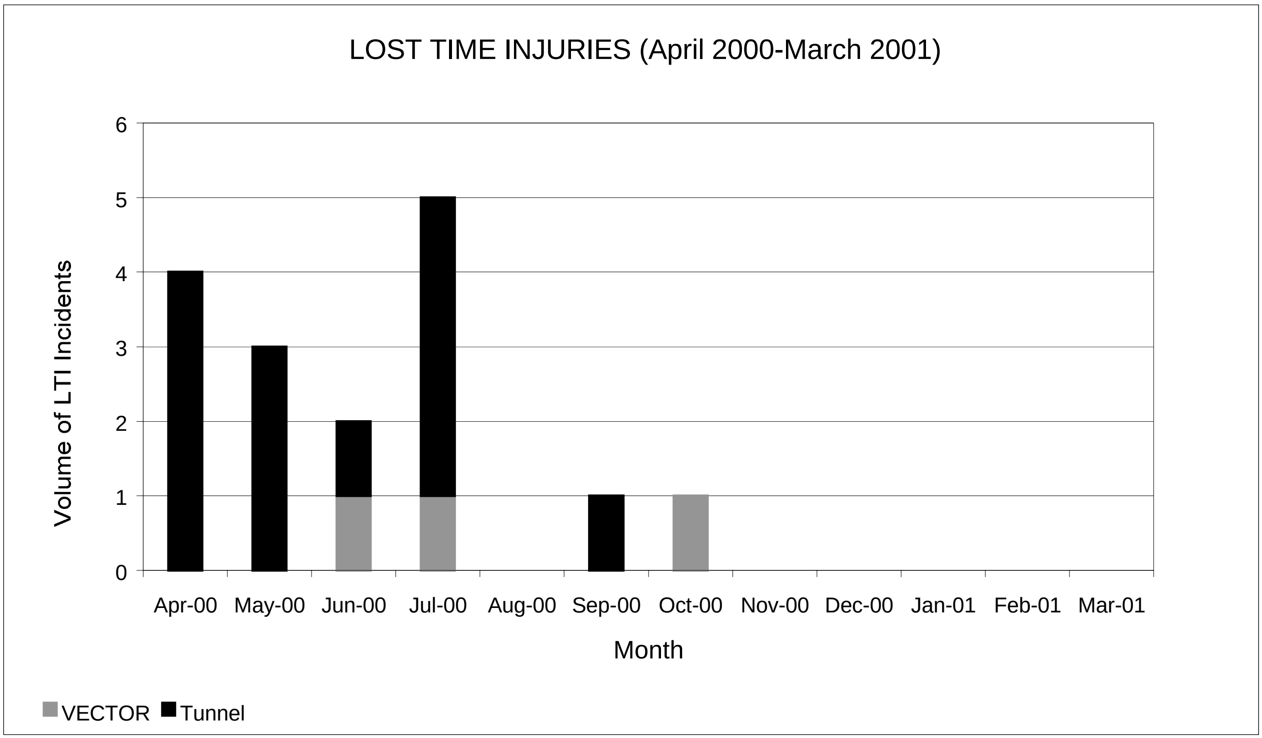


Figure 6.3 Lost Time Injuries: April 2000 to March 2001

Our safety target for 2001/2 is simply:

"No lost time injuries to any person working on our network."

7. EVALUATION OF PERFORMANCE

7.1. PROGRESS AGAINST PLANS

7.1.1. NETWORK DEVELOPMENT

The forecast 2000/01 capex plan included a total of $27 million for new capital projects expected to be approved in the 2000/01 financial year. The total value of new network capital projects (excluding customer initiated projects) approved was $10 million. The main driver for this deferral in expected spend was the refinement of the security design and reliability standards, the enhanced information on the cable ratings and the use of switching and automation. Specific projects that were deferred include:

- St Johns substation: Application of revised cable ratings, the new reliability standards and projected installation of fast load transfer capability when required in the future, means that the proposed substation can be deferred for ten years

- Mt Albert second transformer: Application of revised cable ratings, new reliability standards and automation solutions means that the second circuit is not required for at least six to seven years

- Manukau 11kV switchboard extension: Application of revised cable ratings and new reliability standards meant that only one feeder was required instead of the expected three. An innovation solution was found to provide the extra feeder in a way which defers the required building and switchboard extension for two to three years

- Wiri new 33kV cables: Cable temperature monitoring revealed that the ratings of the existing cables were unduly conservative, so the upgrade is now not needed for several years

- 11kV network reinforcements: Application of the new reliability criteria meant that many less projects were justified than in previous years

7.1.2. MAINTENANCE

The majority of work on maintenance, condition assessment and replacement went ahead as planned in last year's AMP. Any replacement deferrals were based on the results of detailed condition assessments that indicated that assets were achieving the required functionality at low or acceptable risk of failure.

7.1.3. SYSTEMS

The GIS enhancements have progressed as planned. The replacement of the SCADA system has been moved into 2001/02 to fit in with VECTOR's overall information systems strategic plan.

7.2. PERFORMANCE AGAINST TARGETS

VECTOR has in place detailed performance targets that are defined and linked to ensure that we are striving for and achieving the company goals in an optimum and efficient way.

Physical performance in VECTOR is tracked through:

- Reliability
- Safety
- Customer satisfaction

These measures:

- Are directly applicable to the core business
- Support the aims of the strategic business
- Enable VECTOR to track and easily communicate performance
- Enable direct comparison with other companies for the purposes of benchmarking

The ongoing results of these measures are communicated on a monthly basis to all VECTOR employees and contractors. Accountability for the performance targets is a function of all employees. The zone based contractors are incentivised through the contract bonus structure to achieve their targets and VECTOR direct employees have the physical performance measure embedded in the performance related pay scheme.

7.2.1. RELIABILITY

The reliability targets and actuals for 2000/01 are shown in Table 7.1.

	2000/01 Planned Target	2000/01 Planned Actual	2000/01 Unplanned Target	2000/01 Unplanned Actual	2000/01 Total Target	2000/01 Total Actual
SAIDI	3.05	0.497	41.95	48.24	45	48.7
SAIFI	0.02	0.003	0.78	0.987	0.8	0.99
CAIDI	180	176.15	54	48.874	56	49

Table 7.1 Reliability Statistics (inclusive of Transpower outages)

The targets set for 2000/01, especially the unplanned, were stretch targets designed to push the assets and the zone based contractors who are incentivised to achieve reliability performance. Excellent reductions were seen in all three reliability measures due to a number of factors:

- Car versus pole incidents have declined by 55% over the last six years, with a 38% reduction occurring in 2000/01, illustrating in part the success of the pole reflector programme
- A reduction in tree related fault incidents due to aggressive tree trimming and proactive tree management policies
- Appropriate targeting of the worst feeders
- An increase in live line work

The CAIDI unplanned target was successfully achieved, partly being a function of the above but also due to the zone based contractors being innovative in their approach to fault repairs. Where possible power is restored first and permanent repairs are progressed later, including the use of live line techniques to avoid further disruption to service.

All planned reliability targets were achieved this year, mainly through increased live line work. In 1995/96 approximately 230 jobs (equating to 21 SAIDI minutes) involved planned shutdowns, this reduced to less than ten incidents in 2000/01 (equating to less than 0.5 SAIDI minutes).

7.2.2. SAFETY

VECTOR sets safety targets around Lost Time Injury Frequency per million man-hours worked by reference to Australasian electricity industry experience. VECTOR includes in these statistics all Lost Time Injuries sustained by employees of VECTOR, and employees of VECTOR's contractors whilst working on our network. The Australasian electricity industry average Lost Time Injury Frequency Rate (LTIFR) is 11.

The targets set for the year ending 31 March 2001 were:

- A LTIFR of ten or less; and
- Zero Lost Time Injuries from January 2001

These targets recognised the time required for implementation of the VECTOR health and safety management plan, a major focus for the business this past year. Future targets will reflect VECTOR's objective to maintain an injury free workplace for VECTOR employees and the employees of our contractors.

VECTOR's performance at 31 March 2001 year-end was:

- A LTIFR of 14.9; and
- Zero Lost Time Injuries were incurred from October 2000

During the year, a total of 16 Lost Time Injuries were incurred by employees of contractors to VECTOR. 13 of these injuries occurred on the tunnel project during construction, and three on the VECTOR network. VECTOR employees incurred no Lost Time Injuries.

7.2.3. CUSTOMER SATISFACTION

VECTOR sets a customer satisfaction target based on a six monthly customer survey. The survey measures customer satisfaction on an overall basis and is also broken down by key service points such as the call centre, the serviceman, and key account managers. The serviceman scores can be then further broken down to give an understanding of how contractors are performing and areas for improvement.

The targets are used to drive improvement in customer service and the results are communicated to all VECTOR staff and contractors. The targets are part of the performance bonus for staff and contractors. Current satisfaction actuals and targets are shown in Table 7.2.

1999/00 Actual	2000/01 Target	2000/01 Actual	2001/02 Target
74/100	79/100	77/100	80/100

Table 7.2 Customer Satisfaction Score

Although the target for 2000/01 was not achieved, significant progress was made with a movement of 3% points. At 77, VECTOR is performing at a "good" level of customer satisfaction. 80/100 would be considered a high performing organisation and is the target for the coming year. The addition of new information systems should again help to improve our ability to meet our customers needs.

7.3. PLANNED IMPROVEMENTS FOR PERFORMANCE

To improve performance and to ensure resources are targeted most appropriately, VECTOR has a number of planned improvements for 2001/02:

- Reliability targets for zone based contractors fully based on the standard service levels
- Implementation of smarter equipment in the field to enable automation and more efficient fault finding
- New SCADA system and DMS, fully linked with the GIS and the Siebel Customer Management System
- Development and implementation of employee customer service focus within the business supported by the Siebel Customer Management System
- Ongoing analysis of equipment performance through rating and asset capability checks
- Review of network architecture and equipment type standards