Executive Summary

The Asset Management Plan is a foundation document, which drives the planning for all work undertaken on Westpower's assets.

Each year, a comprehensive update of the plan is completed including network changes that have taken place. Furthermore, the results of a formal, external peer review process are taken into account to ensure that this plan meets current disclosure requirements in terms of the Electricity Information Disclosure Requirements 2004 and is continually improved in both content and layout.

Period Covered

This particular plan was completed in March 2006 and covers a planning period from 1 April 2006 through to 31 March 2016. The main focus is placed on the next three years, with updates being completed annually.

The summary is prepared for people who may not be involved within the business of electricity distribution networks and associated services, but who understand and have an interest in efficient management.

This plan was approved by Westpower's Board of Directors on the 8th September 2006

Objective of the Plan

The defined objective of the Asset Management Plan is:

"To provide a systematic approach to the planning of programmes which are intended to ensure that the condition and performance of infrastructure assets are being efficiently maintained or improved to satisfy stakeholders requirements."

Westpower has developed a mature approach to asset management that will protect the value of the infrastructure assets for stakeholders. In the continual pursuit of excellence, every effort will be made to improve the high standard already achieved in the management of Westpower assets.

Asset Management Systems and Information

Technology

The basic technology involved in the transmission and distribution of electrical energy has changed little over the last fifty years. Nevertheless, small incremental changes continue to be made in the materials employed leading to improved performance and higher efficiency, and Westpower will continue to monitor these and apply the technologies where appropriate.

The major impact of technology on Westpower's activities will be in the areas of Information Technology, SCADA (Supervisory Control and Data Acquisition) operation of remote pieces of plant, and the potential impact of distributed generation. By means of an ongoing Distribution Automation (DA) programme using these technologies, Westpower intends to continually improve the reliability of its network by reducing fault restoration times. This allows remote switches to be immediately operated from the control room over radio links that previously could have taken up to an hour for fault staff to reach, leading to greatly reduced power outage times.

A GIS (Geographic Information System) allows Westpower to analyse the condition of the network and make informed decisions crucial to achieving optimal Asset Management levels. In addition, the GIS has also allowed Westpower to view the location of lightning strikes within the network area. This helps to speed up the recovery of lightning related faults and identify lightning prone areas.

A tree structured job costing system ensures any costs incurred on the network are reportable to feeder level. This system divides network expenditure into appropriate Activities (Inspection-Service and Testing, Faults, Repairs, Replacements, Enhancements and Development), Asset Type and Location. Detailed reports including capital and operating expenditure may be generated at any time.

A computerised Service Maintenance Management maintenance tracking system has been developed to maintain a complete history of each asset and to ensure that regular scheduled maintenance is carried out when needed.

When maintenance is required, live line maintenance techniques will be used wherever possible to reduce the number and duration of power outages. Westpower's line contractor is trained in live line Glove and Barrier techniques and has all of the specialist equipment needed to provide a level of repair service equal to any in the country. Most maintenance tasks involving voltages from 400V to 33,000V can now be carried out without taking the power off.

New technology will continue to be employed where Westpower group engineers are satisfied that it will be reliable and it is shown to improve service quality and performance.

Information

Adequate and accurate information is a fundamental need in order to manage assets efficiently. Historic information about the assets currently in place has some gaps. Previous records were inconsistent and lacked detail of equipment types.

Westpower now has practices established for all contractors in the field who carry out work on the networks to improve this information.

Accurate records are also being obtained for all new work and replacement projects carried out on the network.

Asset Management Practices

Westpower is constantly striving to find more efficient ways to carry out its daily functions, by reducing costs and improving productivity.

The benchmark of best commercial practice is constantly moving, particularly with the introduction of regulatory control by the government, which looks at factors such as price and supply reliability. Therefore, Westpower must be dynamic and innovative, and this culture starts with the Board of Directors, which includes significant commercial and financial experience.

The condition of all equipment is regularly assessed and equipment technical and condition data is stored in a sophisticated database. The GIS system is used to present this data geographically.

Best practice maintenance techniques are employed wherever possible, and the company regularly exchanges information with other utilities. Furthermore, the technical awareness of staff is maintained through regular staff training programmes

Westpower encourages suppliers to continuously improve their services and techniques, and at the same time negotiates competitive supply and maintenance contracts. A fully commercial relationship exists between Westpower and its contracting subsidiary ElectroNet Services, which encourages price efficiency and high productivity through commercial discipline.

Network and Asset Description

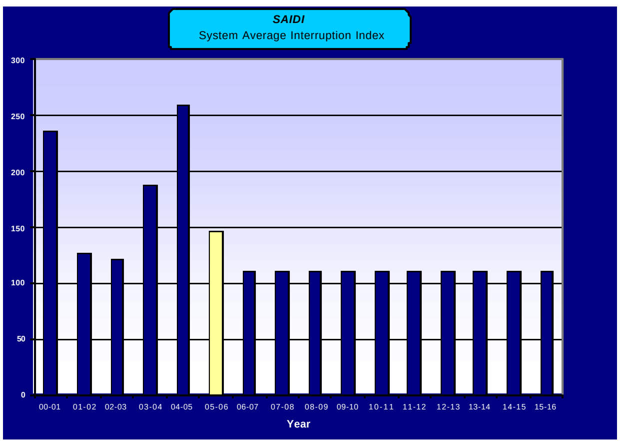
Westpower's distribution lines comprise 1970 circuit kilometres of high voltage AC distribution lines of varying line capacities, which are dependent upon local demands and geographical considerations. Operating voltages include 66 kilovolt (kV), 33 kV, and 11 kV. These lines involve a large population of power poles of varying types.

The Asset Management Plan covers the electrical and associated systems owned by Westpower.

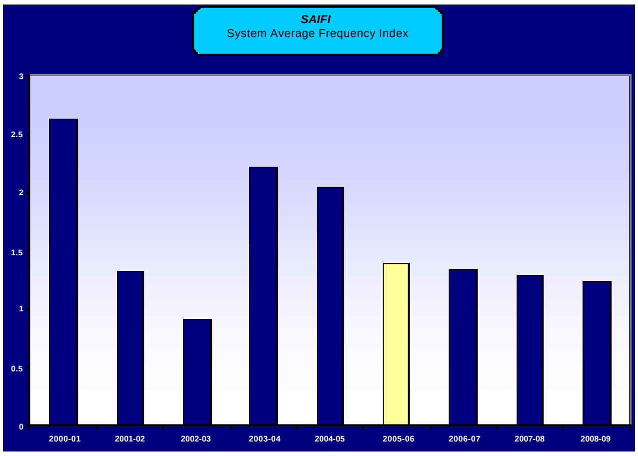
Service Level Objectives

While ultimately it is customers' requirements and financial commitments that drive work that might alter system reliability, the asset management plan is based upon maintaining the target of 110 system-minutes lost per year for 2005/06 and into the future. Customers committing to commercial agreements may be provided with supply reliability either greater or lesser than that projected for the network as a whole.

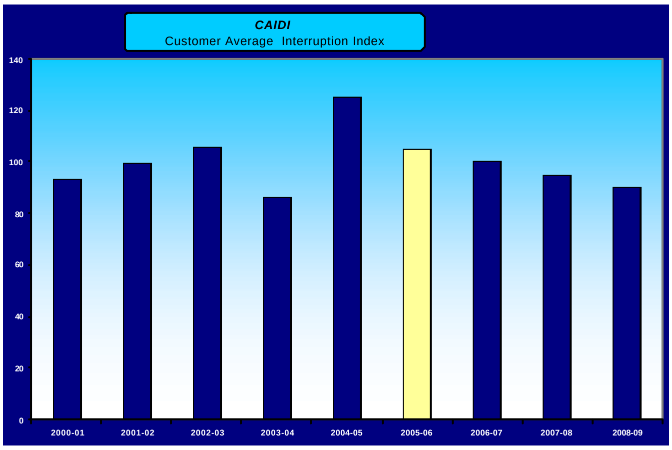
SAIDI



SAIDI - System Average Interruption Duration Index
This gives the average total time in minutes per year that each customer is without supply. A SAIDI of say 100 minutes means that every customer on a particular network experiences an average total time without electricity of 100 minutes per year.



SAIFI - System Average Interruption Frequency Index
This gives the average number of interruptions every customer experiences in a year. A SAIFI of 2.5 means that, on average, every customer experiences 2.5 interruptions in the year.



CAIDI - Customer Average Interruption Duration Index
This gives the average duration of an interruption. In other words a CAIDI of 60 minutes means that if a customer experiences an interruption, the average duration of that interruption is 60 minutes. It is a measure of how long a power company takes to locate and repair a "typical" fault.

Lifecycle Asset Management and Development Plan

Regular site checks of all Zone Substations take place on a monthly basis. For large distribution substations this is extended to three months, while for a small rural distribution substation this is further extended to five years.

Large transformers are subjected to extensive testing because of their critical role in network reliability. This includes Dissolved Gas Analysis (DGA) which monitors the internal transformer condition based on gases dissolved in the transformer oil.

For distribution transformers, regular demand checks, visual inspections and basic oil tests provide the necessary baseline condition data. For some of the older painted transformers, refurbishment or replacement is required rather than general maintenance.

Risk Assessment

Risk Management practices have been embraced as a means of ensuring that all commercial risks are taken into account and appropriate strategies are in place to manage these risks. In this way the long-term viability of Westpower is protected.

A full Risk Management Plan (RMP) has been completed after an in-depth look at Westpower's operations and environment in conjunction with risk management consultants.

Westpower network assets can be at risk from:

- Natural disasters – earthquakes, flood, slippage, climatic conditions etc.
- People related – excavations, vandalism, poor workmanship etc.
- Non-supply – non-supply by Transpower, Generators.
- Asset failure – capacity, reliability, structural, cost.

At all stages through the Asset Management planning process, Westpower's staff strive to reduce the impact of such risks.

Performance and Plans for Improvement

Westpower's Asset Management approach is based on evaluating the following key areas of life cycle asset management:

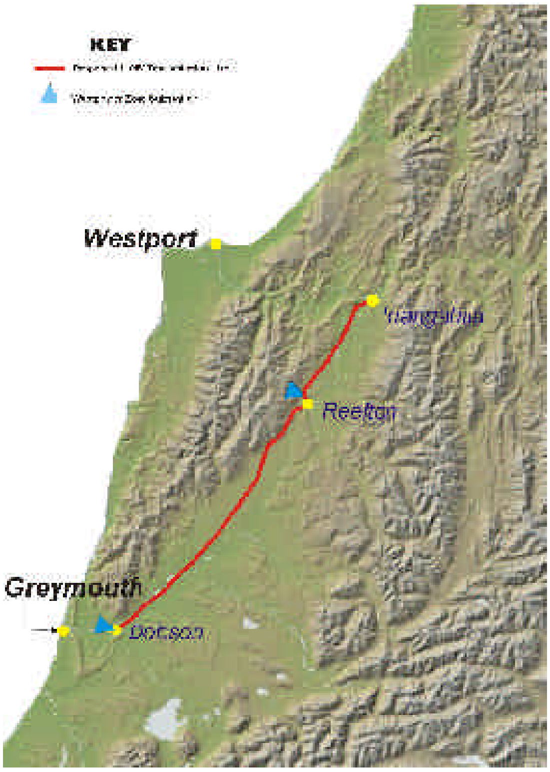
- Processes and Practices
- Data and Knowledge
- Information Support Systems
- Commercial Tactics;
- Organisational / People issues
- Asset Management Plans

Westpower has a goal of meeting and exceeding industry best practice through a process of continual improvement. This is achieved by means of ongoing reviews based on a gap analysis, which categorises areas and individual processes that need attention.

As each area is dealt with as a team exercise throughout the year, the gap analysis is updated to show current performance levels.

MAJOR PROJECTS

West Coast Grid Reinforcement



The West Coast has reached the limits of a secure supply of electricity (measured by a single contingency) presently supplied from Transpower's Coleridge and Inangahua substations and TrustPower's local generation. Transpower will need to reinforce transmission to meet the needs of the West Coast's load growth of industrial and tourism based loads. In addition, TrustPower are carrying out studies on the feasibility of a new 40 MW generation station near Dobson. Even should this project proceed, however, TrustPower will be constrained from exporting the excess generation from the West Coast if transmission is not improved.

Studies have determined the most economical transmission solution is to build a single circuit 110 kV line from Inangahua to Dobson and interconnect with Transpower substations at both ends. The first stage of this project from Inangahua to Reefton was completed in October 2005 and planning is well underway for a start on construction of Stage II during the current financial year.

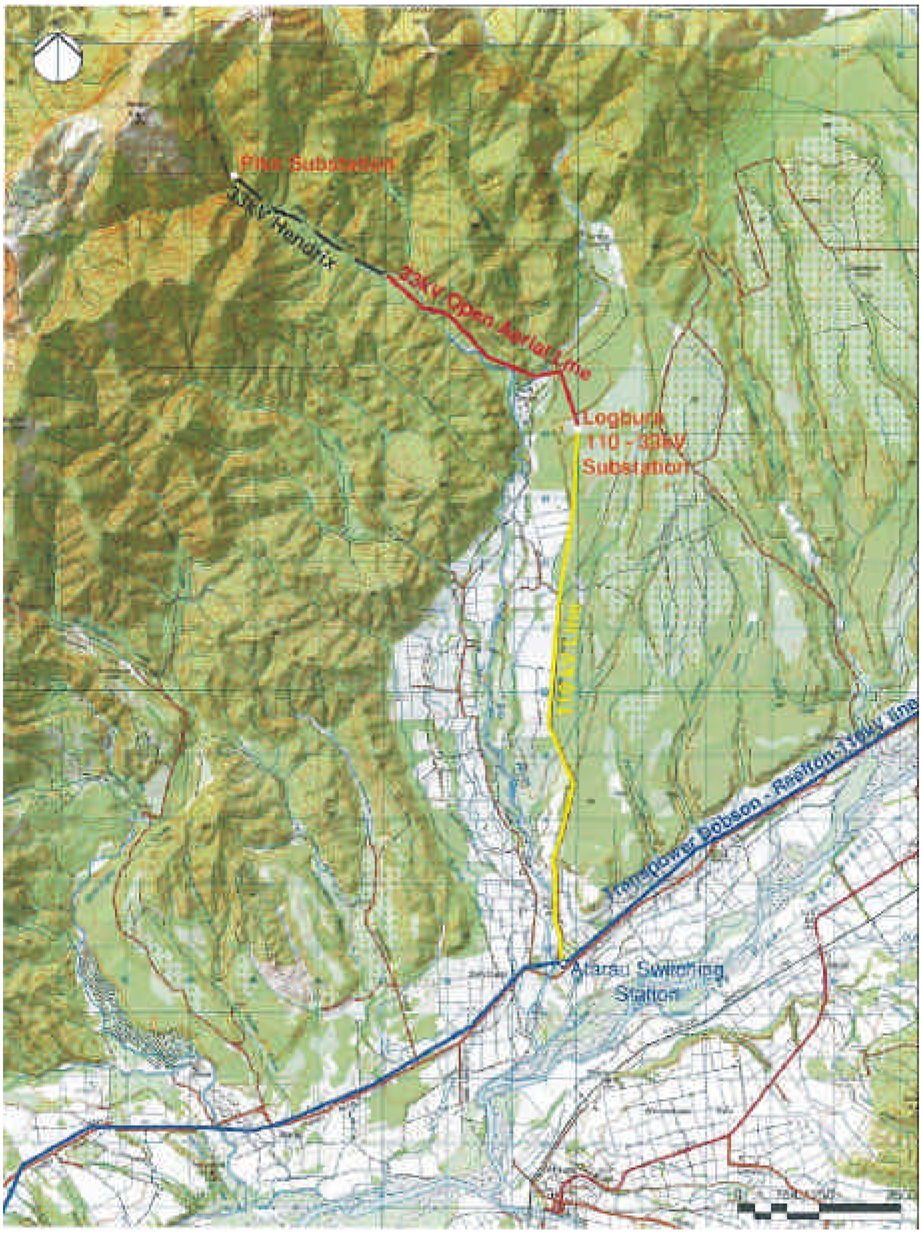
Final commitment on this project by Transpower is awaiting approval from the Electricity Commission and the Commerce Commission through the Grid Upgrade process, and these approvals are being actively sought.

Project 07-6001 Pike River Coal - Build new 33 kV sub transmission line

Pike River Coal are opening a new coal field at Pike River with a forecast demand of 14 MW. This will be supplied via a tee off to Transpower's Inangahua - Reefton - Dobson line at Atarau.

A switching station will be required at this point and this will become a new GXP

Westpower is to construct a new 8 km 110 kV line from Atarau to the 110/33/11 kV 20/30 MVA Logburn Substation, and then a further 8 km of 33 kV line to a 33/11 kV 15/20 MVA substation at the Pike Mine site. The key details are shown in the figure below.



Pike River Line Details

Reefton Gold Supply Project (RGPS)

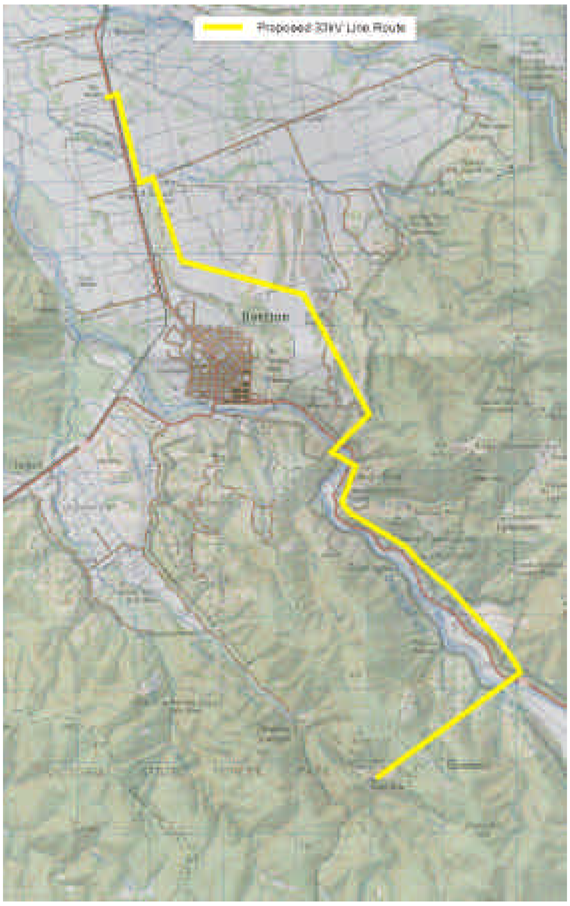
Oceana Gold Limited (OGL) have decided to proceed with the mine development at Globe Hill, will require a 7 MW supply necessitating a 110/33 kV supply point at Reefton. This also involves the construction of a new 33 kV line to the mine site (as shown in the attached figure) followed by a 33/11 kV substation and 11 kV reticulation around the site itself.

Stage I, including construction of the Reefton 110/33/11 kV substation was completed in October 2005 and provided collateral benefits to the township of Reefton and surrounding areas by providing a secure n-1 supply, whereas the area was previously supplied by a long single circuit 33 kV feeder from the Dobson GXP.

A 12 km 33 kV line is being constructed from the Reefton Substation site at Waitahu through to the Globe Hill mine site. Some of this route is built as double circuit as it shares some of Westpower's existing 11 kV line routes.

At the mine site, a new 33/11 kV substation will be constructed, and this will feed several kilometres of 11 kV line and approximately six distribution style substations.

Based on requests from OGL, supply to the mine site is targeted for September 2006.



FINANCIAL SUMMARY

Financial Forecasts

The tables below shows the projected ten-year asset management plan expenditure, by asset type and by activity.

These tables have been built up from the individual project and programme expenditures developed in Section 6 – Lifecycle Management Plan, and demonstrate a generally falling expenditure over the duration of the planning period.

Summary by Activity

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Inspection, Service & Testing	3286	3062	2740	2570	2655	2690	2455	2575	2420	2410
Faults	412	412	412	412	412	412	412	412	412	412
Repairs	191	175	175	175	175	175	175	175	175	175
Replace	2169	1823	1380	1102	1400	890	930	845	815	815
Enhancement	1325	1605	610	375	225	155	145	105	105	105
Development	11960	5472	2445	2060	4190	1640	840	840	840	840
Total	19344	12550	7763	6695	9058	5963	4958	4953	4768	4758

Summary by Asset Type

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Subtransmission	5699	5229	1725	1672	1442	977	617	577	577	567
Distribution	3778	2832	2665	2242	2220	2100	2100	2025	2025	2025
Reticulation	279	370	209	142	117	117	117	117	117	117
Services	158	158	158	158	148	148	148	148	148	148
Zone Substations	7054	2112	1187	613	3118	1018	283	403	248	248
Distribution Substations	462	472	522	482	532	532	582	582	582	582
MV Switchgear	664	497	517	377	292	212	252	212	212	212
SCADA, Comms, Protection	604	234	134	364	544	164	164	194	164	164
Distribution Transformers	620	620	620	620	620	670	670	670	670	670
Other	25	25	25	25	25	25	25	25	25	25
Total	19344	12550	7763	6695	9058	5963	4958	4953	4768	4758

It should be noted that the estimates for the first half of the planning period are based on known drivers and hence are more accurate than those for the second half which are more in the nature of educated guesses due to a large number of unpredictable factors. Furthermore, in developing these figures, Westpower has the benefit of several years of experience in budgeting and controlling this expenditure and there is a high degree of certainty in the values.

Figure A below shows the distribution of expenditure in terms of work activity. As expected, the level of expenditure for Development is significantly greater than for other activities, due to major projects such as the West Coast Grid Reinforcement Project .

Previously Westpower has had a large proportion of older lines that were rapidly approaching failure, and a replacement programme of the last ten years has substantially overcome this problem. The I,S&T expenditure has been increased when compared to the previous year to provide enhanced monitoring of the condition of older components such as small transformers that have developed a gasket problem and increased tree trimming allowances. By doing this, future maintenance may be targeted toward life extension of ageing assets.

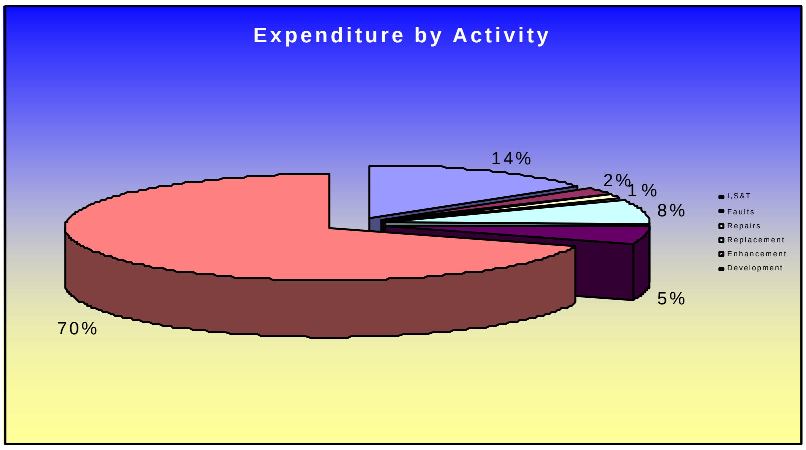


Figure A Expenditure by Activity

The enhancement expenditure also reflects a continued emphasis on distribution automation as reclosers and disconnectors are progressively automated. As a result Westpower is able to greatly reduce outage durations and switching times, resulting in an improved SAIDI reliability statistic.

The expenditure by asset type is depicted in figure B. As would be expected, the bulk of the expenditure involves subtransmission and zone substation assets related to the major projects discussed above.

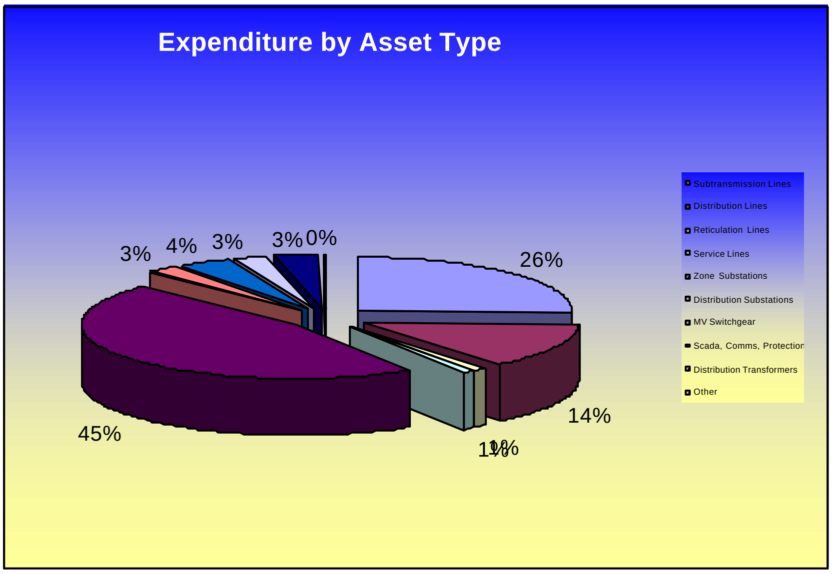


Figure B Expenditure by Asset Type

Assumptions and Sensitivity Analysis

Some basic assumptions have been made. These include:

- As a Lines Business, Westpower will continue to be a going concern under the new regulatory regime.
- Asset Management, Asset Development and Maintenance, System Control and Corporate Services functions will be provided by ElectroNet Services and be based in Greymouth.
- The Lines Business will continue to own ElectroNet Services and to operate it on an arms length basis

Contents

FOREWORD

This is the thirteenth Asset Management Plan to be produced for Westpower and includes only minor changes from last year.

The Plan defines the service objectives and gives focus on life cycle management by presenting operations, maintenance and renewal policies, needs and programmes by asset type. The following Asset Management planning process has been suggested in order to effectively integrate best practice features. These establish the service standards and future demands to meet business, legislative and other needs, while developing optimum lifecycle Asset Management strategies, and cash flow projections based on assessing non asset solutions, failure modes, cost/benefits and risk.

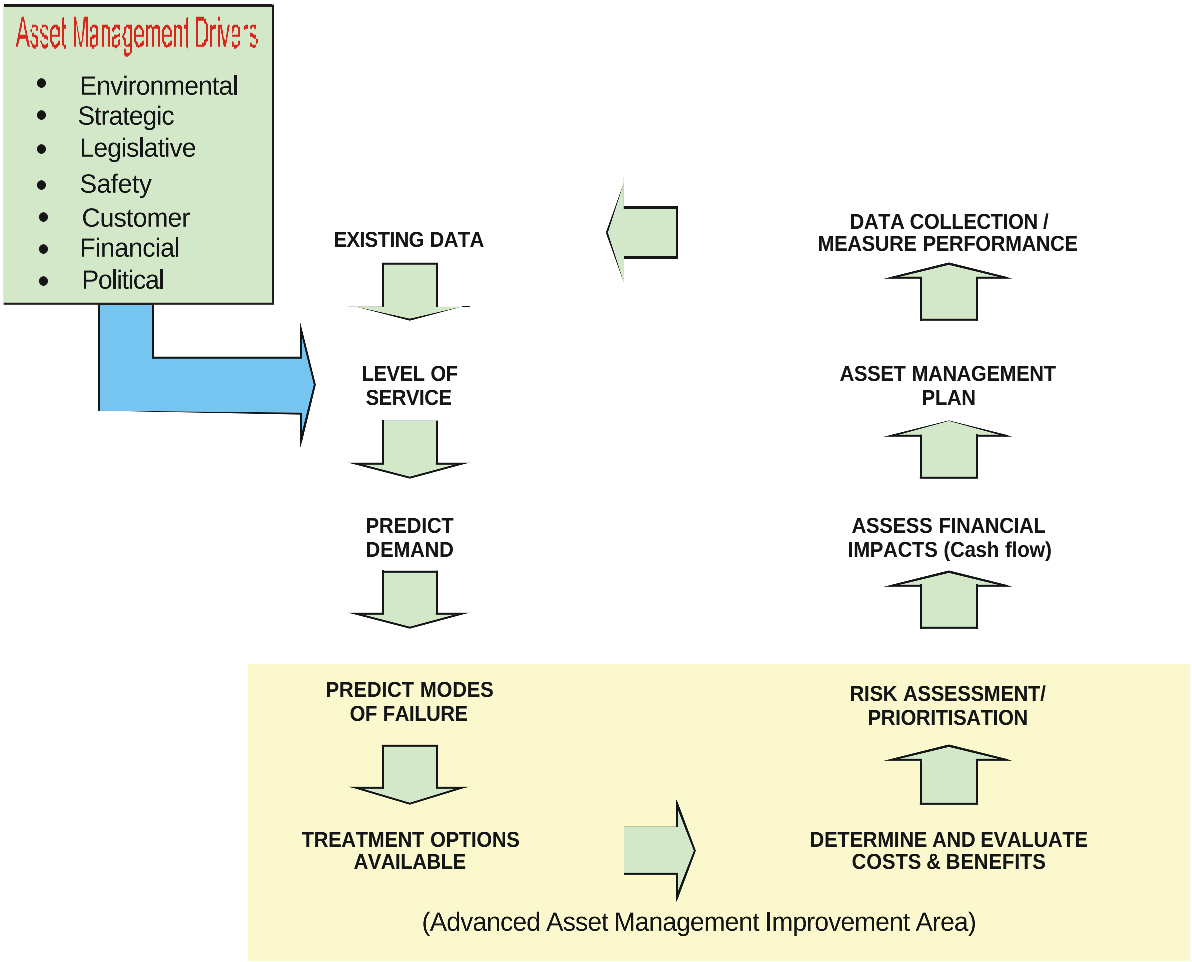


Figure 1 : Asset Management Plan Process

Overview of Westpower Organisation

Westpower Limited is a stand-alone lines business with a contracting subsidiary ElectroNet Services Limited. Westpower is essentially an electricity distribution company that is a shell or holding company however will continue to own the infrastructure assets. The 100% owned subsidiary contracting company ElectroNet Services is the employer of all the staff and not only performs work on the Westpower Infrastructure assets but also plans and controls the Asset Management Function.

The Asset Management Division holds the technical knowledge and is responsible for technical decisions regarding to the Asset. Thus the Asset Management Division is in charge of Westpower Assets and hence the requirements of equipment and safety issues remain with the Asset Manager. The Company structure is shown in figures 2 and 3 below.

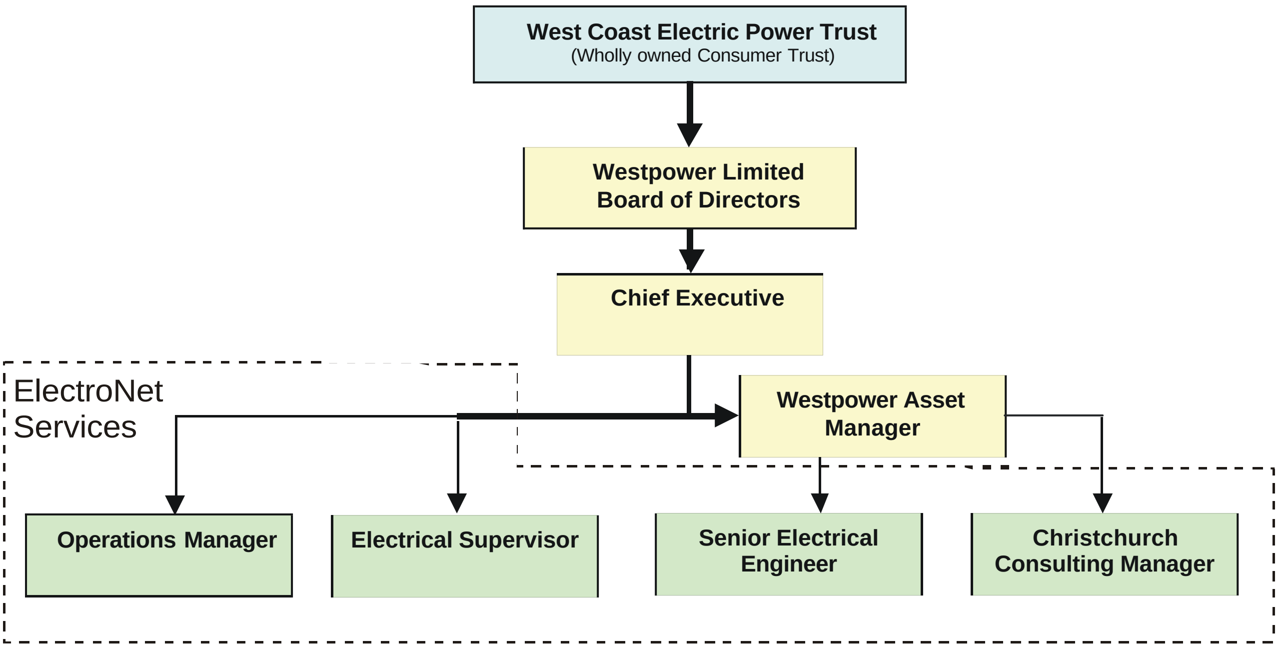


Figure 2 : Organisation Chart

The key functions of the groups are:

- ***Chief Executive Officer***

Financial accounting of Network Assets, management and company secretariat, attaining of revenue streams.

- ***Westpower Asset Manager***

Managing the network to maximise system availability. Developing maintenance strategies, setting and managing priorities, controlling standards and issuing works orders to ensure reliability at minimum cost and key contact point with Energy and Generation Companies wishing to use the Westpower network for the distribution of electricity..

A Delegation Policy is in place for the Westpower Group that clearly states the authorities required to approve certain types and levels of expenditure. The following is an excerpt from this policy: -

Equipment write offs are subject to the same delegated authorities as set out for capital expenditures for each position holder.

Delegation limits apply to both works orders and stores requisitions.

In the event that a member of staff needs to breach his/her limit, the signature of a member of staff with a higher delegated authority will be required.

The delegations for non-chargeable works rely on the assumption that Board approval is in place through the budgeting process.

Capital Purchase approvals are subject to the approval process and sign off of forms as implemented in 2000, i.e. a separate approval process for each item.

Delegations	
Position	**Chargeable Work Limit**
Management Team	$2,000,000
Chief Executive	$1,000,000
Asset Manager	$1,000,000

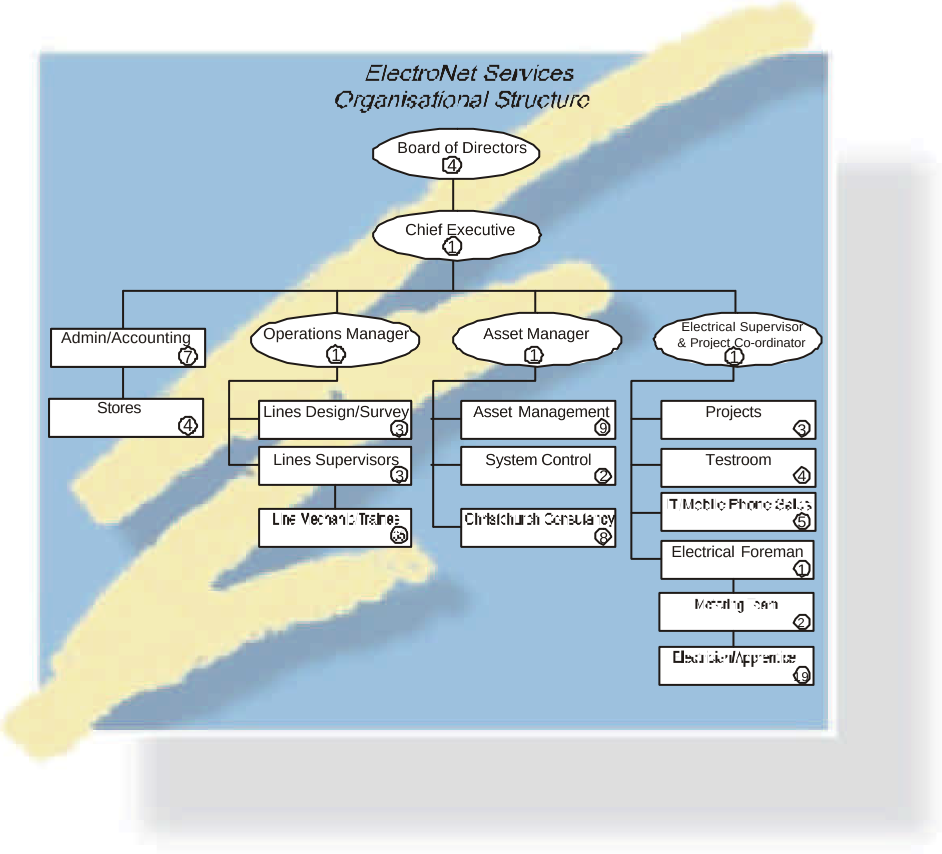


Figure 3: ElectroNet Services Organisation Chart

Human Resource Management

Westpower has no operational staff itself and the following comments apply to its subsidiary Electronet Services.

ElectroNet Services strive to incorporate concepts, stratagies, policies and practices within their organization which will effectively manage and develop the people who work within the company.

ElectroNets' employees provide the character or personality of the Company and it is through their efforts that the company will fulfil its commitments. ElectroNet aims to have a supportive team producing and supplying consistently high quality products and services in a manner that makes ENS the customers' supplier of choice.

ElectroNet is committed to:

- providing job security
- encouraging satisfaction and personal development
- feeding back relevant key performance information
- being fair
- providing a safe and healthy working environment
- providing effective leadership and communication
- listening to staff
- becoming an employer of choice

ElectroNet Services make every effort to appoint a staff of employees whose abilities and skills will compliment the roles they are to undertake, and who will contribute to the success of the business.

ElectroNet will further provide all training and supervision as determined necessary to enhance the growth and development of employees.

1.0 INTRODUCTION

1.1 Westpower Yesterday

In the late 1800's early 1900's private power generating schemes were being built throughout the West Coast Region to supply mainly gold claims. Reefton was the first public supply connected in the Southern Hemisphere in December 1887. Other supplies were at Dillmanstown and Kaniere in the Hokitika area.

1.2 Westpower Today

Westpower is a combination of a number of these early power companies and generators on the West Coast. In 1972 the West Coast Electric Power Board was formed by the amalgamation of the Amethyst, Grey and Westland Electric Power Boards. Westpower has network assets throughout the 18,017 square kilometers of the West Coast from the Lyell in the North to Paringa in South Westland

The distribution system comprises 1,978 kilometers of high voltage AC distribution lines, 15 zone substations and switch-yards, 1,853 distribution substations, 1 control room, and a telecommunications network.

Westpower's distribution lines consist of varying line capacities, dependent upon local demands and geographical considerations. Operating voltages include 66 kilovolt (kV), 33 kV, and 11 kV.

The maintenance of the network is carried out by ElectroNet Services as the preferred contractor and a wholly owned subsidiary of Westpower. They are contracted to undertake the Inspection, Servicing and Testing, along with Fault Callout and Fault Repair work. Major lines Replacement, Enhancement or Development projects are also issued to ElectroNet Services as design build contracts.

1.3 Westpower Tomorrow

Asset Management Plans must address growth. Projections for the West Coast are continually studied by Westpower to ensure that the sub-transmission and distribution network is adequate for the demand. This plan projects that the total load will be over 70 MW in ten years.

1.4 Issues Facing Westpower

Key Asset Management issues facing Westpower are:-

- Maintaining network performance and reliability. Included in this are setting clearly defined service levels and backing these up with customer guarantees.
- The cost of environmental improvements and easements need to be factored into planning.
- Decision making between maintenance of assets and their renewal, will be a major part of asset management.
- Acquiring revenue funding through prices at a level acceptable to customers.

1.5 Objective and Stakeholders

1.5.1 Objective of the Plan

The defined objective of the Asset Management Plan is:

"To provide a systematic approach to the planning of programmes which are intended to ensure that the condition and performance of infrastructure assets are being efficiently maintained or improved to satisfy stakeholders requirements."

1.5.2 Stakeholders in the Plan

Stakeholders are defined as those parties with an interest in Westpower's asset management. The principal stakeholders are:

- Westpower's shareholders;
- Westpower's customers, that is electricity retailers, generators and end-use electricity customers.

Mass market customers have not expressed any dissatisfaction in the status quo combination of price and reliability. Some of the 25 largest customers have expressed an interest in paying for additional reliability, mainly based on the criticality of their operations.

Westpower shareholders wish to ensure, as owners of the assets, that their financial capital is protected in the long term, by ensuring that the operating capability of the system is protected and that the system is maintained efficiently so that they earn an acceptable return on their investment.

The shareholders also have an interest in how Westpower provides customer service and how it meets its obligations to other parties (as described below).

Other parties with a potential interest in Westpower's asset management include workers (including contractors) who physically work on the system, the public through whose land the distribution system is built and any agencies with which Westpower comes into regulatory contact.

ElectroNet Services Asset Management has responsibility for the day to day management of the company and its assets and for carrying out company policies. Westpower is the "owner" of the plan, responsible for its creation and for using it as a tool for improving the efficiency and effectiveness of the management of Westpower's assets.

Westpower's shares are held by the West Coast Electric Power Trust (WCEPT) on behalf of the capital beneficiaries who comprise the electors within Westpower's area. As such, the WCEPT is treated as the nominal shareholder, or owner, of the business.

The WCEPT is regularly kept informed of key matters through the annual issue of a Statement of Corporate Intent (SCI), quarterly financial reports and Shareholder's Newsletters. Each year, Westpower and WCEPT meet together after their respective Annual General Meetings to discuss issues of mutual interest. Additionally, the Chief Executive or Chairman will often attend regular WCEPT meetings when invited to promote good communication and answer any concerns that may arise.

Clearly there will be times when individual interests of various stakeholders may create potential conflict, and Westpower takes a consultative approach by listening to the concerns of the parties involved and taking this into account when making decisions. The overarching drivers of providing a safe and reliable supply of electricity at a reasonable cost, while ensuring that wherever possible all stakeholders are treated equitably, form a framework within which best case outcomes are determined. Of course, this will often involve some form of compromise except where health and safety issues are concerned.

Where a good case is made that requires a change in the AMP, this can either be reviewed during the year if urgent, subject to budgetary approval from the Board, or included in the following year's AMP. In support of this, the Asset Management Group maintains a register of recommended changes that are incorporated into the AMP each year.

Westpower's policy is that new connections to Westpower network should not be subsidised by its existing customer base, and therefore new customers are charged the full cost of new connections. This is taken into account when determining the best solution to supply new or increased loads

1.6 Scope of Asset Management Plan

The Asset Management Plan covers a period of 10 years from the financial year beginning on 1 April 2006 until the year ended 31 March 2016. The main focus of analysis is the first 3 to 5 years and for this period, most of the specific projects have been identified. Beyond this time, analysis tends to be more indicative based on long-term trends and it is likely that new development project requirements will arise in the latter half of the planning period, that are not identified here.

To provide a framework for asset management within the planning period, it is necessary to determine the longer-term direction in which the system should be developed. For example, it would not be prudent to invest heavily in enhancing a system at a particular voltage if, beyond the planning horizon but well within the life of those assets, it was likely that they would be overlaid by a new higher voltage system. A case in point is the augmentation of supply to the Reefton area. Further, strategic development planning must be responsive to a range of scenarios that might occur.

1.6.1 Working Assumptions of the Asset Management Plan

It is important for stakeholders that the manner and the basis upon which the asset management plan are intended to operate are clearly understood. For the purposes of clarity, and in order to avoid any confusion, the following underlying assumptions need to be taken into account by the shareholders in dealing with the Asset Management Plan:

- The plan interacts with other Westpower working plans. Of particular importance are the annual budgets, which set out the specific resources required for asset management activities. Those parts of the annual estimates relating to the management of the system are closely based on the annual Asset Management Plans.

- Authorisation of expenditure results from approval of the annual estimates by the Board of Directors and from specific approvals. The Asset Management Plan does not represent an authorisation by Westpower to commit expenditure, nor does it represent a commitment on the part of Westpower to proceed with any specific projects or programmes.

- A process of annual consultation will be initiated with the customers described above, starting with the release of this asset management plan.

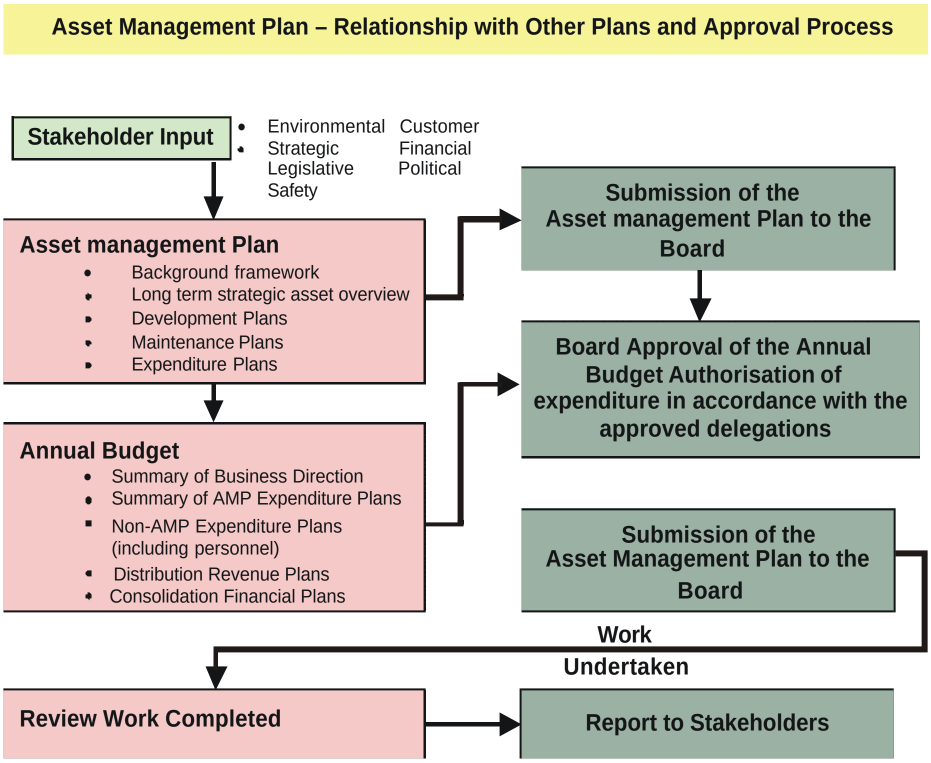


Figure 4: Relationship with other plans and approval process

Figure 4 shows the interaction of the different Westpower plans.

1.7 Corporate Asset Management Drivers

The factors that drive asset management activities and their relationship to Westpower's performance are derived from the external performance required of Westpower by its customers, workers (including contractors), shareholder(s) and the public. The drivers that have been determined for this plan are as follows.

1.7.1 Safety

Safety is determined by a combination of asset design, maintaining the assets in a safe condition and the use of safe operation and work practices.

The Electricity Regulations 1997 contain the principle legal drivers for Westpower's safety related asset management. These standards require Westpower to operate as a reasonable and prudent operator.
The Electricity Regulations 1997 specify criteria for new lines which take into account the design and construction strength, physical security of substations, high voltage feeder electrical protection, overhead construction of electric lines and the insulation and protection of underground electric lines along with earthing requirements for distribution lines

They also require existing assets to be maintained in good order and repair to secure immunity from danger.

The Building Act 1991 puts in place a building maintenance regime that is aimed at ensuring the existence of essential safeguards for the users of buildings; specifically that buildings are safe, sanitary and offer adequate means of escape from fire.

The Health and Safety in Employment Act and the Electricity Act 1992 now dictate the legislative framework

with a performance based regime which puts the onus on Westpower as the employer and as a principal to take control for ensuring the safety of workers and others in the work place.

The Health and Safety in Employment Act's main objective is to provide for the prevention of harm to employees, contractors and subcontractors, who in Westpower's case will be working on Westpower equipment. Westpower has the responsibility for putting in place preventive measures. The way in which Westpower does it is discretionary, but the outcome is not.

1.7.2 Customer Service

Westpower's customer service objective is to manage the network reliably, efficiently and economically to meet the needs of its customers.

1.7.2.1 Capacity (i.e. Adequacy of Service)

Westpower's policy is to provide sufficient capacity to meet customers' requirements, subject to satisfactory arrangements to cover the additional costs associated with any capacity additions required.

For asset management planning purposes, projected demands, security and capacity criteria are assumed from additions and modifications to the network which have been projected.

Large step changes in load cannot be accurately forecast as these are often associated with large industrial projects whose promoters are notoriously loath to make firm commitments until the latest possible point in time. Nevertheless, Westpower keeps up regular dialogue with these parties so that it can take possible changes into account when carrying out its regular planning activities.

1.7.2.2 Reliability (i.e. Continuity of Service)

Reliability is a function of

- Asset design, the most important mechanism being built-in equipment redundancy (referred to as the security level) so that, for example, failure of any one component does not lead to a supply outage. [1]

- Asset condition where this affects the likelihood of failure of a component

- Efficient operation and maintenance practices (i.e. minimising the effects of planned equipment outages). With the introduction of Live Line Work the incidence of planned outages has reduced dramatically.

Within the network Westpower's policy is to focus expenditure on areas that give reliability improvements where the greatest benefits can be achieved for its customers in the most economical manner. Generally this involves focusing attention on distribution automation including the installation of

- modern reclosers for automatic fault isolation; and

- remote controlled disconnectors for fault sectionalising.

Consultation with the 25 largest customers has revealed a high degree of satisfaction with existing reliability but with a recognition that additional reliability might be useful.

1.7.2.3 Transient Effects

Where problems are identified in relation to short-term voltage variations, Westpower works with individual customers to identify the best economic and engineering solution. Modern technology is available to customers to record supply profiles at individual installations and provide analysis of reoccurring problems.

The customer consultation referred to above also revealed a high level of dissatisfaction with sags, spikes and similar effects. Customers have difficulty understanding that the rural, bush-clad, lightning-prone nature of Westpower's network makes such transient events inevitable, and also have difficulty understanding that their own equipment or that of other customers may be a source of transients. Nevertheless, Westpower will aim to resolve such difficulties where technically and financially possible.

1.7.2.4 Voltage Profile

The present terms and conditions of supply specify voltage levels and tolerances at points of supply.

Westpower generally adopts the policy that the supply bus voltage will not vary from the nominal voltage by more than +/-4 % for supplies at 11kV or +/- 6 % at a customer's low voltage switchboard. Specific values are agreed with individual customers where required or there is a need to reduce these tolerances due to specialised equipment.

1.7.3 Economic Efficiency

Economic efficiency is an important driver for maintenance and development work. A large proportion of repair work, refurbishment and asset replacement work is undertaken only after economic analysis to determine the most cost-effective solution. This frequently involves the choice between a development option and continued maintenance.

Westpower's policy is to conduct an economic cost benefit analysis on key projects, where these are justified by some other consideration. Economic analyses are conducted on a discounted cash flow basis using an 7% per annum real discount rate after tax.

1.7.4 Environmental Responsibility

Westpower's policy is to act in an environmentally responsible manner and as required under legislation.

The Resource Management Act 1991 is the major legal driver for Westpower. The provisions relating to the discharge of contaminants into the environment, the duty to avoid unreasonable noise and the duty to avoid, remedy or mitigate any adverse effect on the environment are of particular relevance to Westpower.

1.7.5 Corporate Profile

Westpower's policy is to develop and maintain assets in a way, which reflects well on the organisation, and to adopt a socially responsible attitude towards community impacts. While this is not a major driver of asset management work, it is a consideration in all work.

1.7.6 Legislation and Compliance

Westpower operates an active compliance management regime and this is driven from the Board of Directors downward.

Each month, management are required to provide full disclosure to the Board of any actual or impending breaches of legislative compliance along with action plans for dealing with the issues that have arisen.

1. This is referred to as an n-1 security level. Security in which failure of a single component causes a supply outage is referred to as "n level" security, while design which allows for any 2 components to fail without causing a supply outage is referred to as n-2

In the area of Health and Safety, the company ensures that the main contractor ENS, has an active safety management program in place and that regular audits are carried out. A recent audit of safety processes by the Accident Compensation Corporation (ACC) resulted in the award of a tertiary level Workplace Safety Management Practices certificate, the highest standard available.

Health and Safety is paramount in everything that the company does and this culture extends throughout the organisation with all staff encouraged to take any active role in this area.

Compliance checks include, but are not necessarily limited to, the following key pieces of legislation: -

- Electricity Industry Reform Act 1999
- Electricity Act 1992
- Electricity Regulations
- Commerce Act 1996
- Heath and Safety in Employment Act 1992
- Building Act

1.8 Asset Management Linkage with Westpower Performance

The figure 5 on the following page shows the relationship between asset management and Westpower's performance.

These relationships serve as a framework for focussing on the reasons why particular asset management activities are required.

Ultimately Westpower's performance is judged externally and the drivers outlined in section 1.7 above are the parameters by which this performance is judged.

For many cases different asset management and operational responses can meet Westpower's external performance requirements. These may include maintenance to improve the condition of the asset, development to install assets in a new configuration, enhancements to the existing system or changes to the way in which the assets are operated. Effective management of the business involves selecting the most appropriate asset management or operational responses, as proposed in this plan.

1.9 Plan Structure and Approach

This plan uses a consistent set of defined activities and asset types to categorise work programmes and their associated expenditure. Budgeting and financial reporting within Westpower allows actual programme achievement and expenditure outcomes to be compared with the plan. Consistent use of this framework will facilitate comparisons over time.

It should be noted that the activity and asset definitions are independent of accounting classifications of expenditure (i.e. between maintenance and capital expenditure). Therefore trends over time should not be altered by any changes in the application of accounting policies regarding the accounting treatment of expenditure. However it should also be noted that, under the current application of accounting policies, all activities

could be classified as either entirely operating expenditure or entirely capital expenditure.

Similarly, the activity and asset type definitions are also independent of Westpower's organisational structure and responsibilities, although closely aligned with the present structure. In the long run, adherence to the definitions will ensure that the plan remains meaningful in spite of any changes in organisational structure or responsibilities.

The asset and activity planning categories are defined in Appendix A "Asset Types and Activity Categories", otherwise known as the Job Costing Tree Structure. It is obvious that not all asset type and activity combinations are used. In addition maintenance activities can generally be planned at the detailed asset level (e.g. servicing of transformers, of circuit breakers etc), whereas development projects or programmes, which typically involve a combination of different asset types (e.g. lines, transformers, circuit breakers, protection, communications and network management) are kept intact rather than attempting to allocate the expenditure against the component asset types.

One further definitional distinction is made throughout this plan: between projects and programmes. The word "programme" is used to define a generic activity with a generic justification, but which may apply at a number of different sites. Replacement of defective insulators, fitting vibration dampers to lines, and upgrading metering are therefore classed as such programmes. On the other hand "projects" are site (or asset) specific; for example adding a second circuit to a particular line, or upgrading a particular transformer bank.

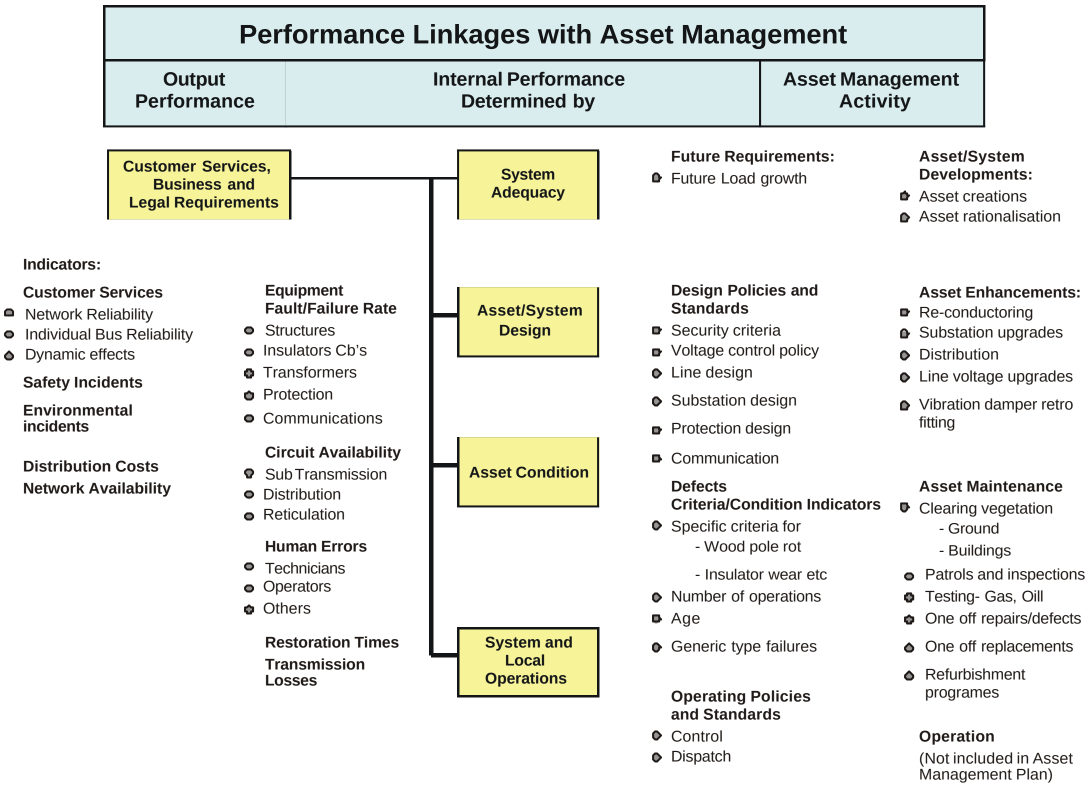


Figure 5 : Performance linkages

2.0 LEVELS OF SERVICE

2.1 Introduction

The Electricity Information Disclosure Requirements 2004 are designed to ensure that Network Line Companies provide an appropriate level of security of supply to their customers. The indices used are "faults per 100km", **"SAIDI"** (System Average Interruptions Duration Index) and **"CAIDI"** (Customer Average Interruption Duration Index). The requirements also require the disclosure of "Proportion of interruptions not restored within 3 hours" and "Proportion of Interruptions not restored within 24 hours".

These principles of condition-based maintenance provide the framework within which Westpower plans and undertakes system maintenance work. The successful application of these principles relies on

- accurate knowledge of the condition of the assets, and
- defined defect criteria for each asset type

Taken together, these determine whether work is required. Thus, the amount of maintenance work is determined by and therefore is sensitive to the defect criteria. These criteria are to be documented in Westpower's maintenance standards, which will be used as a reference point during inspections and servicing.

Once it is determined that work is required, Westpower must decide when and how the work should be undertaken. Westpower determines the preferred course of action to remedy the problem, and its priority, by analysis and judgements taking into account the number and type of customers that may be affected due to future outages. Where an individual customer's service is affected, then Westpower's policy is to consult with the customer affected to help ensure that the solution meets their needs while not unduly affecting other customers connected to the Network.

2.2 Customer Research and Expectations

In order to set reasonable security standard targets, that are compatible with end user expectations, appropriate research must be carried out.

The needs of electricity users have changed greatly over the last ten years with the rapid introduction of technology into the domestic market. Appliances from video recorders to bread makers and home computers are now commonplace in many homes and have greatly increased the sensitivity of householders to power outages and minor interruptions. Consultation with the 25 largest customers has confirmed that adoption of PLC's and SCADA by industry has reduced tolerance to fleeting events – rotating and thermal plant that has sufficient inertia to continue through a fleeting outage will now probably be tripped when its controller loses power for a cycle or two

The degree to which modern society has come to be reliant on a secure supply of electricity was clearly enunciated during the Auckland CBD Power Failure in February 1998. While Westpower's area cannot boast a similar level or density of critical business users, this perception is merely a matter of degree. The small gift shop owner in Greymouth, running on small margins and high overheads, is just as reliant on electricity to power cash registers and EFTPOS terminals as the largest multinational company is for power to it's multi-storey tower office block.

Part of Westpower's Vision is to *"maintain an efficient and reliable electricity distribution network on the West Coast".* In this context, "efficiency" and "reliability" are relative terms that are subject to personal perceptions. In turn, these perceptions must be viewed from the customer's viewpoint, which must be actively sought.

Westpower intends to liaise closely with the Energy Retailers to determine the expectations of their customers, and quantify these in terms of desirable reliability indices.

2.2.1 Impact of the Proposed New Regulatory Regime

In September 2003 the Commerce Commission released its Final Threshold Decisions on the new regulatory environment for electricity lines businesses. This consists of a targeted control regime whereby individual businesses will be investigated with a view to imposing individual price control in the event that they exceed particular thresholds with respect to:

1. Price Path
2. Reliability

At present, the price path involves an annual adjustment of Consumer Price Index (CPI) – X% per annum, where X is currently set at 1% for Westpower, effectively resulting in a 1% revenue drop in real terms over each year of a five year period that began in 2003.

The resulting reduction in revenue requires that Westpower continue to focus clearly on cost reduction, while at the same time ensuring that there is no material reduction in reliability. The professional asset management planning processes applied by Westpower over the last ten years have placed the company in an excellent position to respond to the challenges of the new environment with a well-maintained asset base. New disciplines required by the regulatory environment will be incorporated into future asset management plans, although the reducing real revenue stream will make planning more difficult over time as trade offs will increasingly have to be made.

2.2.2 Impact of Maintenance Expenditure on Network Reliability

A key issue for managers of infrastructure assets is to determine an appropriate level of maintenance expenditure that will provide for adequate performance of the network while at the same time aiming for economic efficiency through either reduced costs or improved returns to shareholders.

In Westpower's case, network performance, particular with regard to reliability as measured by the SAIDI statistic, is largely driven by external factors such as climatic conditions and expenditure is targeted to address this issue.

A key reason for this is that Westpower has taken a very pro-active approach to network replacement over the last ten years so that very old assets, or those that were in poor condition because of specific environmental factors such as proximity to the sea coast, have been largely replaced so that equipment failure is no longer a major contributor to the overall SAIDI result. For instance, in the year ending March 2005, equipment failure accounted for only 6.2% of the overall SAIDI outcome.

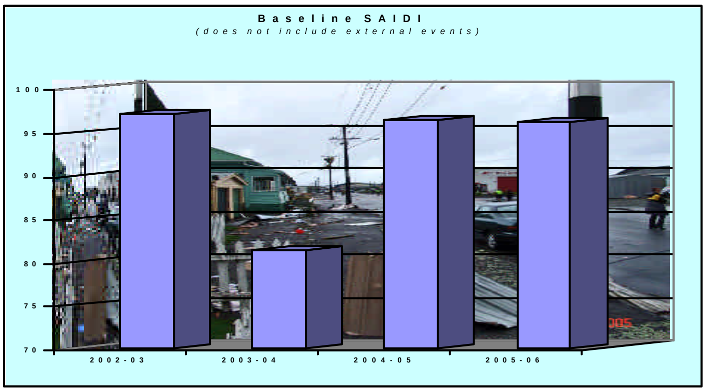
Moreover, and as noted throughout this plan, when equipment type failures are identified following a regular review of outage causes, programmes are instituted to upgrade or replace the equipment to minimize the risk of future impact. Examples of this, along with annual costs, include

- Chance drop out fuse replacement (Section 6.7.3) $30,000
- Replacing lightning arrestors (Section 6.7.4) $80,000
- Replacing tinned live-line taps (Section 6.7.3) $10,000
- Replacing transformer gaskets and bushing (Section 6.10.1.1) $50,000
- Andelect Ring Main Unit Replacement $75,000

Because impacts on SAIDI are not directly quantifiable by the application of a dollar amount, there is little purpose to be served by trying to determine efficient expenditure relationships in an arbitrary mathematical fashion. Instead, Westpower takes the view that any equipment that exhibits a higher than acceptable risk of failure will either be repaired or replaced and a programme is developed that will deal with these issues in a reasonable timeframe.

While there are clearly financial and resource constraints that impinge on the level of preventative maintenance that can physically be carried out, these constraints have not resulted in any significant curtailment of the

programmes below what would be seen as a level demonstrating best practice risk management. In part, this is due to the trust ownership structure of the business, which generally values reliability of supply equally as highly as pure financial performance.



Experience and monitoring of the baseline SAIDI (excluding extreme climatic events and external causes such as trees wildlife or vehicle accidents, which has been around 85 system minutes over the last four years), confirms the level of maintenance expenditure appropriate to meet the levels of service required by our customers. Furthermore, and in general terms, because of the good condition of the network, network performance is relatively insensitive to ongoing levels of maintenance expenditure in the short term.

Critical Maintenance Expenditure		
Area	Justification	Programme
Condition Assessment	In order to identify the performance and likelihood of failure of critical network components, an accurate and timely monitoring programme is required.	A five yearly inspection programme of all lines and substations with an annual budget of $123,000
Faults	Company policy and customer satisfaction requires that supply be restored as quickly as possible after an interruption.	An annual budget of $293,000 has been allowed based on experience.
Repairs	After a fault and power is restored, permanent repairs need to be made expeditiously to avoid repeat failures	An annual repair budget of $175,000 has been allowed based on experience
Faulty component replacement	Components with an unacceptably high failure risk need to be repaired or replaced.	Individual programmes as noted above totaling around $250,000 per annum.
HV Line insulation replacement	Insulation breakdown of porcelain and EPDM on lines of 33 kV and above is likely over time and will result in rapidly increasing failure rates unless dealt with.	Porcelain disc replacement programme ($125,000 p.a.) and 33 kV EPDM replacement programme ($25,000 p.a)
Tree Trimming	With the verdant growth on the West Coast, this has become a critical issue for Westpower. Trees accounted for over 25% of the SAIDI result for 2004/5. Additional powers and responsibilities from the new trees regulation mean that Westpower needs to become more proactive in its approach.	An annual tree identification and trimming programme with a significant budget increase over previous years ($240,000 for 2005/6).
Pole replacement	Substandard poles can result in significant unplanned outages and risk to life and property should they fail.	Ongoing pole replacements for older 33 kV and 66 kV lines ($100,000 p.a.). Service pole replacement ($35,000 p.a.)

Nevertheless, there remain some critical areas where maintenance expenditure must be applied to avoid potential rapid deterioration of network performance and these are detailed below.

Westpower is committed to maintaining its network to a high standard in comparison to the industry in general because of the large distances, and hence delays, involved in restoring power after a fault. Many areas are very remote from fault bases and it makes good business sense to minimize the risk of failure from faulty network components.

In summary, the current levels of maintenance expenditure are expected to continue, although little further improvement in baseline SAIDI can be expected since, with the notable exception of the increased tree trimming programme, most of the “easy” issues are already being addressed.

2.3 Statutory Requirements

Westpower is required by statute to take all reasonable precautions to secure continuity of service. However a certain level of outages is inevitable and they occur in all utilities. Westpower is subject to large occurrence of lightning strikes in relation to other areas of the country and these contribute to a high percentage of fault outages. The overall level of system reliability can be measured in annual outage system minutes. This is the average time for which power is not supplied due to transmission system faults, measured as if the various outages that occur are a single outage affecting all users simultaneously.

In addition, the following published parameters are used to measure Westpower's performance in comparison to other power companies.

SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
CAIDI	Customer Average Interruption Duration Index

Other statutes apply to Westpower in its operation and maintenance of the distribution network.

These include the Resource Management Act.

Section 9 of RMA relates to Restrictions on use of land

1 No person may use any land in a manner that contravenes a rule in a district plan or proposed district plan unless the activity is:

(a) Expressly allowed by a resource consent granted by the territorial authority responsible for the plan; or

(b) An existing use allowed by section 10 (certain existing uses protected).

Westpower's Network currently crosses land governed by three different Territorial Authorities, each with their own District Plan and each slightly different in the rules governing the construction of new distribution lines.

Westpower's protection of existing works are covered by Section 22 of the Electricity Act 1992 and the rights of entry in respect of these works is covered in Section 23 of the Act. Prior to commencement of any Construction or Maintenance of Works, Westpower must give notice to other utility owners and the appropriate Territorial Authority of its intention to commence construction or maintenance on its works.

Westpower's Distribution Network runs throughout a very high sensitivity area along the length of the West Coast due to the number of National Parks and their importance to the clean green image of New Zealand. Westpower does have a high regard for the environment. For this reason Westpower may be required to use alternative methods of construction to minimise the effects on the environment. An example of this has been the replacement of overhead conductors to underground cables across the flight path of the Westland Black Petrel in the Punakaiki area. Consideration is also given to areas of high scenic value and Westpower consults and works with the Department of Conservation when working in these areas. This may be required for tree trimming, agreement on line routes or just general distribution line upgrades.

2.4 Strategic and Corporate Goals

Westpower is committed to an open and transparent policy of operation. Its prime responsibilities are to manage the distribution system reliably, efficiently and economically and also to meet its users' needs in providing quality electricity supply services. Westpower operates to meet those needs effectively and

efficiently, recognising its position as the West Coast's dominant provider of electricity distribution services. Minimisation of industry costs is sought through the introduction of distribution automation as appropriate and the strict management of all projects to set standards of safety, performance, budget and timing.

The present condition of any distribution line is largely a factor of its age and the environmental corrosiveness of the locations it traverses. Figure 5.2a shows the age profile of distribution lines, by route kilometer.

The construction of lines in the past has often been driven by customer demands and political influences, which has resulted in the seemingly erratic nature of the line ages. The aim of the Asset Management Plan is to normalise the age profile of the system as much as possible by maintaining the average age of the network at approximately half of the weighted service life of the assets. At the same time, the condition of all lines will be carefully monitored to make sure that the integrity and reliability of the network is not unduly compromised.

Network performance, as measured by SAIDI will be one of the key indices in determining whether sufficient maintenance expenditure is provided to sustain the continued levels of operation of the network.

2.5 Target Levels of Service

While ultimately it is customer requirements and financial commitments that drive work that might alter system reliability, the asset management plan is based upon maintaining a constant level of service measured by SAIDI of 110 system-minutes per year . As a result of preferences expressed during Westpower's consultation with its 25 largest customers, alternative combinations of price and quality may be available to customers who commit to a commercial contract.
It should be noted that these statistics could vary significantly from year to year due to the random occurrence of a single major outage, seriously skewing the overall statistic. Further analysis by Westpower will

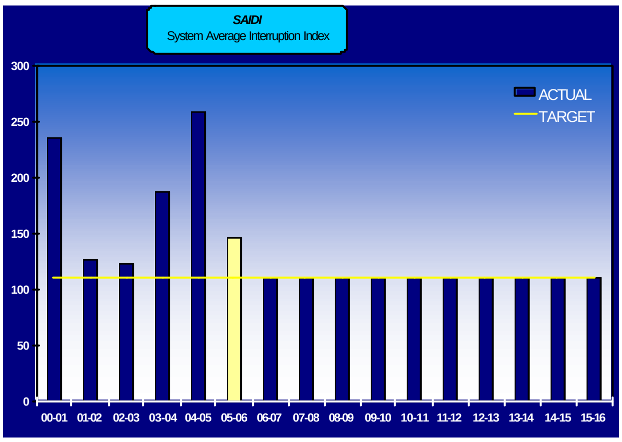
Service Level Performance Summary 1-04-04 - 31/03/05

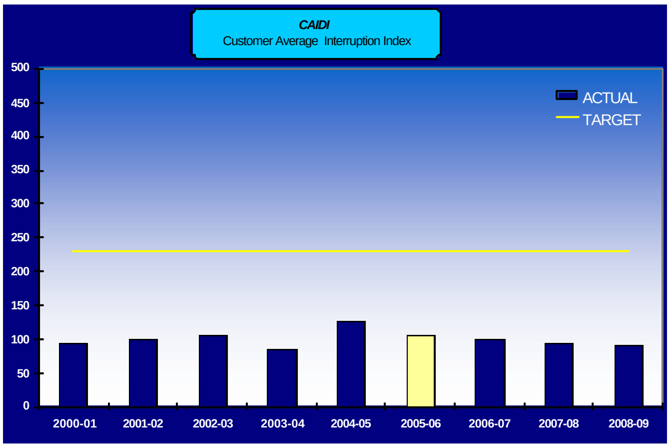
Service Criteria	Quality Group	Target Level of Service	Level of Service	Indicator	Measurement Process
Health and Safety	Safety of staff and contractors	0	0	Number of 'serious harm' accidents	Accident/incident reports
Environment	PCB's	0	0		n/a
	OIl Spillage	0	0	Identification of potential environmental issues	Reporting of environmental incidents
	SF_6 Gas	0	0		SF_6 Gas inspections.
Reliability	Faults/100 km of cct	5.3	7.76		
	SAIDI	110	145.88	Figures disclosed in accordance with the Electricity Information Disclosure Requirements 2004	Westpower network faults, logged as outages occur.
	SAIFI	1.25	1.39		
	CAIDI	88	105.20		
Efficiency	Capacity Utilisation	30	31	% Utilised	Max demand/transformer capacity

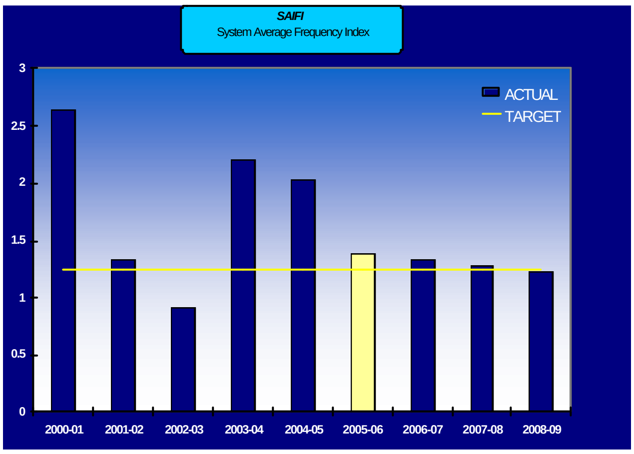
seek to identify trends in underlying system reliability so that appropriate management responses can be taken.

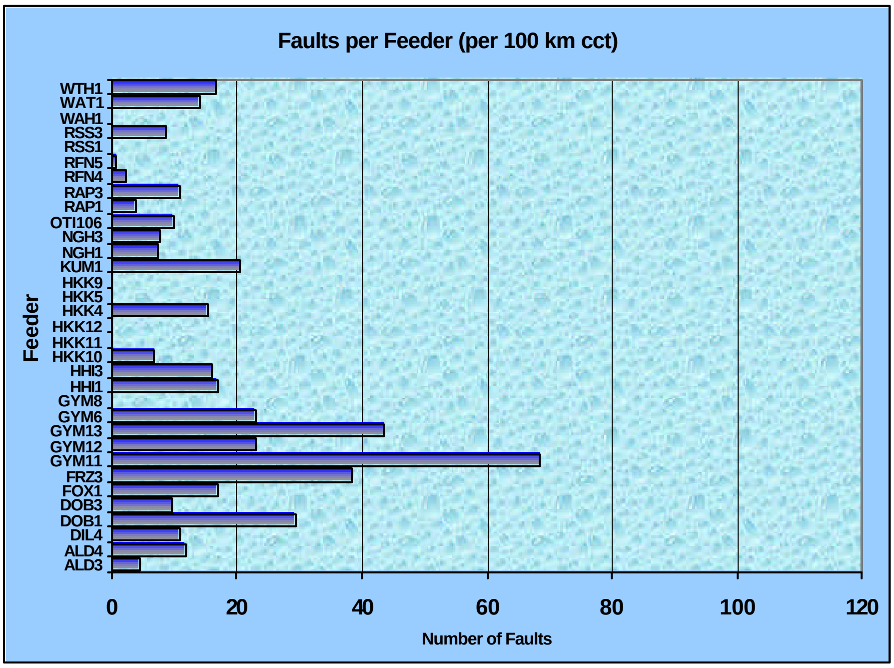
These figures are calculated with the use of the Electrical Network System, which is a module on the

These figures are calculated with the use of the Electrical Network System, which is a software module used to store asset data. This allows for the attachment of individual customer installations to their supply transformer which is attached to to a line segment of a zone transformer feeder. This information is used in the calculation of system minutes lost for each fault on the distribution network.









Sanderson Computer System. This allows for the attachment of customers to their supply transformer and then these transformers are attached to a line segment of a zone substation feeder. This information is used in the calculation of system minutes lost for each fault on the distribution network.

2.5.1 Customer Service Targets

Westpower's Use of Systems Agreements with individual retailers detail the target levels of service for outage notifications, restoration of supply and first time connections to Westpower's network.
Following its customer consultation programme planned for 2005/6, Westpower will be developing further Key Performance Indicators (KPI's) based on feedback received throughout the consultation round as well as a review of current industry best practice in this regard.

Customer Service Targets		
Service Area	**Customers Affected**	**Performance Target**
Restoration of Supply	Urban Areas	Within 3 hours of notification
	Rural Areas	Within 8 hours of notification
	Remote Rural Areas (South of Whataroa	Within 12 hours of notification
Fault Outages	Urban Customers	No more than 2 planned outages per annum No more than 2 unplanned outages per annum
	Rural Customers	No more than 2 planned outages per annum No more than 4 unplanned outages per annum
	Remote Rural Customers	No more than 2 planned outages per annum No more than 8 unplanned outages per annum
Outage Notification	All Areas	Retailers notified at least ten business days prior to a planned network outage
New Connections	Where existing network infrastructure is in place	Connection provided within 5 working days of receiving all statutory approvals.
Complaints Resolution	All Customer Complaints	Written acknowledgement within 2 working days of receipt of complaint. Notification of intended action within 7 working days of receipt of complaint. Outcome provided within 40 working days of receipt of complaint.

2.5.2 Asset Performance and Efficiency Targets

The following asset performance targets are used in the asset management planning process.
Actual performance for 2004/5 was very close to and slightly better than the targets shown above.
The targets chosen have been based on historical performance, industry best practice and regulatory disclosure requirements. In Westpower's case, because of the nature of the geography, social issues which affect both customer and energy density and prevailing climatic conditions, Westpower will never match the results achieved by predominantly urban distribution companies. The targets have therefore been designed to reflect a compromise between best industry practice and the prevailing conditions peculiar to the West Coast

Customer Service Targets		
Service Area	**Measure**	**Performance Target**
Asset Utilisation	Asset Utilisation Factor based on system peak demand and installed distribution transformer capacity	Not to go below 30%
System Losses	High Voltage Network	Not to exceed 5%
	Overall	Not to exceed 8%
Voltage Regulation	High Voltage Network	Voltage maintained within 5% of nominal excluding momentary fluctuations

2.6 Justifying service levels

Our service levels are justified in four main ways…

- By what is "do-able" within our constrained revenue.
- By the physical characteristics and configuration of our assets which are expensive to significantly alter (but which can be altered if a consumer or group of consumers agrees to pay for the alteration).
- By a consumers' specific request (and agreement to pay for) a particular service level. In Westpower's case 83% of large consumers who responded to the recent survey indicated a prefer ence for "paying bout the same to receive about the same". This correlates well with other large consumer and mass- market research that Westpower is aware of. This gives a strong commu nity mandate for maintaining a flat SAIDI projection.
- When an external agency imposes a service level on us (or in some cases an unrelated condition or restriction that manifests as a service level such as requirement to place all new lines underground or a requirement to maintain clearances).

2.6.1 Findings of Consumer Consultation

This section firstly describes the service levels we expect to create for our consumers (which are what they pay for) and secondly the service levels we expect to create for other key stakeholder groups (which our consumers are expected to subsidise).

Our research indicates that our customers value continuity and restoration of supply more highly than other attributes such as answering the phone quickly, quick processing of new connection applications etc. What has also become apparent from our research is the increasing value our customers place on the absence of flicker, sags, surges and brown-outs. However other research that we are aware of indicates that flicker is probably noticed more often than it is a problem.

The difficulty with these conclusions is that the service levels most valued by our customers depend strongly on fixed assets, and hence require CapEx solutions (as opposed to process solutions) to address which in itself raises the following three issues…

- Limited substitutability between service levels eg. our consumers prefer us to keep the power on rather than answer the phone quickly or process new connection applications quickly.
- Averaging effect ie. all consumers connected to an asset will receive about the same level of service.
- Free-rider effect ie. consumers who choose not to pay for improved service levels would still receive improved service due to their common connection.

2.7 Primary Service Levels

Our primary service levels are continuity and restoration. To measure our performance in this area we have adopted the following three internationally accepted indices …

- SAIDI - system average interruption duration index. This is a measure of how many system minutes of supply are interrupted per year.
- SAIFI - system average interruption frequency index. This is a measure of how many system

interruptions occur per year.

- CAIDI - consumer average interruption duration index. This is a measure of how long the "average" consumer is without supply each year.

Projections of these measures for the next five years ending 31 March are set out in Table 2.7.1.(a) below.

Table 2.7.1 (a) - Primary service levels

Measure	2007	2008	2009	2010	2011
SAIDI	110	110	110	110	110
SAIFI	1.25	1.25	1.25	1.25	1.25
CAIDI	230	230	230	230	230

In practical terms this means consumers can broadly expect the reliability stated in the table below.

Table 2.7.1 (b) – Expected reliability by location

General Location	Expected Reliability
Urban	Within 3 hours
Rural	Within 8 hours
Remote Rural (South of Whataroa township)	Within 12 hours

2.8 Secondary Service Levels

Secondary service levels are the attributes of service that our consumers have ranked below the first and second most important attributes of supply continuity and restoration. The key point to note is that some of these service levels are process driven which has three implications…

- They tend to be cheaper than fixed asset solutions eg. someone could work a few hours overtime to process a back log of new connection applications, we could divert an over-loaded phone, or we could improve our shut-down notification process.

- They do not represent sunk costs ie. a person who works a few hours overtime to process a backlog of new connection applications can be easily redeployed to other work. Fixed assets cannot be so easily redeployed.

- They are heterogeneous in nature ie. they can be provided exclusively to consumers who are willing to pay more in contrast to fixed asset solutions which will equally benefit all consumers connected to an asset regardless of whether they pay.

These attributes include…

- How quickly we answer the phone when our consumers call us.
- How quickly we process applications for new connections.
- How promptly and how well we provide technical advice to our consumers.
- Absence of power flicker which is a broad term encompassing a whole range of phenomena such as brown-outs, sags, surges and spikes.
- Do we give our consumers sufficient notice of planned shutdowns?

As of yet, these secondary service levels have not been projected or recorded but are planned for the next period and will be disclosed in all future plans.

Below is a list of these service levels that will be recorded;

1. Phone response;

- Number of rings that we take to answer the phone during normal office hours and under normal operational circumstances.
- Number of rings that we take to answer the phone outside of working hours except under extreme fault conditions.

2. New connections;

- Number of working days to process correctly completed applications for a new domestic or small commercial supply.
- Number of working days to install and liven a new domestic or small commercial supply in the immediate vicinity of existing lines with sufficient capacity.
- Number of working days to install and liven a new large commercial or industrial supply that requires new lines excluding the time required to obtain all necessary resource consents.

3. Provision of technical advice

- Number of working days to acknowledge inquiry.
- Number of working days to investigate inquiry or if the inquiry is a complaint, to validate the complaint.
- Number of working days to provide advice to consumer where the inquiry was not a complaint.
- Number of working days to resolve a proven complaint unless resolving that complaint requires more than minor asset modifications.

4. Power flicker;

- Number of consumers for whom power flicker causes problems with lawfully connected equipment and that problem can be reasonably attributed either to our network or to another consumer.

5.Sufficiency of shutdown notices;

- Number of consumers to whom we fail to give 5 working days notice of a shutdown.

- Number of large consumers whom we fail to also provide half-hour ahead notice of an advised shutdown.

- Number of large consumers that we cannot accommodate their preferred shutdown times.

2.9 Other Service Levels

In addition to the service levels that are of primary and secondary importance to our consumers and which they pay for, we create a number of service levels that benefit our other stakeholders such as safety, amenity value, absence of electrical interference and performance data. Some (in fact most) of these service levels are imposed on us by statute and while they are public goods necessary for the proper functioning of a safe and orderly community we are expected to absorb the associated costs into our overall cost base often with little or no ability to recover those costs through our constrained revenue.

2.9.1 Public Safety

Various legal requirements require our assets (and consumers' plant) to adhere to certain safety standards which include earthing exposed metal and maintaining specified line clearances from trees and from the ground…

- Health & Safety In Employment Act 1992.
- Electricity (Hazards From Trees) Regulations 2003.
- Maintaining safe clearances from live conductors (NZECP34:2001).
- Power system earthing (NZECP35:1993).

2.9.2 Amenity Value

There are a number of Acts and other requirements that limit where we can adopt overhead lines…

- The Resource Management Act 1991.
- The operative District Plan.
- Relevant parts of the operative Regional Plan.
- Land Transport requirements.

In general, we will need to place all new assets underground which is obviously significantly more expensive and also creates reliability levels beyond what consumers generally expect and are prepared to pay for.

2.9.3 Industry Performance

Various statutes and regulations require us to compile and disclose prescribed information to specified standards. These include…

- Electricity Information Disclosure Requirements 2004 and subsequent amendments.
- Commerce Act (Electricity Distribution Thresholds) Notice 2004.

2.9.4 Electrical Interference

Under certain operational conditions our assets can interfere with other utilities such as phone wires and railway signaling or with the correct operation of our own equipment or our consumers' plant. The following code imposes service levels on us.

- Harmonic levels (NZECP36:1993).

Maintenance triggers

Asset category	Components	Maintenance trigger
LV lines & cables	Poles, arms, stays & bolts	-Evidence of dry-rot -Loose bolts, moving stays -Displaced arms
	Pins, insulators & binders	-Obviously loose pins -Visibly chipped or broken insulators -Visibly loose binder
	Conductor	-Visibly splaying or broken conductor.
Distribution substations	Poles, arms & bolts	-Evidence of dry-rot -Loose bolts, moving stays -Displaced arms
	Enclosures	-Visible rust -Cracked or broken masonry
	Transformer	-Excessive oil acidity (500kVA or greater) -Visible signs of oil leaks -Excessive moisture in breather -Visibly chipped or broken bushings.
	Switches & fuses	-Corona discharge monitoring annually
Distribution lines & cables	Poles, arms, stays & bolts	-Evidence of dry-rot -Loose bolts, moving stays -Displaced arms
	Pins, insulators & binders	-Evidence of pin corrosion - rusting/necking of the pins -Visibly chipped or broken insulators.
	Conductor	-Evidence of "birds nesting" following strand/s breaking -Evidence of vibration - fit damper
	Ground-mounted switches	-Evidence of pin corrosion - rusting/necking of the pins -Long rod types chalking if EPDM type
	11 kV Switchgear	-Corona discharge monitoring annually

Maintenance triggers cont...

Asset category	Components	Maintenance trigger
Zone substations	Fences & enclosures	-Monthly checks made of fences with Zone Sub checks, breakages to be made good -Maintenance fitters to monitor corrosion at ground of galvanised support types
	Buildings	-Landscaping - exterior of buildings to be kept tidy - especially gardens and lawn -Foam sandwich type buildings to be washed on an annual basis. Items noted that need repair to have service request raised.
	Transformers	-Annual DGA Oil sampling -Monthly zone sub checks, including Buchholz inspection, insulator integrity, no oil leaks, etc.
	11 kV and 33kV switchgear	-Monthly check of gas pressure, insulator integrity, etc. -Maintenance in line with manufacturers manua
	Instrumentation	-Check calibration with CB release as above, particularly transducer inputs to SCADA
Sub-transmission lines & cables	Poles, arms, stays & bolts	-Evidence of pole movement -Evidence of decay/splitting of timber -Evidence of lightning damage
	Pins, insulators & binders	-Evidence of pin corrosion - rusting/necking of the pins -Visibly loose binder -Visibly chipped or broken insulators.
	Conductor	-Evidence of "birds nesting" following strand/s breaking -Electrical load increasing beyond conductor capacity

3.0 PLANNING FRAMEWORK

3.1 Load Forecasting

3.1.1 Introduction

Typical customer requests relate to issues of capacity, quality and or security of supply and can lead to plans for asset enhancement or development.

The most common upgrade in relation to capacity is that of installation of new or transferred supply transformers at connected points thus providing sufficient capacity to allow for future demand growth.

Supply quality typically includes provision of local voltage support in the form of regulators or capacitors to maintain the steady state voltage within specified ranges.

Alternatively, network analysis including load projections at points of supply, power flows, network and point of supply performance leads to options for consideration by customers and Westpower management.

3.1.2 Historical Drivers

Future load projection is a difficult task and is based on a complex multivariate environment.

Some of the drivers that effect future load include

- climatic conditions
- economic activity
- commodity prices
- foreign exchange rates
- major step load increases/decreases

A relatively warm winter has a significant impact on winter heating loads and as a result has a major effect on the annual peak load.

Overall economic activity, which is to some extent also linked to gold prices and coal markets, has a filter down effect on electricity consumption, and this can take effect slowly over the medium term.

With the relatively small overall demand of 38 MW, major step load changes have a great impact on system demand. Unfortunately these are also the most difficult to predict or quantify as they depend on investment decisions from major industries. Historically, final commitments on these projects have been deferred to a very late stage, often involving significant last minute load revisions, leaving Westpower in a difficult situation from a planning perspective.

A careful and rigorous approach has been taken to developing future load projections based on historical trends, available information and estimates on future changes.

Firstly, load trends at each Grid Exit Point over the previous 7 years are studied to try and identify historic baseline changes. The effects of known step load increases are extracted leaving the underlying long-term historic load profile..

Based on this data, and general knowledge of the local economy and other drivers discussed above, an estimate is made of the likely future trend in load growth on a Grid Exit point basis. This then provides a new baseline for further work.
These trends are used to develop regional forecasts and assist with the development of plans for investment in Transpower's grid, which is normally the binding constraint for new loads on the West Coast.

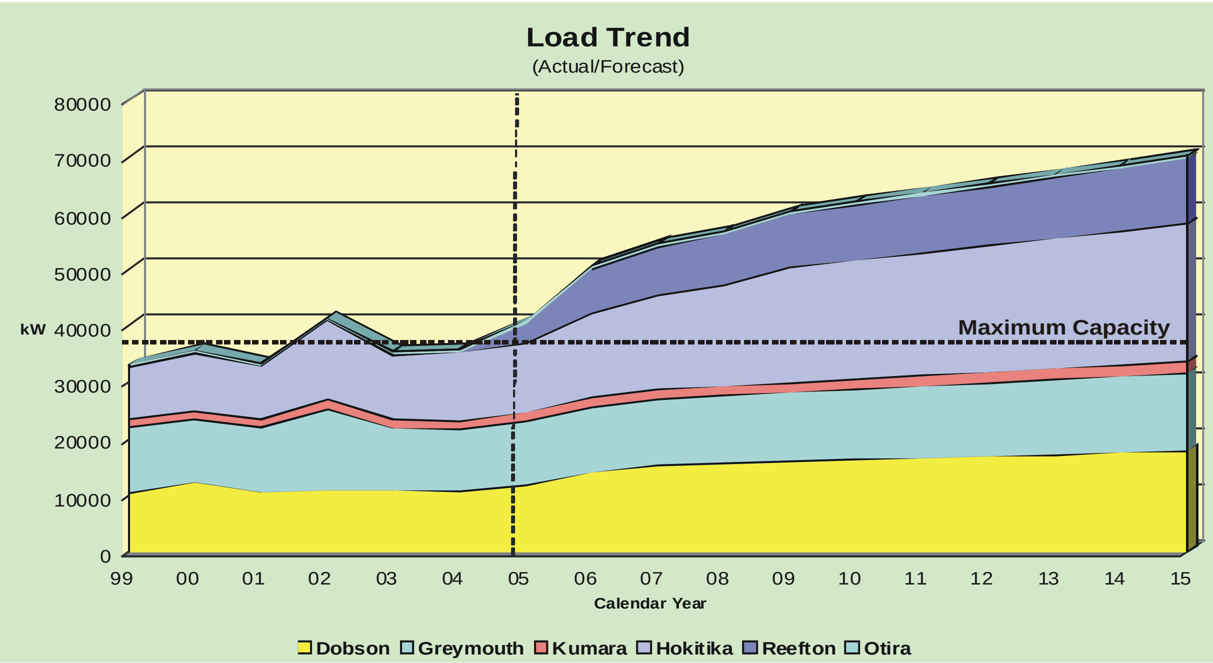


Figure 3.1 Load Trends

3.1.3 Future Zone Substation Load Projections

In addition, load forecasting is carried out at the Zone Substation level and this is critical to ensure that sufficient capacity is available in Westpower sub-transmission and zone substation infrastructure. These forecasts are developed using a zero-based approach from information and requests received directly from customers including intelligence on future load trends such as proposed dairy farm conversions. A summary of the results by major Zone Substation is shown below in 3.1.1

In Westpower's case, most of the sub-transmission infrastructure has been built within the last 20 years and has been prudently designed to cater for future load growth, which means that there is usually ample capacity to cater for marginal load growth, and this is clearly demonstrated in the table. In the event of proposals for major load steps crystallizing, each case is considered in isolation and in combination with other proposals to make sure that the effects fn substation capacity is taken into account.

3.1.4 Future GXP Load Projections

Customer input is sought through forums where major potential users are gathered and provided with updates on current load trends and capacity projections. Following this, each customer or customer group (e.g. tourism) is asked to provide realistic forward load projections based on their specific industry knowledge. This information has proved to be extremely valuable, and the data collected for the current planning exercise has resulted in a significantly increased projection for future loads. This has a direct impact on Westpower's future plans for network reinforcement.

Table 3.1.1 shows the forward load projections for the next ten years based upon the information collected.

Strong economic growth on the West Coast coupled to the dairy, gold and coal mining industries is underpinning a vibrant general economy. Over the next three years this effect is expected to continue, and when added to the large step loads that are projected, the net result is a doubling of Westpower's current load.

Unfortunately, severe constraints currently exist in the transmission network feeding the West Coast meaning that much of the new load must be treated as interruptible as there is insufficient *n*-1 transmission capacity available. Clearly, the consumers involved are very concerned about the potential impacts on their business and are pressing hard for investment by Transpower in additional 110 kV infrastructure, namely a new 110 kV circuit from Reefton to Dobson.

The greatest challenge is determining the likelihood and size of future step changes and this is based to a large extent on discussion with existing or potential large consumers. Early load indications provided by these consumers are often very approximate and are subject to major variation if and when the project proceeds.

The West Coast has a history of premature major development announcements being made, only to fall through when macro environmental changes occur such as the gold price dropping or a change in government policy occurs. For this reason, the projected step load changes must be viewed circumspectly until there is a firm commitment.

Four of the larger industrial customers have indicated they will be requiring significantly increased capacity over the next year including

1. Following a resurgence in gold prices and improvements in the exchange rate, the Birchfield Minerals gold dredge, which was shut down in 2004, is now scheduled for restarting in early 2007. **Estimated Load 1.3 MW**

2 .Oceana Gold Limited is now planning to reopen the Globe Progress open cast gold mine near Reefton in late 2006. **Estimated Load 7.5 MW.**

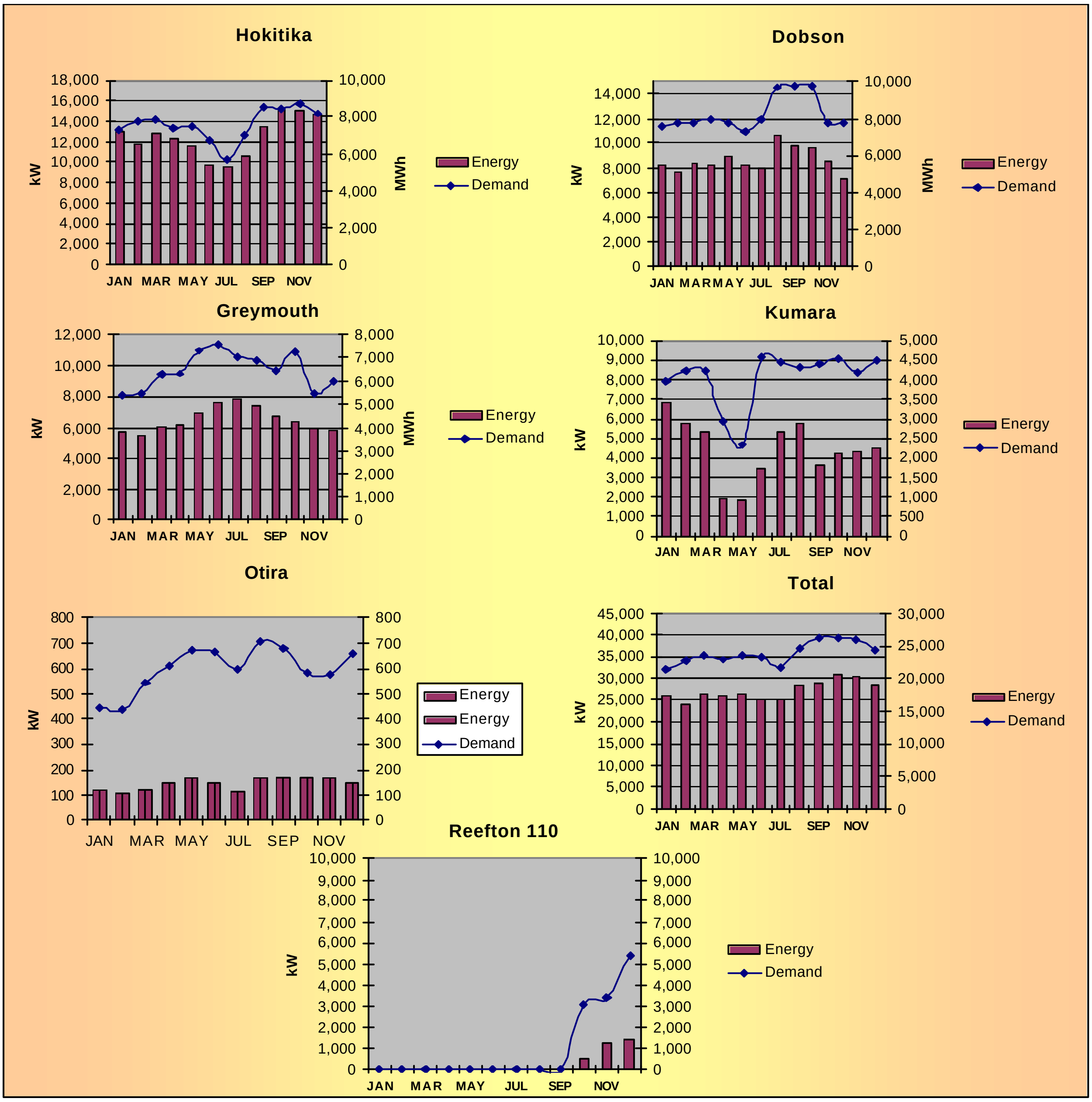
In addition to this it is also investigating additional mining load in the Waiuta area which could add a further 4 MW to this figure, although this is far from committed after a false start in 2005 when the original shaft was found to be damaged beyond repair..

3. The Westland Dairy Products factory at Hokitika is continuing to grow with a new powder plant under construction and due for commissioning by August 2006**. Estimated Load 4 MW**

4. The Pike River Coal Company has begun construction of a new underground coal mine in the Paparoa Ranges near Atarau in the Grey Valley. All of the major road construction and tunneling contracts have been let and a contract signed with Westpower for the provision of electrical reticulation to the mine site. Commissioning is expected in early 2007 with production ramping up over the following 12 months. **Estimated Load 14 MW**

As can be readily noted, the projected *additional* demand over the next three years could potentially reach as high as 30 MW, and considering that the total system demand is around 39 MW with around 24 MW of this supplied by Transpower, the capacity of the transmission network will effectively need to triple of the demand is to be met.

GXP Energy and Demand Statistics - 2005



The following table demonstrates that most of Westpower's Zone Substations have sufficient capacity to deal with expected load growth throughout the planning period, although some substations may require capacity upgrades in around 3 - 5 years. Of course, as these load forecasts are subject to change, and there is considerable uncertainty as to what the load will actually be at the time the upgrade is projected to be required, no further action is planned at this stage other than to keep a close watch on customer's load expectations and maximum demand meter readings.

Table 3.1.1 **Zone Substation Forecast Demand**

Block	Substation	Firm Capacity (MW)	Peak (MW)	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16
	Arnold	5	2.784	2.78	3.08	3.26	3.45	3.64	3.84	4.05	4.26	4.47	4.70
3% Base Growth				0.08	0.09	0.10	0.10	0.11	0.12	0.12	0.13	0.13	0.14
Forecast Growth				0.21	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
Predicted Load				**3.08**	**3.26**	**3.45**	**3.64**	**3.84**	**4.05**	**4.26**	**4.47**	**4.70**	**4.93**
	Dobson	5	1.848	1.85	1.96	2.08	2.21	2.32	2.44	2.57	2.66	2.81	2.97
3% Base Growth				0.06	0.06	0.06	0.07	0.07	0.07	0.08	0.08	0.08	0.09
Forecast Growth				0.06	0.06	0.06	0.05	0.05	0.05	0.02	0.07	0.07	0.07
Predicted Load				**1.96**	**2.08**	**2.21**	**2.32**	**2.44**	**2.57**	**2.66**	**2.81**	**2.97**	**3.13**
	Fox Glacier	5	0.880	0.88	1.13	1.56	1.96	2.12	2.24	2.37	2.44	2.51	2.59
3% Base Growth				0.03	0.03	0.05	0.06	0.06	0.07	0.07	0.07	0.08	0.08
Forecast Growth				0.22	0.40	0.35	0.10	0.06	0.06	0.00	0.00	0.00	0.00
Predicted Load				**1.13**	**1.56**	**1.96**	**2.12**	**2.24**	**2.37**	**2.44**	**2.51**	**2.59**	**2.66**
	Franz Josef	5	1.717	1.72	2.20	2.97	3.66	4.03	4.27	4.51	4.76	5.02	5.26
3% Base Growth				0.05	0.07	0.09	0.11	0.12	0.13	0.14	0.14	0.15	0.16
Forecast Growth				0.43	0.70	0.61	0.26	0.12	0.12	0.12	0.12	0.09	0.09
Predicted Load				**2.20**	**2.97**	**3.66**	**4.03**	**4.27**	**4.51**	**4.76**	**5.02**	**5.26**	**5.51**
	Greymouth	15	11.314	11.31	12.31	14.27	15.01	15.77	16.73	17.36	17.98	18.62	19.27
3% Base Growth				0.34	0.37	0.43	0.45	0.47	0.50	0.52	0.54	0.56	0.58
Forecast Growth				0.66	1.60	0.31	0.31	0.49	0.13	0.10	0.10	0.09	0.10
Predicted Load				**12.31**	**14.27**	**15.01**	**15.77**	**16.73**	**17.36**	**17.98**	**18.62**	**19.27**	**19.94**
	Harihari	1	0.600	0.60	0.72	0.84	0.96	1.09	1.23	1.36	1.50	1.65	1.80
3% Base Growth				0.02	0.02	0.03	0.03	0.03	0.04	0.04	0.05	0.05	0.05
Forecast Growth				0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Predicted Load				**0.72**	**0.84**	**0.96**	**1.09**	**1.23**	**1.36**	**1.50**	**1.65**	**1.80**	**1.95**
	Hokitika	20	15.708	15.71	16.53	17.04	17.58	18.14	25.14	25.93	26.73	27.56	29.60
3% Base Growth				0.47	0.50	0.51	0.53	0.54	0.75	0.78	0.80	0.83	0.89
Forecast Growth				0.35	0.02	0.02	0.04	6.46	0.04	0.02	0.02	1.22	0.02
Predicted Load				16.53	17.04	17.58	18.14	25.14	25.93	26.73	27.56	29.60	30.51
	Kumara	10	1.600	1.6	1.65	0.95	1.03	1.11	1.19	1.28	1.36	1.40	1.45
3% Base Growth				0.05	0.05	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04
Forecast Growth				0.00	-0.75	0.05	0.05	0.05	0.05	0.05	0.00	0.00	0.00
Predicted Load				**1.65**	**0.95**	**1.03**	**1.11**	**1.19**	**1.28**	**1.36**	**1.40**	**1.45**	**1.49**

Table 3.1.1		Zone Substation Forecast Demand (contd)											
lock	Substation	Firm Capacity (MW)	Peak (MW)	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16
	Ngahere	5	2.756	2.76	4.14	4.36	4.59	4.83	5.08	5.33	5.59	5.86	6.13
% Base Growth				0.08	0.12	0.13	0.14	0.14	0.15	0.16	0.17	0.18	0.18
orecast Growth				1.30	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
redicted Load				**4.14**	**4.36**	**4.59**	**4.83**	**5.08**	**5.33**	**5.59**	**5.86**	**6.13**	**6.42**
	Rapahoe	6.25	2.183	2.18	2.40	2.60	2.81	2.92	3.04	3.16	3.26	3.40	3.56
% Base Growth				0.07	0.07	0.08	0.08	0.09	0.09	0.09	0.10	0.10	0.11
orecast Growth				0.16	0.13	0.13	0.03	0.03	0.03	0.00	0.05	0.05	0.05
redicted Load				**2.40**	**2.60**	**2.81**	**2.92**	**3.04**	**3.16**	**3.26**	**3.40**	**3.56**	**3.71**
	Reefton	30	3.300	3.30	11.46	12.11	12.77	13.45	13.91	14.37	14.85	15.35	15.86
% Base Growth				.10	.34	.36	.38	.40	.42	.43	.45	.46	.48
orecast Growth				8.06	0.30	0.30	0.30	0.05	0.05	0.05	0.05	0.05	0.05
redicted Load				**11.46**	**12.11**	**12.77**	**13.45**	**13.91**	**14.37**	**14.85**	**15.35**	**15.86**	**16.39**
	Ross	1	0.480	0.48	0.50	0.87	1.25	1.30	1.34	1.39	1.44	1.49	1.54
% Base Growth				0.01	0.02	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.05
orecast Growth				0.01	0.36	0.36	0.01	0.01	0.01	0.01	0.01	0.01	0.01
redicted Load				**0.50**	**0.87**	**1.25**	**1.30**	**1.34**	**1.39**	**1.44**	**1.49**	**1.54**	**1.59**
	Wahapo	6	2.997	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
% Base Growth				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
orecast Growth				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
redicted Load				**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**
	Waitaha	1	0.240	0.24	0.30	0.36	0.42	0.43	0.44	0.46	0.47	0.48	0.50
% Base Growth				0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
orecast Growth				0.05	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00
redicted Load				**0.30**	**0.36**	**0.42**	**0.43**	**0.44**	**0.46**	**0.47**	**0.48**	**0.50**	**0.51**
	Whataroa	1	0.691	0.69	0.76	0.83	0.91	0.99	1.07	1.15	1.23	1.32	1.41
% Base Growth				0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04
orecast Growth				0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
redicted Load				**0.76**	**0.83**	**0.91**	**0.99**	**1.07**	**1.15**	**1.23**	**1.32**	**1.41**	**1.50**

This projection forms a key driver for investment in sub-transmission infrastructure over the next three years and associated projects are expected to dominate Westpower's capital expenditure program.

Options for Handling Load Increases	
Strategy	**Application**
Economic tariff structure models	These options include demand based tariffs, off peak discounts and penalties for poor power factor. By signaling the true marginal economic costs of network extensions, the consumer is able to respond to these pricing signals by modifying their consumption behaviour and reducing their costs. This is best applied in the case of marginal load growth where optimization of the network is able to unlock its full potential. Power factor penalties are used to encourage industrial loads to correct their power factor, reducing losses and
Demand Side Management	Demand side management is typically applied by means of ripple control switching of interruptible lads such as water heating and night store heaters. Westpower routinely applies this method to reduce regional peak demand, which assists Transpower in managing existing transmission constraints. Large new customers, such as Pike River Coal mentioned above, are required to make their load interruptible to cover post fault contingencies in Transpower's network. Cost effective, but can have a negative impact on the consumer's business, particularly if processes
Line Drop Compensation	On long rural feeders where most of the load is situated toward the middle or far end of the feeder, line drop compensation is a valid means of improving receiving end voltage regulation and maximizing the line capacity. Westpower uses this strategy for its 64 km Hokitika to Harihari 33 kV circuit. This is generally not applicable for 11 kV feeders with distributed load as near end customers would be adversely affected by voltage rise. Cost effective, but only applicable in limited cases.
Distributed Generation	Distributed generation is actively encouraged throughout Westpower's network, but Westpower is reliant on others investing in this technology. Furthermore, unless the generation is very reliable, or sufficiently diverse, the network must still be sized to provide full load without the benefit of generation to cater for times when the generation is unavailable or being maintained. The Fox Glacier Power Station is an example of distributed generation which provides voltage support and additional capacity in a remote area. Distributed Generation is not seen as applicable where it is the only means to supply continuous loads, but may be used by a customer who is happy to put up with occasional interruptions or constraints.
Voltage Regulation	On long 11 kV or 33 kV feeders, voltage constraints can be dealt with by installing either continuously variable or stepped voltage regulators. Westpower applies this technology in areas where either marginal or step loads increases would otherwise result in unacceptable voltage profiles. These are routinely applied in Westpower's 33kV or 11 kV networks, with a recent example being the installation of a combination of regulators and capacitors near Haupiri to cater for a increase in dairy farm loading in the area.
System Reconfiguration	Where significant loads are situated at the end of a meshed feeder, it is sometimes possible to provide enhanced capacity by switching the load to a nearby feeder. In the case of one bulk customer, situated near the tie point between two feeders, a planned load increase will be catered for by spreading the factory load across two feeders. This is very cost effective, but depends very much on factors such as location of the load and therefore has limited application.
Reactive Compensation	This technique involves installing capacitors on the 11 kV distribution network to boost voltage and improve capacity. Westpower uses this technique extensively to support rural feeders and support the transmission grid voltage throughout the West Coast. Since only a certain number of fixed capacitors can be installed throughout the network before voltage rise problems occur, much more expensive switched banks are ten required and the cost benefit balance is shifted. Switched capacitor banks are also used to support large motor starting applications such as the ball mill at Oceana Gold's Reefton Gold Project.
Reconductoring	Reconductoring is usually applied where a line is reaching its thermal capacity limit or losses are very high. The line to Waiuta was recently upgraded to support a planned new gold mine development there which would have exceeded the thermal limit of the existing line. In Westpower's situation, most of the network constraints are voltage related due to the long rural nature of the network and reconductoring has very limited benefit in this situation.
Overlaying with a higher voltage	Upgrading the operating voltage often involves the construction of new zone substations and this additional investment on top of the need to re-arm and re-insulate the associated power line can lead to a very capital intensive solution. In some cases, however, such as the feed into South Westland, this will eventually be required after all voltage regulation and reactive support options have been exhausted

3.1.4 Options for Handling Load Increases

A number of strategies are available for dealing with load increases and include:

Each of these options is carefully evaluated based on economic efficiency and technical performance. Wherever possible, capital intensive development is delayed until absolutely necessary and non-asset intensive solutions used where these are not incompatible with future development plans.

For instance, reactive support and/or voltage regulation is routinely employed to support dairy farming load growth in rural areas as this is far more cost effective than overlaying with a higher voltage.

Where very short timeframes are involved, and permanent solutions are not possible before the load comes on stream, demand side management is often employed by making at least part of the additional load interruptible until a long term solution can be put in place. In the case of Pike River Coal, the new 110 kV circuit could take several years to get through the required regulatory approvals before construction can commence, and so the mine will need to drop most of its load in the event of certain transmission contingencies.

Ignoring such increases, the first three solutions identified above are essentially non-asset intensive

Demand based tariffs give the end user strong incentives to reduce peak demand and maximise plant load factors. This results in less peak demand and better regulation on the Westpower network.

Use of Demand Side Management is linked to the tariff structure and allows the plant or Westpower to control its internal demand by shedding nonessential load at peak periods.

Line Drop Compensation (or LDC) can be used in specific circumstances to boost the sending end voltage on a feeder to improve down line regulation. This effectively increases the available capacity on a feeder. Westpower has also begun a programme of installing capacitors at strategic points in the network where voltage constraints are present or imminent. In some cases, load growth for a particular installation is dependent upon increased reactive support, and the consumer is required to contribute to the capital expenditure involved.

Reconductoring and overlaying with a higher voltage are very asset intensive, and often cannot be justified in terms of the cost involved. In many cases this cost must be borne by the consumer requesting the supply, and becomes their decision in the final analysis.

Distributed Generation is seen as an excellent means of reducing demand on the Transpower network and enhancing the performance of Westpower's distribution network. As such, Westpower actively supports this approach, and a transparent pricing methodology is in place to ensure that there are low entry barriers for new generators, and if large enough that they receive the full avoided cost of transmission benefits that they are entitled to.

Technical requirements for connection of distributed generation are based on the industry standard EEA Guidelines.

Notwithstanding the above comments, the quantum of the increase Westpower is currently facing, as depicted in Figure 3.1.1, means that energy conservation, distributed generation or small renewable generation projects are not, in themselves, viable solutions to the constraints now being faced, but they do improve the quality of supply and reduce the marginal costs and losses associated with transmitting energy into the area.

Any capital expenditure must be fully justified and in normal circumstances such a project is expected to add value to the company by providing a Return on Investment (**ROI**) of at least 7% after tax. Competing projects are compared using Discounted Cash Flow (**DCF**) studies, and this is used to prioritise the order of projects in terms of Net Present Value (**NPV**). This determines which projects can be funded out of a limited capital budget. The consumer must meet any shortfalls if they are the initial drivers for the

upgrade.

As noted above, very large load increases are unable to be handled by the present Transpower transmission infrastructure, which is already voltage constrained. To provide for such load increments a major upgrade to the transmission network and/or further local generation will be required However, as there is no major generation planned in next two years, enhanced transmission is the only viable solution to medium term load growth This will involve the construction of a new 110 kV transmission line from Reefton to Dobson along with a 110/66 kV kV Interconnector at Dobson, all of which is in Transpower's network. The reader is referred to Transpower's Annual Planning Report for more information on this project..

Projections of future loads on the system scenarios have been developed and modified where necessary for this plan. The load growth projections were used as a basis for determining the likely timing of those projects, which are justified by load growth.

3.2 Design Policy and Planning Guidelines

The following design policies act as drivers for Asset Management purposes.

3.2.1 Security Guidelines

The security guidelines are the basis for analysis and for determining the future performance of the distribution system.

The security guidelines adopted for planning purposes are outlined on the following page. Customers who are prepared to enter into commercial agreements can be provided with alternative levels of security

Probabilistic planning techniques are also applicable to network planning processes as power systems behaviour is stochastic in nature, and this has been acknowledged since the 1930's. A justification for the use of this approach is that it instills more objective assessments into the decision making process.

In particular, probabilistic techniques can be used to provide measurable performance indices such as
· System Availability
· Estimated unsupplied energy
· Number and size of of Load Curtailments
· Number of Hours of Interruption
· Excursions beyond set voltage limits

In fact, Westpower has applied this technique to a major transmission line development project commissioned in the late 1990's (the Kumara-Kawhaka 66 kV line) where there were significant costs and security benefits involved with a decision on the final network configuration, and whether the line should be built as a single or double circuit. This was possible because of the very limited network topology involved and the large amount of historical outage data available at the transmission network level and the outcome of the statistical study demonstrated a clear cost-benefit relationship that was applied in the final network design.

While the use of a probabilistic planning approach offers significant benefits in terms of targeted capital expenditure, the proper application of this technique also involves significant investment, both in terms of cost and resources. In particular, the following pre-requisites should be noted
· Competent staff including experienced reliability engineers familiar with the application of probabilistic techniques to power systems
· Accurate and complete historical fault outage records over a large number of years
· Expensive and complex reliability evaluation software packages, user friendly versions of which have only become generally available in the last two years or so

Westpower does not currently consider that the advantages to be gained by applying probabilistic planning techniques are economically viable for the value of projects Westpower is commonly involved with and will therefore, at least in the meantime, continue to apply the simpler and more generally understood deterministic

Table 3.2.1 - Load Trends and Forcasts to 2015/16

	PERCENT INCREASE OR DECREASE																
	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/2013	2013/2014	2014/15	2015/16
Reefton	4.90%	--------	--------	--------	--------	--------	--------	--------	8.97%	5.00%	5.00%	5.00%	3.00%	3.00%	3.00%	3.00%	3.00%
Blackwater	--------	--------	--------	--------	--------	--------	--------	--------	--------	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%
Dobson 33 Delivered	-4.42%	19.89%	-15.05%	4.48%	-0.62%	-1.82%	10.38%	19.88%	8.51%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%
Dobson 33 Received	--------	-93.83%	-100%	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
Greymouth Delivered	13.72%	-4.26%	3.15%	24.06%	-23.43%	1.13%	1.58%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%
Greymouth Received	7.21%	-6.27%	-36.35%	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
Kumara Delivered	3.00%	-1.30%	11.88%	5.77%	-6.57%	-11.80%	20.30%	0.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%
Kumara Received	--------	--------	--------	3.18%	-0.04%	-0.04%	4.42%	-0.73%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Hokitika	-3.74%	10.48%	-9.33%	50.67%	-17.67%	5.52%	1.73%	22.07%	11.26%	7.14%	13.89%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%
Otira	-4.77%	-3.87%	-2.70%	-63.22%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Inangahua	0.00%	0.00%	0.00%	0.00%	0.00%	--------	0.00%	0.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Total Load ex TPNZ	-1.73%	3.86%	10.02%	-8.33%	3.34%	-6.37%	12.41%	26.04%	7.64%	4.06%	6.25%	2.81%	2.51%	2.51%	2.51%	2.52%	2.52%
Total System Load	10.72%	1.03%	6.03%	1.34%	-4.18%	-2.73%	5.70%	20.43%	6.28%	12.39%	4.81%	2.20%	1.97%	1.98%	2.00%	2.01%	2.02%

	Actual kW	Actual kW	Actual kW	Actual kW	Actual kW	Actual kW	Actual kW	Forecast kW	Forecast kW	Forecast kW	Forecast kW	Forecast kW	Forecast kW	Forecast kW	Forecast kW	Forecast kW	Forecast kW
	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/2013	2013/2014	2014/15	2015/16
Reefton	0	0	0	0	0	0	3300	7800	8500	8925	9371	9840	10135	10439	10752	11075	11407
Blackwater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dobson 33 Delivered	10264	12306	10454	10922	10854	10656	11762	14100	15300	15606	15918	16236	16561	16892	17230	17575	17926
Dobson 33 Received	-810	-50	0	0	0	0	0	-705	-683	-660	-638	-615	-592	-568	-500	-400	-300
Greymouth Delivered	11740	11240	11594	14384	11014	11138	11314	11540	11771	12007	12247	12492	12741	12996	13256	13521	13792
Greymouth Received	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Kumara Delivered	1382	1364	1526	1614	1508	1330	1600	1600	1648	1697	1748	1801	1855	1910	1968	2027	2088
Kumara Received	-9632	-9912	-9064	-9282	-9286	-8870	-9262	-9194	-9194	-9194	-9194	-9194	-9194	-9194	-9194	-9194	-9194
Hokitika Delivered	9274	10246	9290	13997	11524	12160	12370	15100	16800	18000	20500	21115	21748	22401	23073	23765	24478
Hokitika Received	544	-612	-426	0	-570	-120	-570	0	0	0	0	0	0	0	0	0	1
Otira	544	570	520	556	594	528	704	600	600	600	600	600	600	600	600	600	600
Total Load ex TP	24454	23204	23968	24842	27642	27420	30824	38850	41820	43517	46234	47535	48728	49951	51207	52496	53819
Total System Load	36103	35075	32435	35940	38550	37172	39291	47317	50287	56517	59234	60535	61728	62951	64207	65496	66819

planning processes shown above.

It is hoped that as probabilistic techniques become more widely accepted in the electricity distribution industry, practitioners become more widely trained and the cost of reliability engineering software continues to reduce that this approach will become economically viable for smaller companies like Westpower.

3.2.2 Voltage Policy

Programmes and projects are typically justified on the basis of the following benefits from improved voltage level or controls:

- the ability to meet any regulatory requirements with respect to voltage standards
- specific customer requirements which the customer is willing to pay for
- savings in losses
- improvements in transmission circuit capacity and the consequential deferment of capital expenditure

Most initial customers were connected to the system at 400 V and Westpower undertake to control this within a range of +/- 6%.

For 11kV and higher voltage customers, the design voltage range is from 96% to 102% of rated voltage.

3.2.3 Voltage Control

Supply Transformers

In order to allow the system to be operated as efficiently as possible, all new Zone Substation transformers will be purchased with on load tap change facilities (OLTC) with HV tapping ranges of -15% to +5%.

Where applicable, Line Drop Compensation techniques are used to improve downline regulation and reduce losses.

Distribution transformers will have off load tapchangers to a range of –7.5%. These will allow greater flexibility in the operation of the main distribution system while meeting the obligations to customers.

Where obligations to existing customers to control the connection voltage level restricts the flexibility of operation of the distribution system then Westpower may replace the supply transformer with one which is better suited to the situation.

Direct Customer Connections

For new customers Westpower will require agreement to the standard tolerances on the system voltage at the point of customer connection.

However if a closer tolerance is required, the customer will be required to pay the additional cost associated with the installation of any voltage control equipment necessary to achieve this.

For existing customers Westpower will continue to observe the agreed supply voltage tolerances by restricting the system voltage variations as far as practicable.

3.2.4 Protection Policy

Protection systems for the Westpower distribution network will be designed to;

- detect faults between phases or between phases and earth
- allow plant to carry rated emergency load without disconnection
- disconnect faulty plant from the system with minimum damage
- disconnect faults quickly enough to avoid system instability
- minimise the likelihood of personal injury or property damage
- minimise supply interruptions
- detect abnormal operating conditions which could result in plant damage
- disconnect only plant item effected
- prevent damage due to faults
- operate reliably as economically justified

Sensitivity

Protection sensitivity will be adequate for each application but not so sensitive that it will result in tripping of circuit breakers unnecessarily at normal load levels.

Abnormal Conditions

For transformers the protection will be set to detect conditions which may lead to overheating and possible failure of equipment. No overload protection will be provided for transmission circuits.

Selectivity

The protection will be set so that when all protective relays and circuit breakers are functioning as designed, the protection system will clear only the faulted equipment from the system.

If a circuit breaker fails to operate correctly, it is desirable that the remaining equipment operates selectively.

Fault Clearance Time

- clearance times will be limited so that damage at the point of fault is reduced to that economically justified by the increasing protection expenditure
- clearance times will be such that the short time rating of equipment is not exceeded
- clearance time will be short enough to ensure that system stability is maintained for all foreseeable fault conditions, where the fault is cleared by the main protection It is desirable that this time is also short enough if the fault is cleared by backup protection

Risk to People

The protection system will always be set to comply with the Electrical Supply Regulations. Particular attention will be paid to providing fast and reliable protection in urban areas.

Security Guidelines for Distribution Planning				
Load (MW)	**Basic Security Level**	**Transmission Circuits**	**Busbars**	**Transformers**
Less than 10	n	One circuit	One Bus or Bus section	4 x 1-phase units or 1 x 3-phase unit, if backed up from alternative supply points
10 to 300	n-1 circuits	Two circuits	Two busbars or bus sections	7 x 1-phase units or 2 x 3-phase units Firm supply of peak demand using any short term overload capacity
More than 300	n-2 circuits n-1 lines	Three circuits on at least two routes	One redundant bus or bus section, such that supply not lost after a single contingency while one bus out of service for maintenance	

Protection Reliability

Protection systems will be designed to have a high degree of reliability because of the extreme consequences of failure to operate.

3.3 Strategic Plans by Area

3.3.1 Reefton Network

In 1999, Westpower extended its 33 kV sub-transmission network in the Grey Valley as far as Reefton and built a new Zone Substation on the Transpower Reefton Substation site. The Reefton area demand is currently within the supply capability of this Zone Substation and associated 11 kV network. The current base demand of 2.3 MW can increase to 3.0 MW before further voltage support measures such as additional reactive compensation are required.

Development of the 7 MW Oceana Gold Limited project at Reefton requires significant strengthening of the supply into the Reefton area. After considerable investigation, the solution chosen is for Westpower to construct a new 2 x 20 MVA 110/33/11 kV Zone Substation at Reefton fed by two 110 kV lines from Inangahua. One of these lines is the existing Transpower DOB-IGH 66 kV circuit, which is in the process of being upgraded to 110 kV, and the other is a new 110 kV spur from Inangahua to Reefton which is currently being constructed by Westpower.

This work has been designed to be compatible with Transpower's own transmission development in the area to ensure that the greatest shared benefit accrues to consumers in the area in terms of both capacity and security.

The future 11 kV distribution capacity to the Ikamatua area is limited by voltage support considerations and will become constrained when load growth of around 200 kW is realised. A new 33/11 kV 3 MVA Zone Substation will be required at Blackwater to provide an additional 1500 kW of demand for the Waiuta Gold Mine currently being developed by Oceana Gold.

3.3.2 Greymouth Network

Several significant coal-mining projects are in the planning stages including the Pike River Coal Company development in the Paparoa Ranges and further development of the Solid Energy Spring Creek Mine near Rapahoe. The estimated loads for these projects are 5 MW for Pike River and an additional 1 MW for Spring Creek. In addition, base load growth, and continuing expansion in the exotic timber milling and tourism industries will require significant capacity increases in the short term. The existing Westpower 33 kV subtransmission network can support these loads, however, this does not also hold true for the old 66 kV transmission network into the West Coast, which is severely constrained.

Accordingly, the West Coast Grid Reinforcement Project (WCGR) has been launched, in co-operation with Transpower, to provide significant additional and secure transmission capacity into the area. This involves the construction of a new single circuit 110 kV line from Inangahua to Dobson that will be operated as part of Transpower's national grid. Contemporaneously, Transpower are upgrading their existing Dobson-Inangahua line to 110 kV, as well as installing a 110/66 kV interconnecting transformer bank at Dobson. This will result in significantly improved transmission capacity and security with two route-diverse 110 kV transmission lines into the central West Coast region.

This development has been allowed for in the design of the Transpower Dobson Substation which was commissioned in 1995

To support the more demanding communication requirements of the transmission development projects, a new digital radio backbone is being installed, initially serving the Greymouth and Hokitika areas, but designed to be extended to other areas of the network as required. This will replace aging analogue UHF radios that have become technically obsolete.

Older distribution lines will be repaired and refurbished as required by ongoing condition assessment.

Voltage support measures including the installation of both capacitors and voltage regulators will continue to be applied at strategic points in the network to maximise performance of the existing assets, improve power quality and reduce marginal losses.

3.3.3 Hokitika Network

The recent completion of the Westland Dairy Factory Supply, comprising a new Westpower 2 x 15 MVA 66/33/11 kV substation at the East Town Belt of Hokitika, has vastly improved both the capacity and security of supply to the town of Hokitika and surrounding districts including all of South Westland. This will also provide for continuing expansion at the Westland Dairy Products factory, along with downstream growth in the dairy industry in general, for at least the next ten years.

The dairy factory is likely to continue with plans for major step load increases throughout the planning period and this will require some reconfiguration and possible augmentation of the 11 kV feeder cables into the plant along with changes to the network within the plant itself.

With the exception of some additional strengthening required in the Kokatahi/Kowhitirangi and Ruatapu areas due to industrial and farming growth over the next few years, there is little other major work required within the planning period.

The South Westland Grid Reinforcement Project (SWGR), when it proceeds, will involve an extension of the Hokitika 66 kV bus and provision of an additional 66 kV feeder.

3.4.4 South Westland Network

After the amalgamation of the Grey, Westland and Amethyst Boards in 1972, it was found that the infrastructure assets in South Westland were in a very poor condition. Considerable expenditure has occurred over

the last thirty years to bring the reticulation system up to an acceptable standard.

Notwithstanding the above, significant load growth due to expansion in the tourism industry is currently being experienced and the network is approaching voltage constraint limits under certain operating scenarios. In view of this, system planning studies have identified the need for additional voltage support in the short term, and this will be provided by a mixture of fixed, switched and variable capacitor banks at both 11 kV and 400 V.
In addition, a new 33 kV regulator is currently being commissioned at Harihari, and this will provide for significant additional capacity into areas south of that point including the glacier region.

To support the load growth at Fox Glacier, a new 33/11 kV zone substation was recently constructed in the area and the existing line from Franz Josef to Fox Glacier upgraded to operate at 33 kV

Major step load increases are expected in the Franz Josef area as a burgeoning tourism industry begins to invest heavily in new accommodation units. This has been made possible by the recent development of several large, new subdivisions in the area.

Depending upon actual load growth, it is possible that the South Westland Grid Reinforcement Project (SWGR) may be implemented toward the end of the planning period and this will involve upgrading the Hokitika-Harihari line to 66 kV along with conversion of the Waitaha and Harihari Substations to 66 kV operation. A possible variation to this plan involves the option of supplying the relaitive small Waitaha load at a lower voltage from nearby Ross.

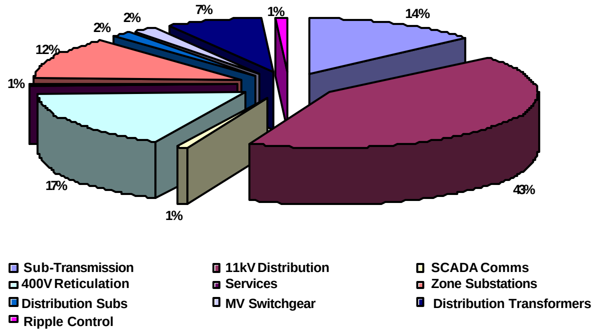
Security of supply is always going to be a major concern in this area as it is fed by a very long single circuit line and the benefit of alternative supply from local generation, particularly from TrustPower's Wahapo Power Station, is fast becoming eclipsed by load growth. The only practical and economic solution is to encourage more local generation in the area.

4.0 ASSET DESCRIPTION

Westpower owns electricity reticulation assets that are used to provide distribution and connection services to electricity retailers and generators. These assets generally comprise equipment that is common to all New Zealand Electricity lines businesses and wherever possible, industry standard assets have been employed. In particular, the Asset Management Plan covers the electricity and associated systems owned by Westpower, comprising:

- *Sub-transmission Assets* - Electric lines and cables, including associated easements and access ways operating at voltages of 33 kV and higher;
- *Distribution Assets* - Electric lines and cables, including associated easements and access ways oper ating at a voltage of 11 kV;
- *Reticulation Assets* – 400 V electric lines and cables, including associated easements and access ways;
- *Services* – Connection assets at any voltage owned by Westpower for the purpose of supplying a single customer. (not including the line on the customer's premises)
- *Zone Substations* – High voltage substations connected to the sub-transmission network. This includes all plant and equipment within the substations such as transformers, switchgear, structures and buswork, SCADA, protection and metering equipment, together with station land and buildings;
- *Distribution Substations* – Substations connected to the distribution network. This includes plant and equipment within the substations such as fuses, platforms, lightning arrestors and Maximum Demand Indicators, together with land and fibreglass covers, but excludes transformers;
- *MV Switchgear* – Circuit breakers, reclosers, sectionalisers, regulators and disconnectors used in the distribution and sub-transmission systems;
- *SCADA, Communications and Protection Equipment* – SCADA, Communications and Protection Equip ment and associated facilities not installed at Zone Substations . This includes Control Room equip- ment, radio repeaters and fibre optic systems installed, owned and maintained by Westpower;
- *Distribution Transformers* – Standard transformers used in distribution substations ranging from 5 kVA to 1000 kVA and generally having a primary voltage of 11 kV.
- *Ripple Control* – Ripple Injection Equipment.

The size and complexity of Westpower's fixed asset base is considerable when compared to other businesses such as retail chains and serves as a major differentiator for this company and other utility organisations.



ODRC - Optimised Depreciated Replacement Cost

Westpower own assets throughout the length of the West Coast of the South Island, and its area extends about as far as the distance from Christchurch to Dunedin as shown in Figure 4.0a

Figure 4.0a, New Zealand

4.0.1 Transpower Grid Exit Points

Westpower takes supply from five Transpower GXPs at 66 kV, 33 kV and 11 kV as shown in the table below. Maintenance of these GXP's is Transpower's responsibility.

GXP Capacity and Load Profile					
Grid Exit Point	Asset Owner	Voltage (kV)	Capacity (MVA)	Firm Capacity (MVA)	Present Maximum Demand. (MW)
Greymouth	Westpower	66	20	14	12.26
Hokitika	Westpower	66	30	20	14.60
Kumara	Westpower	66	10	0	10.00 (injected)
Dobson	Transpower	33	20	20	13.02
Otira	Transpower	11	5	0	0.56
Reefton	Westpower	110	40	30	2.5

4.1 Sub-transmission Assets

Westpower owns two distinct classes of sub-transmission assets, running at 66 kV and 33 kV respectively. The 66 kV assets are leased back to Transpower for operation as part of their West Coast transmission network.

4.1.1 Asset Justification

Subtransmission assets, either at 66 kV or 33 kV, are required to transmit high levels of electrical energy over significant distances, prior to breaking the voltage back down to 11 kV for local distribution. The long distances involved in reticulation of electricity on the West Coast mean that these assets are essential for the capacity and load diversity involved.

4.1.2 66 kV Lines

DRC - $ 2,074,730
ODRC - $ 2,074,730

Westpower owns three overhead 66 kV sub-transmission lines. Two of these are connected to the Westpower Kumara Substation, while another is an extension of the Transpower owned TMR-OTI circuit. Figure 4.1a shows the locations of these assets.

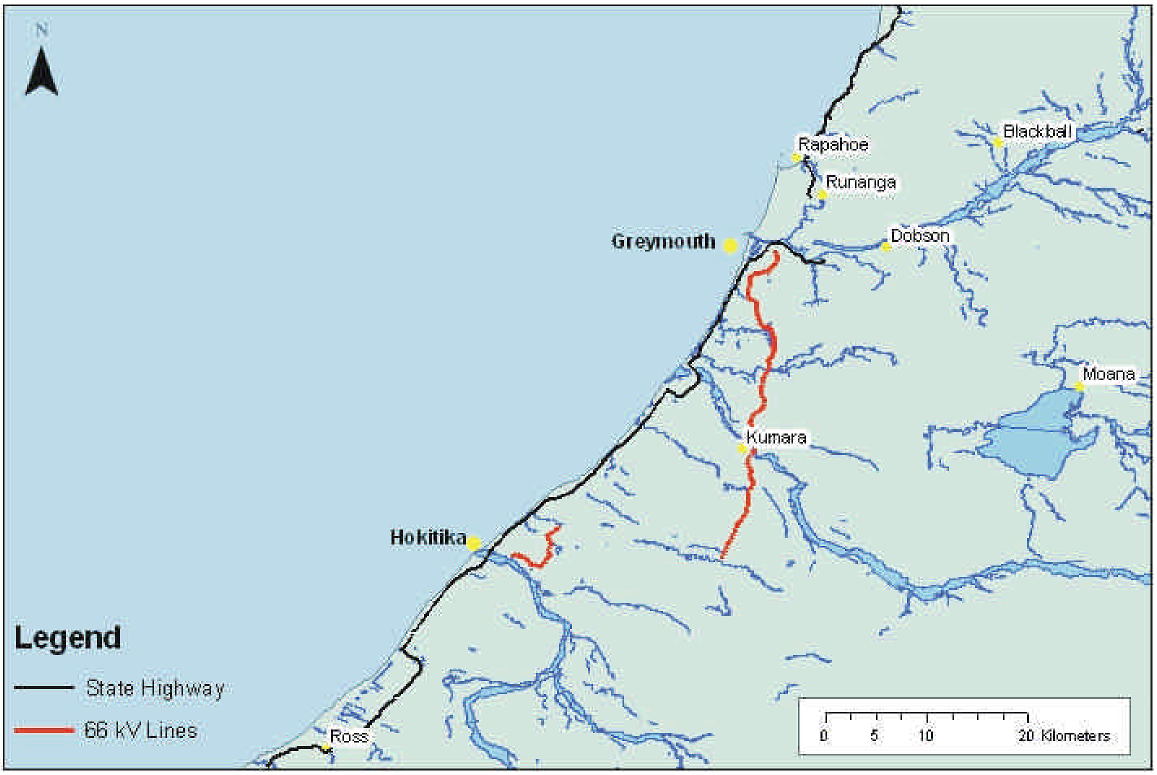


Figure 4.1a - Westpower's 66 kV assets

As discussed above, all three of these assets are currently leased to Transpower on a long-term lease arrangement.

The line between Greymouth and Kumara is a 25 km hardwood-pole line strung with Dog ACSR conductor. This was constructed in 1977 to connect the Kumara Power Station to the Westpower Greymouth Substation and then to the Transpower Grid.

Table 4.2a: 66 kV Lines Summary	
Type	Route Length (km)
Light Overhead	0
Medium Overhead	42
Heavy Overhead	0

The 66 kV double-circuit treated hardwood pole line between Kumara and Kawhaka was commissioned in 1997, and this was subsequently leased to Transpower, allowing them to reconfigure the grid on the West Coast. The line is 11km long and uses Iodine AAAC conductor on both circuits.

The most recently constructed 66 kV line, between Two Mile and Hokitika substation, was completed

in July 2002. This too is a double circuit line, however pre- stressed concrete poles have been used to support the 7.8 km of Iodine AAAC conductor.

Westpower has no underground cables at transmission voltages of 66kV and above.

4.1.3 33 kV Lines and Cables

DRC - $6,556,784
ODRC - $6,556,784

There are two general areas served by Westpower's 33 kV sub-transmission network, one based around the Dobson and Grey Valley areas and the other serving South Westland

Figures 4.1c and 4.1d show the geographical spread of these two assets.

Figure 4.1c Northern 33 kV

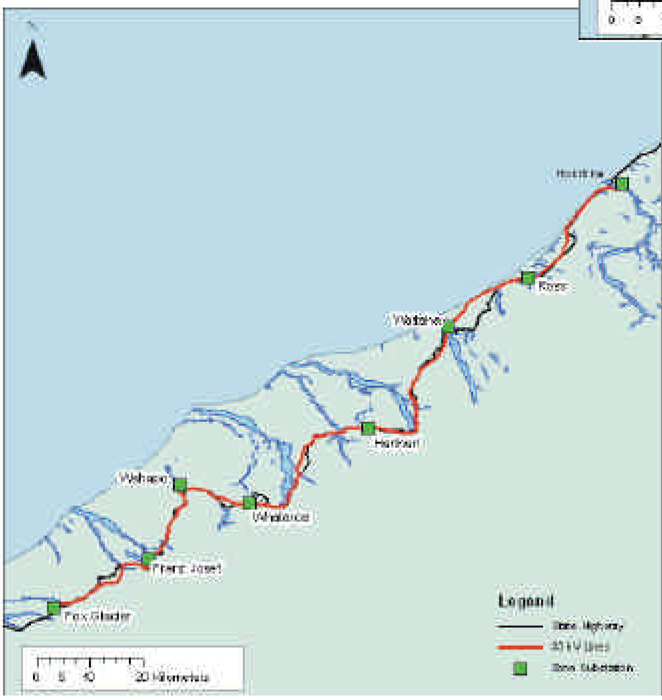


Figure 4.1d Southern 33 kV Network

Table 4.2b: 33 kV Lines Summary

Type	Route Length (km)
Light Overhead	168
Medium Overhead	0
Heavy Overhead	0

The Transpower Dobson Point of Supply serves as the hub of the northern sub-transmission system and is used to feed substations at Rapahoe, Ngahere, Reefton and Arnold. The line to Arnold was originally built in the 1930's and uses 7/.080" copper conductor.

Except for a short length of Mink ACSR line over Mt Hercules and some fully insulated 33 kV overhead line in South Westland, the rest of the sub-transmission lines are strung with either Dog ACSR or Iodine AAAC conductor.
The 33 kV sub-transmission line from Hokitika to Harihari, originally constructed in 1966, was purchased from Transpower. The large majority of the remaining 33 kV assets have been constructed since 1983 and are mainly of concrete pole construction.

Westpower uses some short lengths of PILCSWA 33 kV underground cable as feeder cables at its Dobson Substation.

4.1.3.1 Aerial Bundled Conductor (ABC) and Hendrix Cable Systems

In South Westland, there are two sections of fully insulated 33kV overhead conductor. The first is a fully insulated cable, which is bundled together to form three phases, and then suspended be-

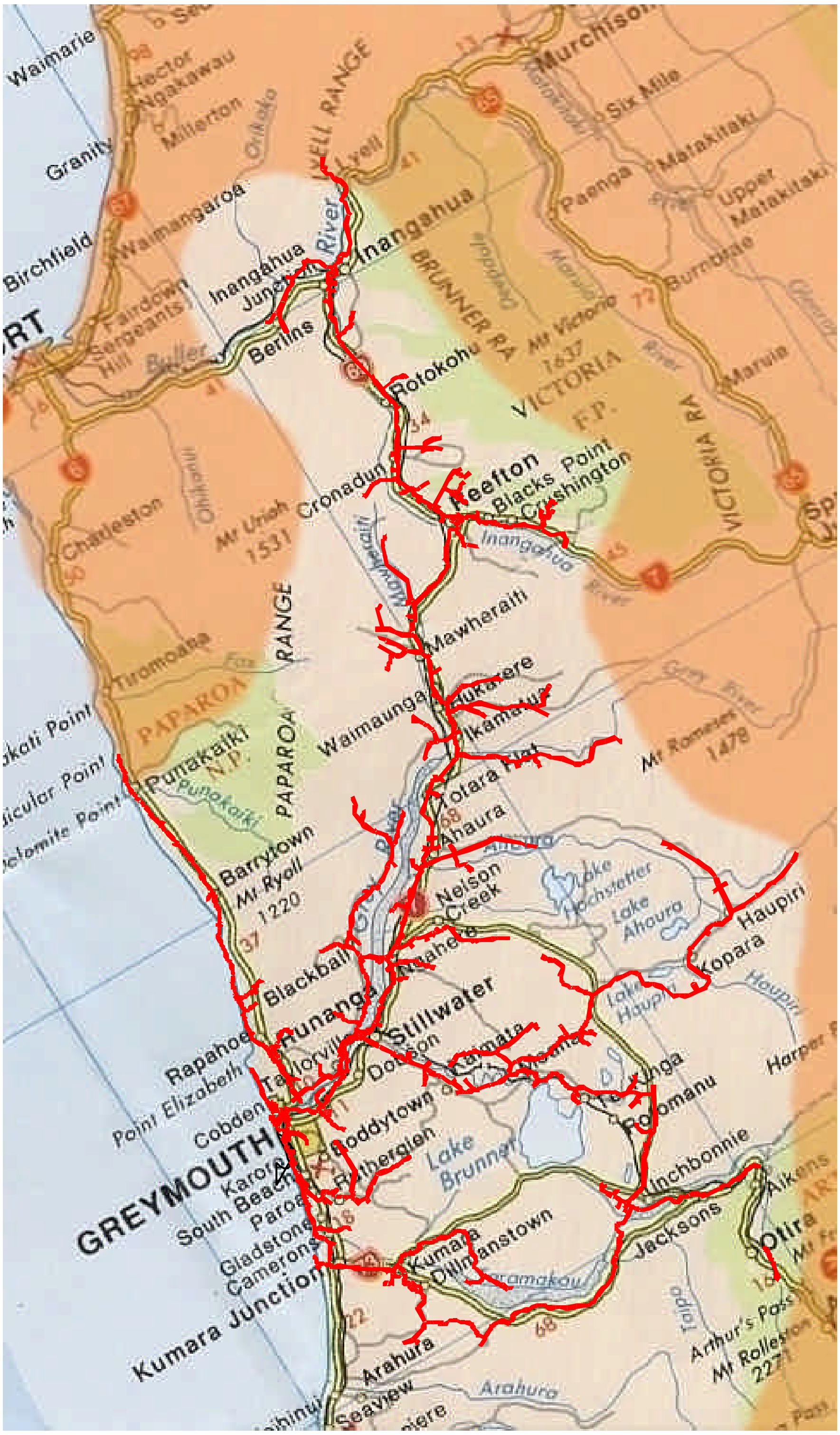


Figure 4.2a - Northern section of Westpower's distribution line assets

Figure 4.2b - Southern section of Westpower's distribution line assets

tween poles.

By using this specialist conductor, Westpower was able to mitigate the environmental effects on a sensitive environment with high scenic values. In fact, this line runs through a National Park. A 2 km stretch of cable runs close to Lake Wahapo. Following reliability problems a 3.6 km section of ABC cable that traverses Lake Mapourika in South Westland was replaced with a Hendrix Cable in 2000 . This is often called Spacer Cable construction, and uses three separate, fully insulated conductors, held apart by insulated spacers.

4.2 Distribution Assets

DRC - $ 25,183,835
ODRC - $ 24, 988,272

Electric lines and cables, including associated easements and access ways operating at a voltage of 11 kV make up the bulk of Westpower's infrastructure assets, in terms of both value and number.

Figure 4.2a and 4.2b on the previous pages show the extent of Westpower distribution line assets spread throughout the length of the West Coast.

Table 4.2c: 11 kV Lines Summary

Type	Route Length (km)
Light Overhead	1152
Medium Overhead	294
Heavy Overhead	4

4.2.1 Asset Justification

These are core assets for lines businesses and comprise the distribution lines and cable that deliver electricity at 11 kV to the distribution substations that supply 415 V or 230 V to individual installations. These assets are therefore essential to the operation of the network.

4.2.2 11 kV Overhead Lines

Table 4.2c above lists the total overhead distribution line assets owned by Westpower Westpower owns a large variety of distribution lines and cables that cover a wide age profile. Overhead lines cover three broad groups including

- Early hardwood pole lines
- Concrete Pole lines
- Treated Softwood Pole lines

Since 1972, most of the major lines have

Figure 4.2e – Modern Pole Construction

been reconstructed with concrete poles and AAAC or ACSR aluminium conductors. Notwithstanding this, there are some notable exceptions such as the Fox-Paringa and Coast Road lines which used treated softwood poles for environmental and constructability reasons.

All of the major 11 kV feeder distribution lines have been completely rebuilt over the last 25 years and this has resulted in a few remaining pockets of earlier hardwood lines in the Greymouth and Reefton areas.

Softwood or concrete poles are used for all replacement or new construction work and these types make up over 60% of the pole population. An example of a modern construction is shown in Figure 4.2e

The insulators consist of porcelain pin insulators and a mixture of porcelain, glass and polymer strain insula-

Table 4.2e Summary of Distribution Line Components

Components		**No.**	**%**
Structures (11 kV)			
Poles-Wood	Hardwood	3423	24.3%
	Silver Pine	33	.2%
	Softwood	1019	7.2%
	Larch	14	.1%
Poles-Concrete	Hokitika	3066	21.7%
	Stresscrete	6511	46.1%
	Spuncrete	10	0.1%
	Buller	24	0.2%
Total Structures		**14099**	**100.0%**
Crossarms			
	11 kV	26599	65%
	400 V	12676	31%
	Service	1400	3%
Total Crossarms		**40675**	**100.0%**
Conductors and Accessories			
	11 kV Conductor (km)		1480
	400 V Conductor (km)		83
Insulators	11 kV	10008	53%
	400 V	83499	45%
	Service	3704	2%
Total Insulators		**187211**	**100.0%**

tors. Westpower has used stand-off post insulators in some environmentally sensitive areas. Apart from these sections however, conventional overhead construction is widely employed.

4.2.3 11 kV Distribution Line Components

Table 4.2e summarises the present numbers of specific distribution line components.

4.2.4 11 kV Cables

Cable makes up a very small portion of Westpower's total high voltage assets, and is generally limited to Central Business Districts or Zone Substations. There are however some exceptions to this, such as the recreational areas of Moana and Punakaiki.

Throughout the 1980's, Westpower had a policy of undergrounding urban areas and this resulted in a significant amount of the overhead reticulation in those areas being replaced. As a case in point, the majority of Hokitika is reticulated underground, and underground high voltage cables are used throughout the CBD and near the airport.

While some of the older 11 kV cables around Greymouth were installed in the 1950's, many of these have since been overlaid or replaced with modern equivalents. Paper insulated lead sheathed cable was the standard for normal distribution purposes until the mid-1980's when XLPE insulation gradually came into vogue.

Table 4.2d: 11 kV Undergound Cable Summary

Type	Route Length (km)
Heavy Underground	0
Medium Underground	13
Light Underground	33

4.3 Reticulation Assets

DRC - $ 6,199,094
ODRC - $ 6,199,094

These assets include 400 V overhead lines and cables used to reticulate electricity to the boundary of consumer's premises.

4.3.1 Asset Justification

Once the electricity is broken down from 11,000 Volts to 230 Volts at distribution substations, the 400 volt reticulation assets comprising overhead lines and cables are necessary to deliver electricity to the boundaries of individual installations. As such, these assets are a core part of Westpower's network.

4.3.2 Overhead 400 V Lines

Westpower uses a conventional overhead low voltage configuration with insulated conductors and cross-arms; Aerial Bundled Cable (ABC) construction techniques are not employed.

In terms of conductor selection, copper was used extensively until the mid-1970's, but was gradually replaced with PVC covered aluminium because of economic and constructability considerations.

Virtually all of the low voltage networks from Hokitika south, and some within the urban area of Greymouth have been replaced in the last twenty years with underground cable. Long lengths of low voltage line in the satellite towns of Greymouth including Cobden, Blaketown and Runanga were rebuilt with new overhead LV construction in the 1990's.

However, in some older areas such as the towns of Dobson and Reefton, there are still sections of older wood-pole low-voltage reticulation.

Table 4.2e: 400 V Lines Summary

Type	Route Length (km)
Light	66
Medium	35
Heavy	0

4.3.3 Underground 400 V Cables

A variety of underground cable types have been used for low voltage reticulation spanning a period of some 30 years.

In the early days, single-core aluminium cables, with either a stranded or solid core was widely used. Over time however, multi-core cables became popular because of the cost advantages.

A standard cable now used in residential areas is 95mm^2 stranded aluminium with a copper neutral screen. For denser CBD areas such as the town of Greymouth, four-core 185mm^2 cables were used.

Currently, all new urban subdivisions are reticulated underground as a requirement of the appropriate District Plan.

4.4 Services

DRC - $637,380
ODRC - $637,380

This asset consists of the equipment used to connect approximately 11,850 consumers to Westpower's network.

The major component of this asset is the service protective device, which may be one of the following

- 400 V rewireable pole fuse
- 400 V HRC pole fuse
- 11 kV Drop-Out Fuse

- 11 kV Circuit Breaker

In the last case, the consumer would own the 11kV circuit breaker and in this situation the connection asset would be an 11kV disconnector.

The service line on the premises of the consumer is owned and maintained by the consumer.

4.4.1 Asset Justification

Services include assets required to make the final connection between the customer's installation and Westpower's network. These are necessary for an individual customer to take supply from Westpower.

4.5 Zone Substations

DRC - $ 11,810,454
ODRC - $ 11,786,895

Zone Substations are used to transform power from transmission and sub-transmission voltages of 33kV and higher down to Westpower's standard distribution voltage of 11 kV.

These substations comprise buildings, switch-yard structures and associated hardware, high voltage circuit breakers, power transformers, instrument transformers, and a multitude of other associated power supply cabling and support equipment. Furthermore, the substations range in size from 1 MVA to 20 MVA and are used to feed large areas of Westpower's network thus playing a critical role in the overall reliability of Westpower's network.

Fig 4.5a shows the location and size of Westpower's 15 Zone Substations.

Fig 4.5b show Westpower's Zone Substation at Greymouth which houses two 10 MVA 66/11 kV transformer banks and was constructed in 1977.
The latticework steel structure is unique within Westpower's area and reflects the common standards used by Transpower at the time.

The high voltage bus and equipment in this substation is leased to Transpower for operation as part of the national grid.

At the other end of the scale are the 1 MVA 33/11 kV substations utilised at sites such as Whataroa Substation and this is shown in Fig 4.5c.

Installations at Harihari, Ross and Waitaha use similar standard designs to the Whataroa site.

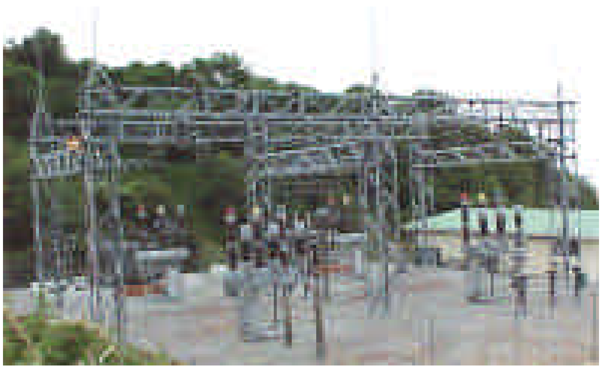


Figure 4.5b – Greymouth Zone Substation

These substations use a small transformer with an external regulator for economic reasons.

Furthermore, they were constructed in the early 1990's and utilise modern construction techniques.

Westpower also owns a number of nominal 5 MVA substations, which are similar to the Arnold construction shown in Fig 4.5d

These substations use On Load Tapchangers (OLTC) and were constructed between 1984 and 1998. Sites included in this classification are Reefton, Ngahere, Arnold, Rapahoe, Wahapo and

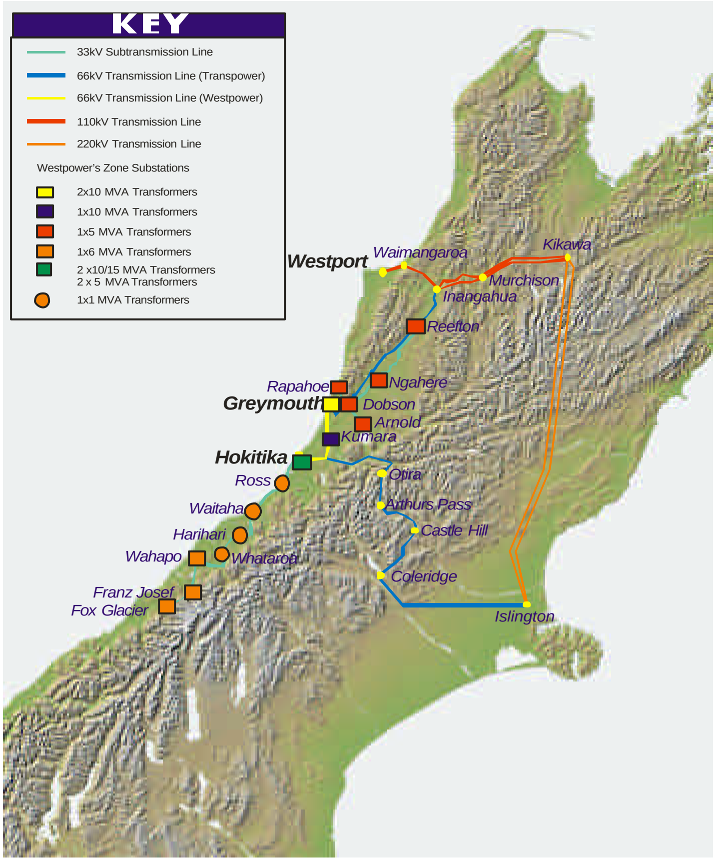


Figure 4.5a - Westpower's Zone Substations

Franz Josef.

All Zone Substations are connected to Westpower's SCADA system for alarm monitoring and remote control operation.

Westpower also owns a number of nominal 5 MVA substations, which are similar to the Arnold construction shown in Fig 4.5d

These substations use On Load Tapchangers (OLTC) and were constructed between 1984 and 1998. Sites included in this classification are Reefton, Ngahere, Arnold, Rapahoe, Wahapo and Franz Josef.

All Zone Substations are connected to Westpower's SCADA system for alarm monitoring and remote control operation.

4.5.1 Asset Justification

Zone Substations are required to break down subtransmission voltages (66,000 volts and 33,000 volts) to the local distribution voltage of 11,000 volts. These assets form an integral part of the supply chain and are strategically spread throughout Westpower's area

Figure 4.5c – Whataroa Zone Substation

4.5.2 Power Transformers

Westpower has 19 power and earthing transformers installed at its Zone Substations, (as opposed to distribution transformers, which are used in Distribution Substation).

Zone Substaion Capacity and Load Profile					
Grid Exit Point	Asset Owner	Voltage (kV)	Capacity (MVA)	Firm Capacity (MVA)	Present Maximum Demand. (MW)
Greymouth	Westpower	66	20	15	11.31
Hokitika	Westpower	66	30	20	15.71
Kumara	Westpower	66	10	0	5.07
Dobson	Transpower	33	20	20	1.85
O tira	Transpower	11	5	0	0.56
Reefton	Westpower	110	40	30	2.5
Ngahere	Westpower	33	5	0	2.76
Arnold	Westpower	33	5	0	2.78
Rapahoe	Westpower	33	5/6.25	0	2.18
Ross	Westpower	33	1	0	0.48
Waitaha	Westpower	33	1	0	0.69
Harihari	Westpower	33	1	0	0.6
W hataroa	Westpower	33	1	0	0.24
Wahapo	Westpower	33	6	0	3
Franz Josef	Westpower	33	5	0	1.72
Fox Glacier	Westpower	33	5	0	0.88

Of these, 11 are fitted with on-load tapchangers.

Table 4.5.2 gives the general details of the power transformer population.
Most of the larger (above 1 MVA) power transformers are three phase units fitted with on-load tapchangers.

Earthing transformers are used at Zone Substations connected to generating stations to provide appropriate source earthing requirements. These are high impedance units designed to limit earth fault currents by providing reactance earthing. They also comprise a 400 V secondary to provide local service to the site.

4.5.3 Switchgear

Table 4.5.3 summarises the present asset mix for this equipment used in Zone Substations

4.5.4 Oil Containment

Oil containment facilities have been installed at major substations constructed since 1993, including Dobson, Reefton, Arnold and Hokitika substations. These facilities have also been retrofitted at the Greymouth,

Table 4.5.2 Summary of Zone Substation Transformers

Type	110 kV	66 kV	33 kV	11 kV	Total Units
Power Transformers					
Supply 3 phase	2	5	13	0	20
Subtotal	2	5	13	0	20
Other Transformers					
Earthing	0	0	2	1	4
Regulating	0	0	1	8	9
Subtotal	0	0	3	9	13
Total Transformers	**2**	**5**	**16**	**9**	**33**

Table 4.5.3 Circuit Breakers					
Type	**100 kV**	**66 kV**	**33 kV**	**11 kV**	**Total Units**
Outdoor					
SF6	2	10	2	0	**14**
Minimum Oil	0	2	0	0	**2**
Oil Recloser	0	0	6	0	**6**
Vacuum Recloser	0	0	13	18	**31**
Total Outdoor	**2**	**12**	**21**	**18**	**53**
Indoor					
SF6	0	0	0	4	**4**
Vacuum	0	0	0	24	**24**
Metalclad Panels (Bulk Oil)	0	0	0	3	**3**
Total Indoor	**0**	**0**	**0**	**31**	**31**
Total Circuit Breakers	**2**	**12**	**21**	**49**	**115**

Figure 4.5d – Arnold Zone Substation

Kumara, Wahapo, Rapahoe, Ngahere and Franz Josef Substations.

4.6 Distribution Substations

DRC - $2,988,413
ODRC - $2,988,413

Distribution Substations generally consist of a distribution transformer and associated equipment including

- 11kV Drop Out Fuses
- Lightning Arrestors
- Low Voltage Fuses
- Support Crossarms
- Earthing System

Figure 4.6a - Typical Distribution Substation

Figure 4.6a shows a typical three-phase distribution substation.

The fitting of lightning arrestors is now standard on all substations, and a retrofitting programme over recent years has ensured that virtually every existing substation meets this requirement.

In addition to these items, larger substations rated at 100 kVA and above, such as that shown in Figure 4.6b will often have the following additional components:

- Galvanised Steel Platform
- Maximum Demand Indicator

Because of the extremely corrosive coastal environment that Westpower is confronted with, galvanised steel or coreten tanks are standard for all distribution transformers.

For large substations over 200 kVA, pad-mount construction is normally used, where the transformer is placed on the ground under as shown in Figure 4.6c.

Extra assets required for these substations are

- Concrete pad
- Fibreglass cover
- HV and LV Feeder Cables
- DIN LV Fusegear

Table 4.6d lists the overall range of distribution substation sites, sub-totalled by number and total capacity.

All substation data including servicing records are stored in the Electrical Network System (ENS) and Service Maintenance Management (SMM) System. In addition, all substations are logically linked to individual Installation Control Points (ICPs) for the purposes of outage notifications and network reliability analysis.

4.6.1 Asset Justification

Distribution Substations are required to break down the distribution voltage of 11,000 volts to either 400 volts or 230 volts suitable for supplying individual installations.

4.7 Medium Voltage Switchgear

DRC - $1,468,901
ODRC - $1,468,901

This class of equipment includes:

- Regulators
- Disconnectors
- 11kV circuit breakers
- Reclosers
- Sectionalisers
- Ring Main Units
- 11kV dry fuse units

These are not installed at Zone Substations. (MV switchgear within Zone Substations is included in that classification).

Figure 4.6b - Distribution Substation >100 kVA < 200 kVA

Figure 4.6c - Pad Mount Substation

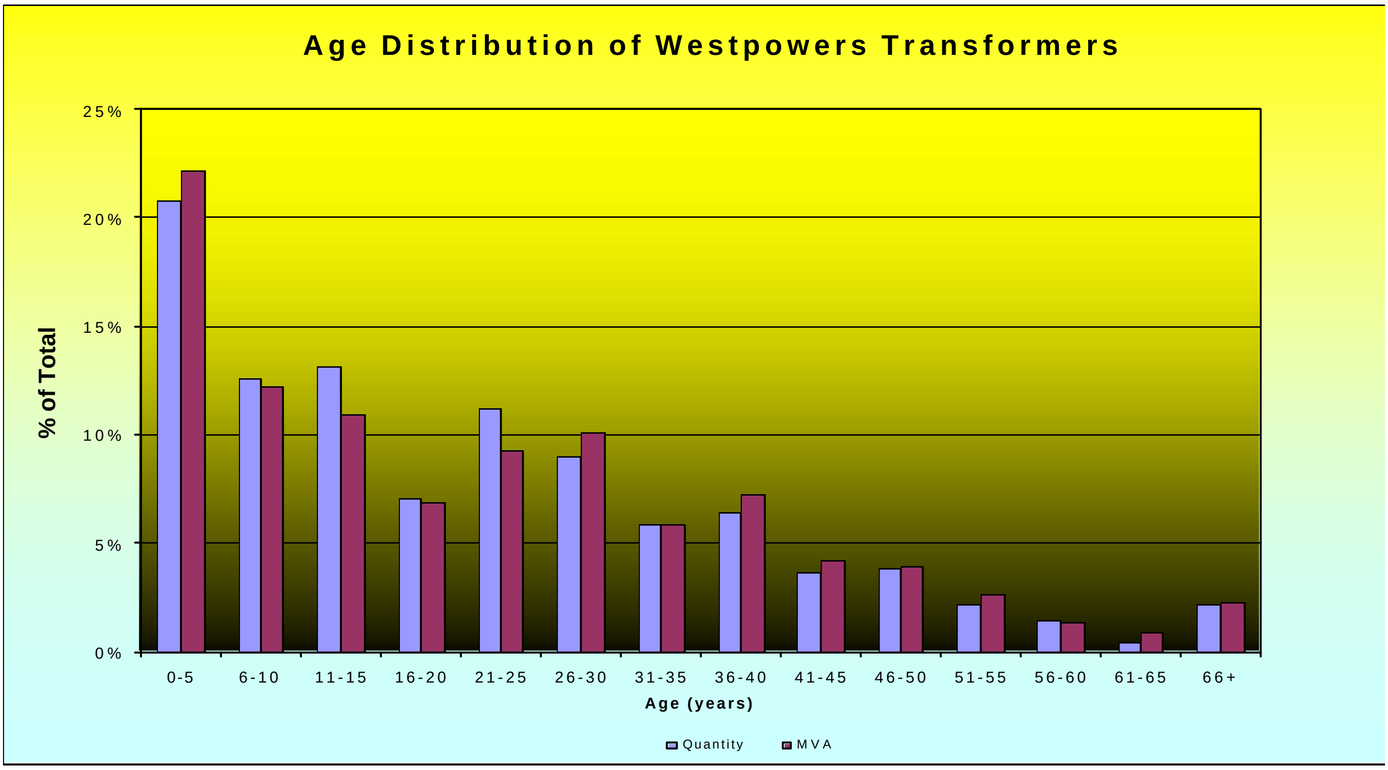


Table 4.6d - Age Distribution of Transformers

Line regulators are installed on long 11kV lines with significant loads near the end. Westpower has such installations at Longford Corner (near Kokatahi), Cronadun (north of Reefton), the Haupiri area and a 33 kV regulator at Harihari.

In general, disconnectors are standard two or three post units made by Schneider (ex Canterbury Engineering), but mainly type DA2. Some units are fitted with "CE Break" load-break heads.

Westpower has used a range of circuit breaker equipment over the last fifty years, but has now standardised on the use of Cooper Power Systems vacuum reclosers and bulk oil sectionalisers, which make up the major

Table 4.7a - MV Switchgear

Type	33 kV	11 kV	Total Units
Disconnectors	2	499	501
Load Break Disconnectors	7	19	26
Motorised Disconnectors	8	19	27
Vacuum Recloser	15	70	85
Ring Main Unit	0	34	34
Dry Switch Unit	0	8	8
Total Units	**32**	**649**	**681**

share of the population.

Small numbers of old 11 kV circuit breakers are still in use as distribution substation HV breakers and in the test bay.

Table 4.7a summarises the present population of MV Switchgear

The Ring Main Units are either Reyrolle or ABB "SD" type and are all less then 25 years old.

Some Hazemeyer dry type equipment has also been installed in the network, but its use is not widespread.

A variant of this equipment made by Krone has been phased out and replaced because of reliability concerns.

4.7.1 Asset Justification

These assets cover a diverse range of devices, but generally include switches of various types that are used to protect and sectionalise the network. In the event of a fault on the network, fuses, reclosers and sectionalisers are needed to isolate the faulted section safely and quickly, and thereby maintain supply to other customers on unfaulted sections of the network. The devices are also necessary to isolate sections of line to allow maintenance to be carried out.

4.8 SCADA, Communications and Protection

DRC - $ 233,333
ODRC - $ 233,333

This includes all communications equipment and radio repeater sites as well as vehicle-mounted equipment and the Supervisory Control and Data Acquisition plant including the Master Station in the Control Room. Any equipment installed at Zone Substations has already been covered under that area.

4.8.1 Asset Justification

The SCADA and communications networks are essential to allow Westpower to monitor and operate its network. In the event of a fault, these systems allow for safe isolation of the defective plant and also for fast restoration of supply to as many customers as possible. The system is also required for Westpower to monitor the real time performance of the asset. Protection systems are required by legislation to ensure safe isolation of faulted equipment.

4.8.2 Supervisory Control And Data Acquisition System (SCADA)

The Human Machine Interface (HMI) data and control is now accessed via Flexview PC software, which is run in the control room on a standard windows XP PC fitted with dual 19 inch LCD screens. This give the operator the ability to not only view SCADA data but also simultaneously use any other PC software. The ability of Flexview to run on PC's allows the SCADA information to be viewed from almost anywhere within the IP network.

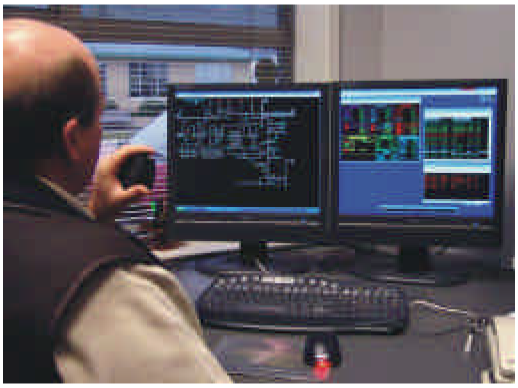


Figure 4.8a SCADA Master Station

The information viewed within Flexview is captured by Realflex 4 Server software which runs on a dedicated pair of PC's located in the control room, one being the online server while the other acts as a hot standby in case of hardware failure. These servers use the QNX operating system, which is similar to UNIX, and provides a peer-to-peer network operating system (NOS) designed for real-time application such as SCADA. The current version of QNX does not support modern computer hardware and is running on PC's that are due for replacement. The latest version of QNX is QNX Neutrino and does support modern hardware. It is planned that the servers be upgraded this year before hardware failure becomes an issue. This upgrade will also require an upgrade from Realflex 4 software to Realflex 6. The work completed to date installing Flexview will allow this upgrade to happen with minimum disruption to the normal operation of the SCADA system, as Realflex 6 only allows viewing via Flexview.

All vital SCADA equipment is powered via the Uninterruptible Power Supply (UPS) (figure 4.8b) which provides an eight-hour backup in case of a major power outage. Furthermore, a 3-phase generator has been installed to provide power to all equipment including the UPS, further extending this back-up period if required.

4.8.3 Remote Terminal Units (RTUs)

In the past, major zone substations were fitted with Siemens Dataterm units (Dataterms), which employ a proprietary communications protocol. These units are now ageing and require replacement, with modern equipment to be installed. The current protection relay upgrade and rollout of our digital radio to major zone substations has required an upgrade of the RealFlex system. The upgraded Realflex has the ability to communicate with many different types of RTU's and field equipment such as protection relays and PLC's via most of today's standard communication protocols. This has allowed the eventual decommissioning of the remaining Dataterms.

For smaller zone substations and remote sites such as reclosers and automated disconnectors in the distribution network, Abbey Systems Modulink and MicroLink RTU's are installed.

The MicroLink is a small unit with fixed I/O, while the ModuLink has a local communication port to connect to a PLC or protection relay, which provides additional control and equipment status data.

A feature of these units is the pre-emptive communications protocol, which allows the RTU to be polled very infrequently, while at the same time providing the abililty for the RTU to update the Master Station whenever a change of state occurs.

Abbey RTU's use Westpower's VHF speech radio channels to communicate with the Master Station.

4.8.4 Communication System

The Westpower communications network consists of a mix of a number of technologies of various ages and age profiles. This equipment provides bearers for operational speech, operational SCADA and management information.

The network consists of assets shown in Table 4.10d

Figure 4.8b - Control Room Battery Backed UPS

4.8.5 Communication Cables

A Self-Supporting Aerial (SSA) 25 pair cable and a fibre optic cable runs from the Control Room to Greymouth Substation for speech and SCADA purposes. A fibre optic link, also in place, is to be used for a number of purposes, such as IP surveillance monitoring, offsite computer network backup and IP communications with relays etc.

4.8.6 VHF Network

The VHF speech network is an extensive system used by Westpower, ElectroNet Services and Trustpower (West Coast Generation).

A major replacement project that took place in 1994 resulted in reliable, modern Tait 2000 series equipment being deployed throughout Westpower's area. As a result of this, the communications network is able to cater for Westpower's current and foreseeable future needs.

Expansion of the VHF network is required in the first year of the planning period as the level of distribution automation has placed increasing load on the existing speech channel. The single channel is no longer able to cope with present loadings.

As vehicles are replaced, regular removal and reinstallation of existing mobile sets takes place.

4.8.7 UHF Network

The UHF network is used exclusively to provide communication paths for the aging Dataterms currently

Figure 4.8c - Abbey Microlink

Table 4.10d: Summary of Communications System Components

Assets	**Number**
Radio Links UHF (analogue) (digital)	7 4
Digital Microwave Radio Links (DMR)	3
VHF Land Mobile Network - Mobiles	40
VHF Land Mobile Network - Bases	20
VHF Land Mobile Network - Repeaters	3
VHF Land Mobile Network - Hand Helds	30

installed at the Arnold, Dobson, Ngahere, Reefton, Whataroa and Wahapo substations.

This equipment is almost exclusively Tait 300 series equipment, with a small amount of 800 series equipment installed in recent years.

Repeater sites are located at Reefton, Paparoa (near Greymouth), Mt Hercules (near Harihari) and Whataroa Substation.

Mains power is reticulated to all of these sites.

The new digital radio network, already in place in Hokitika and Rapahoe, is being extended to cover the Grey Valley and Reefton areas.

As a result of this project, the existing UHF equipment will be used to enhance the South Westland link.

4.8.8 Protection

Protection systems are mainly restricted to Zone Substations, with the notable exception of line reclosers, which use internal proprietary protection relays.

As Westpower has standardised on Cooper Power Systems type reclosers, the protection involved is often that supplied with the reclosers. These often comprise a mixture of the type KFE or KFME Reclosers and FXA /FXB protection controllers.

All protection units are less than 25 years old and are of solid state construction.

All other protection systems are included in the section 4.4, Zone Substations.

Most of the protection assets owned by Westpower are related to overhead line protection and the majority of lines are protected by overcurrent and earth fault relays.

The 33 kV and 11 kV feeder protection equipment are generally of the same age as the switchgear (at 11 kV, the protection is often an integral part of the circuit breaker).

Schweitzer Engineering Labs (SEL) protection relays are now used for all new zone substation feeders.

4.9 Distribution Transformers

DRC - $5,996,168
ODRC - $5,996,168

Table 4.9.1 summarises the population of distribution transformers

A variety of styles exist on the network, from early painted steel tank units through to the current modern galvanised tank transformers.

During the early 1980's, a common small three-phase unit employed a Scott or TEE-TEE connection, but these units were not directly compatible with standard three-limbed units and were discontinued after a short period of use. A so-called stainless-steel tank was also trialed for a short period, but the poor quality tank material exhibited low corrosion resistance and the unit was no longer accepted.

All units used in Westpower's network must now have galvanised or coreten tanks and use stainless steel bolts to maintain resistance from corrosion.

A number of small transformers purchased in the 1990's are exhibiting bushing gasket deterioration and a programme is in place to refurbish these units.

Table 4.9.1: Summary of Distribution Transformers				
	Primary Voltage			
Type	**66 kV**	**33 kV**	**11kV**	**Total Units**
Power Transformers				
Distribution 1 phase	0	2	884	886
Distribution 3 phase	0	4	1163	1167
Total Transformers	**0**	**6**	**2047**	**2053**

In addition, all units have an off load tap switch fitted to provide a range of +2.5% to –7.5% (on the HV side) for voltage regulation.

Two three-phase 33 kV/400 V units were purchased specifically to supply the remote South Westland broad-casting site at Mt Hercules, one unit maintained in service and the other kept as a spare.

Single-phase 33 kV/400 V units supply customers in the South Westland area remote from Westpower's distribution network, but close to the Hokitika-Harihari 33 kV line. The customers accept that no spare will be provided for these units.

4.9.1 Asset Justification

Distribution transformers are the key component of a distribution substation and the justification for these assets is the same as for distribution substations covered in 4.6.1 above.

4.10 Ripple Injection Plants

DRC - $180,000
ODRC - $180,000

Westpower owns four ripple injection plants with one each at Reefton, Greymouth, Hokitika and Dobson.

These plants are used for load control purposes as well as providing tariff-switching signals for use by retailers.

Retailers also use this system, by contractual arrangement with Westpower, to shift load from high cost to low cost periods, provided that load control operational requirements are not compromised.

Three sites, Reefton, Greymouth and Hokitika have Plessey TR series 75 kVA injection plants installed while Dobson has an Enermet SFU-K 203 series 80 kVA plant, and all with associated injection transformers, coupling cells and high voltage fuse equipment. In all cases, the injection plant and major coupling cell components are housed either in a building or a PortaCom type hut. These units were purchased second hand from Electra in 1995 and are now about thirteen years old.

There was only one injection point at Greymouth from 1982 until 1996 when the supplementary plants were installed. During this period, the system relied on the Transpower 66kV transmission system for a signal path to outlying areas.

All plants are controlled by either Siemens Dataterm or Abbey Powerlink Injection Controllers connected to

Westpower's SCADA Load Management system.

The three on-line plants run synchronously, that is they are able to inject the identical ripple waveform at each of the three sites at the same point in time. Global Positioning System (GPS) technology has made this possible by providing an accurate time base at each and every site which is perfectly synchronised in frequency and phase.

4.10.1 Asset Justification

Ripple injection plants are a key part of Westpower's demand side management strategy and are used to send ripple signals to receivers in customer's premises that allow interruptible loads such as water heating to be switched on or off. This is critical to maximise use of existing assets and avoid unnecessary asset expenditure to cover unnecessarily high peak demands

Table 4.11.1 Optimised Assets

Asset	Asset Type	Physical Capacity	Optimised Capacity
Wahapo Zone Sub Transformer	Zone Substation	6 MVA	4 MVA
Franz Zone Sub Transformer	Zone Substation	6 MVA	5 MVA
Punakaiki Feeder	Distribution Line	33 kV	11 kV
Hokitika- Harihari Line	Subtransmisison Line	66 kV	33 kV

Table 4.11.1 shows the only assets that are optimised in the network.

4.11 – Optimised Assets

In the case of the Hokitika-Harihari 66 kV line, this was purchased from Transpower in 2001 and has only been running at 33 kV since 1993, when a physical optimisation took place. A project has been identified toward the end of the planning period (South Westland Grid Reinforcement Project – SWGR) that will involve recommissioning the line to 66 kV and upgrading the connected substations from 33 kV to 66 kV, but this will only take place if the load continues to grow as expected, and all other more cost effective means of reinforcement such as distributed generation, load control and voltage support have been applied first.

The Punakaiki Feeder was built at 33 kV in the mid-1990's when an illmenite mine was planned for the area, but this project has subsequently been shelved, and the line is now only required to operate at 11 kV. Notwithstanding this, the coastal environment in which this line operates is characterized by extreme salt mist pollution, and the additional creepage distance afforded by the 33 kV insulators employed is regarded as beneficial and reduces the numbers of transient faults in the area.

The Wahapo and Franz Josef 6 MVA transformers were purchased second hand for a very low price following the closure of the Tarakohe Cement Works in the late 1980's and the overcapacity now apparent is more to do with optimal capital investment (i.e. a good bargain) than evidence of perceived "gold-plating". In any case, the load at Franz Josef is forecast to require the full 6 MVA capacity by the end of the planning period

4.12 – Generation

Westpower currently owns no generation plant, but is planning to re-enter this market segment through a joint venture with other partners to construct a small hydro scheme near Harihari in South Westland. The final capacity of the plant is still to be confirmed, but this run of the river plant is likely to significantly improve the security of supply to South Westland.

As a lines business, Westpower continues to treat all requests for the connection of new generation to its network transparently and equitably based on common connection standards and will not cross-subsidise any generation proposals from its distribution business.

Legislative constraints in the form of the arms length rules of the Electricity Industry Reform Act (EIRA) presently prevent Westpower from owning and operating more than 5 MW of hydro generation without a specific dispensation, and it is unlikely that Westpower will develop further interests in this area unless and until the EIRA rules are relaxed to allow common management and operation of the plants in order to extract the maximum synergistic benefits.

4.13 Load and Customer Characteristics by GXP

As discussed in Scetion 4.0.1, Westpower is supplied by six GXP's spread throughout its area. The following discusses the load characteristics and large consumers in each of the areas supplied by these GXP's.

Reefton (RFN110)

The Reefton GXP supplies load between Lyell in the North, Berlins in the East and Blackwater to the South.

The load is characterized by mainly dairy farming and domestic load, although there is some small commercial load in the town of Reefton along with some mining. The characteristics will change significantly with the Reefton Gold Project starting in late 2006.

Table 4.13.1 Bulk Customers from Reefton GXP

Bulk Load	Load Type	Load Size
Solid Energy - Terrace Mine	Underground Coal Mine	800 kW
Oceana Gold Limited - Reefton Gold Project	Open Cast Gold Mine	7000 kW
Coastpine - Mc Vicar's Sawmill - Waitahu	Timber Mill	400 kW
Inangahua Sawmill - Inangahua	Timber Mill	300 kW

Dobson (DOB033)

Dobson supplies the Grey Valley from Blackwater in the North to Punakaikai in the West, to north of Greymouth in the South and Rotomanu on the East.

This GXP covers a wide area with a mix of farming, industrial, residential and holiday home load, but relatively little commercial load. It was originally constructed to supply the town of Greymouth and the coal mining load in the lower Grey Valley and Runanga areas, but was situated too far from Greymouth town-

ship to supply the growing load there, and a separate GXP was constructed in Greymouth in the late 1970's.

Table 4.13.2 Bulk Customers from Dobson GXP		
Bulk Load	**Load Type**	**Load Size**
Solid Energy - Spring Creek Mine - Dunollie	Underground Coal Mine	5600 kW
Roa Coal Mine - Roa (near Blackball)	Underground Coal Mine	600 kW
Stillwater Lumber - Stillwater Sawmill	Timber Mill	700 kW
CMP - Phoenix Meat Works, Kokiri	Abattoir	1300 kW

Table 4.13.2 shows the bulk customers supplied from this GXP

Greymouth (GYM066)

The Greymouth GXP supplies the town of Greymouth and the satellite townships of Cobden and Blaketown, as well as South Beach, Rutherglen and Paroa to the South.

As would be expected, the load is mainly domestic, commercial and light industrial with a small but growing load resulting from increased tourism to the area

Table 4.13.3 Bulk Customers from Greymouth GXP		
Bulk Load	**Load Type**	**Load Size**
Kingsgate - Kingsgate Hotel - Greymouth	Hotel	300 kW
Westfleet - Westfleet Fish Processing - Greymouth	Fish Processing Plant	300 kW
Fresh Choice - Greymouth	Supermarket	300 kW
Monteiths Brewery - Greymouth	Brewery	200 kW
New World - Greymouth	Supermarket	300 kW
The Warehouse - Greymouth	Retail Store	200 kW
Coast Health - Greymouth Hospital - Greymouth	Hospital	400 kW

Table 4.13.3shows the bulk customers supplied from this GXP
Kumara (KUM066)

The Kumara GXP is mainly required to provide a Grid Injection Point (GIP) for TrustPower's 10 MW Kumara Hydro Scheme, but also supplies local load in the area between Gladstone in the North to Jacksons in the East to Duffers in the South. When the generation is not running a peak export demand of a little less than 2 MW is provided from this substation.

Table 4.13.4 Bulk Customers from Kumara GXP		
Bulk Load	**Load Type**	**Load Size**
IPL - Plywood Mill - Gladstone	Timber Processor	1000 kW

Apart from the significant generation, the load type is mainly farming and rural residential, although there is one significant industrial load connected to this GXP as shown below in Figure 4.13.4

Hokitika (HKK066)

The Hokitika GXP supplies the town of Hoktika and all areas South of there as far as Lake Paringa, some 200 km away.

The load is a mix of dairy farming, residential, commercial, light industrial and large industrial. South of Whataroa, the load shape is predominantly driven by the tourist centres of Franz Josef and Fox Glaciers.

Table 4.13.5 Bulk Customers from Hokitika GXP		
Bulk Load	**Load Type**	**Load Size**
Westland Dairy - Hokitika Dairy Factory - Hokitika	Milk Processing Factory	6500 kW
Westco Lagan - Ruatapu Sawmill - Ruatapu	Timber Mill	800 kW
W H Whiley - Three Mile Sawmill - Arahura	Timber Mill	300 kW
Mair Venison - Hokitika Venison Factory - Hokitika	Venison Abattoir	250 kW
New World - Hokitika	Supermarket	200 kW
Westland Motor Inn - Franz Josef	Hotel	400 kW

Table 4.13.5 shows the bulk customers supplied from this GXP

Otira (OTI011)

The load at Otira is totally isolated from other GXP's, and apart from a small hotel and a few houses and baches, the majority of the load consists of the fan motors for the Otira tunnel, which is detailed in Fig 4.13.6 below.

Table 4.13.6 Bulk Customers from Otira GXP		
Bulk Load	**Load Type**	**Load Size**
Tranz Rail - Otira	Fan Load	700 kW

4.13.1 Voltage Support Systems

Westpower regularly uses voltage regulators throughout it's distribution network and has also installed a regulators in its 33 kV subtransmission network at Harihari to support the voltage in South Westland when TrustPower's Wahapo generator is not running. Although this regulator is generously rated, it was bought second hand for a price well below modern replacement cost and could be replaced by a smaller unit if it had to be replaced in the future

Table 4.13.7 shows the schedule of voltage regulators installed in Westpower's network.

Table 4.13.7 Voltage Regulators

Regulator Site	Voltage	Size
Cronadun (north of Reefton)	11 kV	2250 kVA
Longford Corner (east of Hokitika)	11 kV	2000 kVA
Haupiri (east of Dobson)	11 kV	2000 kVA
Harihari	33 kV	10000 kVA

In addition to voltage regulators, a number of high voltage capacitors have been strategically installed throughout the 11 kV distribution network. Not only does this improve the apparent power factor of the loads seen from Transpower's GXPs, resulting in improved voltage regulation throughout the West Coast, it also improves the voltage profiles in individual 11 kV feeders leading to improved capacity and reduced losses.

All of the capacitors installed in the network are fixed, as opposed to switched, capacitors although switched banks do exist inside Greymouth and Hokitika Zone Substations.

Because capacitors can absorb ripple signal, depending on the size of the capacitor and the system configuration, they are often installed with separate blocking chokes to avoid this problem.

Table 4.13.8details the 11 kV distribution capacitors installed on Westpower's network and the Zone Substation that they are connected to.

Table 4.13.8 Capacitors			
Location	**Zone Substation**	**Voltage**	**Capacity**
Sh6 Hokitika	Hokitika	11 kV	1000 kVAr
Kaniere Tram	Hokitika	11 kV	1000 kVAr
Strongman	Rapahoe	11 kV	1000 kVAr
Fox Glacier	Fox Glacier	11 kV	500 kVAr
Reefton Saddle	Reefton	11 kV	500 kVAr
Kokiri	Arnold	11 kV	1200 kVAr
Wahapo	Wahapo	11 kV	500 kVAr
Sei Bath House	Rapahoe	11 kV	1000 kVAr
Punakaiki	Rapahoe	11 kV	500 kVAr
Rotomanu	Arnold	11 kV	500 kVAr
Kokatahi	Hokitika	11 kV	1000 kVAr
Kotuku	Arnold	11 kV	500 kVAr
Haupiri	Arnold	11 kV	300 kVAr

4.14.1 Westpower Mobile Substation

Westpower's Mobile Substation (WMS) was developed to provide an effective means of maintaining electricity supplies to areas served by zone substations with single transformers. Essentially, it is a self-contained zone substation on wheels and is rated 33/11/3.3 kV, 8/10 MVA.

The 33 and 11 kV cables are stored on reels and rolled out at site to connect to the local 33 and 11 kV networks. All of the switchgear, SCADA, control and protection systems are on board and ready to go with short notice.

This substation can be used to

- Reduce restoration time in the event of a forced outage of a transformer at a single transformer substation
- Provide for a temporary or augmented supply to an area near to the sub-transmission system when new build is not warranted for short duration peaks or loads
- Allow for extended maintenance outages at substations without interrupting supply to consumers for significant period

This is one of only two such substations that Westpower is aware of and the only one in the South Island, but is expected to greatly improve security and reliability in Westpower's network.

Fig 4.14(a) shows the completed substation

Figure 4.14(a) Westpower's Mobile Substation

5.0 Asset Condition

This section describes the present condition of the assets, based on information from routine inspections.

The reader unfamiliar with the geographical layout of the system is referred to the maps in Section 4.

This assessment of the present condition of the assets and their implications, is the basis for the proposed maintenance programmes. The asset management drivers are:

- Safety
- Network performance
- Economic efficiency
- Environmental responsibility
- Corporate profile
- Regulatory compliance

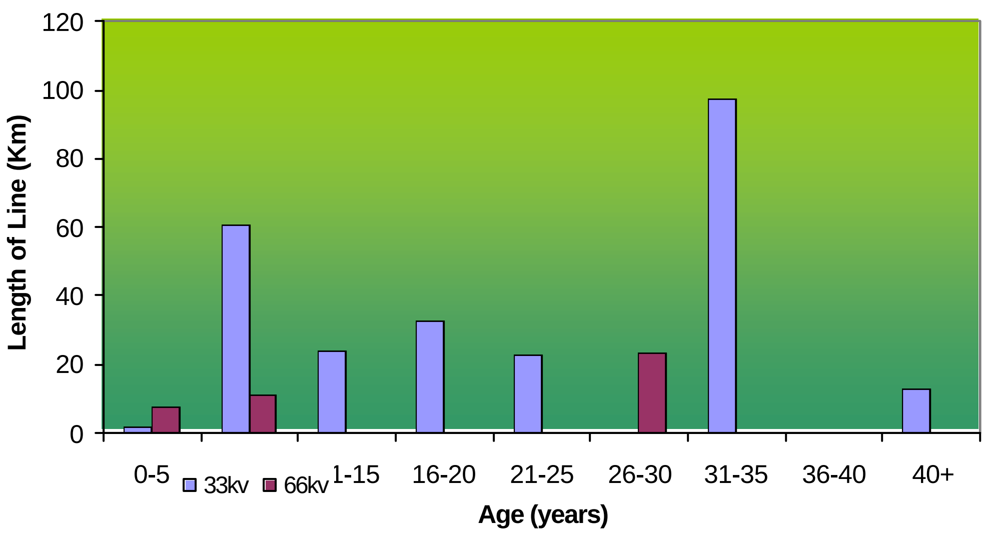
5.1 Sub-Transmission Asset Condition

The condition of the sub-transmission assets largely reflects their age and the quality of materials used in construction.

In general, the 33 kV lines are constructed with concrete poles and the 66 kV lines with hardwood poles.

Figure 5.1a shows the age profile of sub-transmission lines, by route kilometre.

Figure 5.1a - Sub-Transmission Line Age Profile



5.1.1 Current Overhead Line Asset Condition Overview

The present condition of any sub-transmission line is largely a factor of its age, the quality of materials used and the environmental corrosiveness of the locations it traverses.

Westpower sub-transmission lines fall into three broad groups 66 kV wood pole lines, 33 kV pole lines and 33 kV fully insulated lines, either Aerial Bundled Conductor (ABC) and 33 kV Spacer Cable.

5.1.1.1 66 kV Wood Pole Lines

The Greymouth-Kumara 66 kV line constructed in 1977 was constructed with de-sapped, untreated hard-wood poles, which are now showing signs of early ground-line deterioration. A recent major ground-line inspection has shown that there is no reason for immediate concern, but a management plan needs to be put into place within the next five years to contain any risk of premature failure.

The Kumara-Kawhaka line was completed in 1997 and used non-de-sapped treated hardwood poles which are expected to last for at least 45 years. This line is in excellent condition with annual patrols showing no signs of deterioration as would be expected from a brand new line.

Both lines use stand-off porcelain insulators and this has greatly reduced the component count on each pole.

Of note, both the Greymouth-Kumara and Kumara-Kawhaka circuits are leased to Transpower who operate them as part of the national grid. A performance based contract exists between Transpower and Westpower, whereby Westpower provides a minimum level of reliability, and this in turn requires a higher than usual standard of maintenance.

During the early 1990's a programme of pole bandaging was carried out on approximately 50% of the poles on this line. This involved cleaning off any rotten sapwood, placing a heat shrink bandage around the pole at ground line and injecting a fungicidal emulsion to halt any further deterioration. In 1994 however, this programme was discontinued because of concerns over the effectiveness of the process.

5.1.1.2 33 kV Pole Lines

These lines are mostly double-circuit under-built construction, (33 kV above with 11 kV and/or 400 V circuits below) wired in Aluminium Conductor Steel Reinforced (ACSR) and All Aluminium Alloy (AAAC) conductor and are between 3 and 37 years old.

Three distinct construction types are present in the sub-transmission network

- Hardwood poles on the Harihari-Whataroa and Dobson-Arnold lines
- Stresscrete pre-stressed 12.2m concrete poles (used on the majority of lines constructed in the last 15 years)
- Two types of fully insulated construction on hardwood poles

A recent survey of the Mt Hercules line showed the hardwood poles to be in good condition with a remaining life of at least 10 years.

The Dobson-Arnold Line purchased from Transpower in 1994 is over fifty years old and several of the wood poles are approaching the end of their life. Notwithstanding this, a similar survey to that carried out for the Mt Hercules line has shown that all of the poles are operating well within their maximum stress limits. This may be due in part to the maintenance procedures imposed by its previous owner, which resulted in several poles being replaced where there was even a small sign of deterioration. Ongoing inspections are likely to result in small numbers of poles being replaced each year.

The remaining 33 kV lines in the Grey Valley area and South Westland are all less than 15 years old and in

excellent condition. The concrete poles are structurally sound and have an expected life of sixty years.

Premature ageing of some EPDM polymer disc insulators has been noted and further investigations are being carried out as discussed in section 5.1.2.3 below.

5.1.1.3 33 kV Aerial Bundled Cable

The Aerial Bundled Cable lines have experienced poor reliability due to insulation failure and tree damage. Because of the long repair times involved, which in difficult circumstances can take up to 24 hours, and the unavailability of alternative feeds into the area, a higher standard of performance and maintenance is required.

In 1996, a section of cable through virgin podocarp forest around Lake Wahapo was re-routed around the state highway after several events where the line was severed by trees falling through it. Although this overcame tree damage and difficult access problems, there was a subsequent electrical failure in 1997 without apparent explanation.

The 4km ABC cable around Lake Mapourika was commissioned in 1993 and comprised sections adjacent to the State Highway as well as a section of around 1km through dense bush. There had been a number of failures on this line, including a critical failure in the cable in January 1999 which resulted in a loss of supply to Franz Josef and Fox Glacier lasting 16 hours

Attempts to identify the failure mechanism and work with the manufacturer in overcoming it have proved futile and the line was replaced with a new Hendrix Aerial Spacer Cable System on hardwood poles, all of which are now located around the road

5.1.1.4 Hendrix 33 kV Spacer Cable

After considerable investigation, the Hendrix Spacer Cable System was identified as a suitable replacement for the ABC system, while retaining the advantages of a fully-insulated overhead configuration. The Hendrix system has a 40 year track record in the United States and has proven to be very reliable; in particular does not suffer from the same reliablity issues as the ABC system.

Spacer cable was installed for a 6 km stretch of line around Lake Mapourika in 2000, and this replaced the existing ABC system.

This new system also involves fully insulated overhead conductors, but instead of the individual phases being bundled together, they are spaced apart by insulating “spacers” every 10 metres, and supported by a separate, high strength catenary wire.

Experience to date with this system has been excellent, even when large trees have fallen across the catenary wire, as the system continues to operate without the conductors being damaged. Repairs can also be made much more quickly than with ABC because there is no need to apply stress control measures when jointing.

5.1.2 Condition of Specific Line Components

5.1.2.1 Wood Poles

There are approximately 550 wooden poles in service. An estimated 30 poles (6%) are assessed to be currently at replacement criteria, or to reach it within 5 years, these mainly being on the Dobson-Arnold line.

Approximately another 30 are estimated as needing to be replaced between 2006 and 2009.

5.1.2.2 Conductors and Conductor Accessories

Copper 7/.080" conductor is fitted to the Dobson-Arnold lines. Much of it is still in reasonable condition and can remain in service for a further 10 years. However vibration damage and corrosion has taken its toll.

No replacement is planned at this stage, as any further hydro-generation development at Arnold will require that the conductor be upgraded anyway to remove an effective constraint.

Mink ACSR conductor installed on the Mt Hercules line is in good condition and will not require attention within the planning period.

Most of the conductor installed since the 1960's up to mid 1990's, has been conventional Dog ACSR with greased steel core. All conventional ACSR is prone to corrosion, especially where the line is subject to wind borne salt contamination. This will be carefully watched, although there is no evidence to date of such deterioration.

Since the mid 90's, Iodine AAAC conductor has been used exclusively for sub-transmission lines and the enhanced corrosion protection afforded by this alloy material should result in at least sixty years effective life.

Most lines are fitted with spiral vibration dampers where appropriate and this has greatly reduced the incidence of vibration damage to conductors and fittings. The Arnold-Dobson and Greymouth-Kumara lines are exceptions to this and a study will be carried out to determine whether a retro-fitting programme is warranted to minimise any risk of damage.

5.1.2.3 Insulators and Insulator Fittings

There are a number of older porcelain discs now known to be unreliable due to inherent design faults plus in-service internal deterioration. This has not been a major problem on sub-transmission lines because of the use of multiple discs, which affords some redundancy. Nevertheless, the effects of ongoing deterioration will have to be taken into account in the lifecycle management plan.

Replacement insulators are either glass or polymer disc insulators with round pins.

Problems have been noted with the 33 kV EPDM polymer deadend insulators that have failed and showed signs of chalking and cracking. The cracking is through the sheds, and axial to the fibreglass strength member, with no apparent penetration toward the core.

An investigation was carried out to assess the seriousness of the problem and the risk, if any, that this apparent deterioration poses. An independent consultant suggested that the LAPP manufactured 33 kV units have an effective in-service life of approximately ten years, which soon will be exceeded. A replacement programme will need to be initiated to mitigate the risk of future failure.

5.1.3 Condition of Access Roads

The Dobson-Arnold line is serviced by a good quality access road that may be used by trucks and four-wheel drive vehicles. While it is not Westpower policy to provide for this standard of access road, it existence owes much to the line's heritage as a Transpower asset. The road is in excellent condition for the purpose intended.

The Kumara-Kawhaka line had an access road constructed to allow the line to be built and is suitable for four wheel drive vehicle and excavator access. This road is in reasonable condition for the level of use required.

No specific access roads have been constructed to gain access to the Greymouth-Kumara or Mt Hercules. lines.
A contingency sum has been included in the annual budget to provide maintenance on already formed access roads.

5.2.0 Distribution Line Condition

The construction of lines in the past has often been driven by customer demands and political influences, which has resulted in the seemingly erratic nature of the line ages. A major undergrounding programme extending throughout the 1980's coupled with an overhead feeder replacement extending from 1992 through to 1999 has resulted in an average line age of 16 years.

Figure 5.2a shows the age profile of distribution lines, by route kilometre

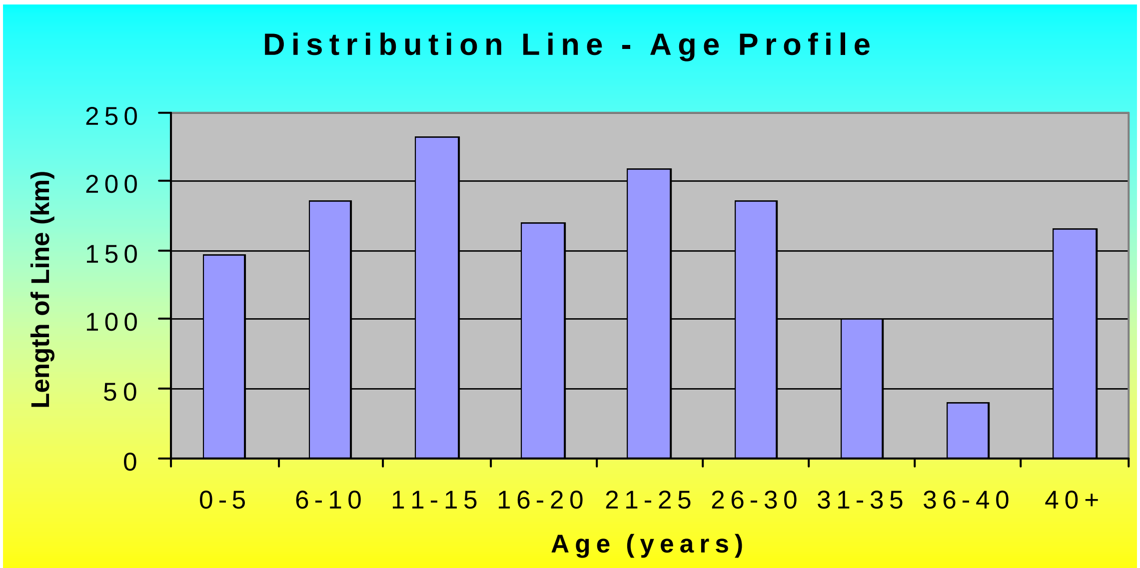


Figure 5.2a - Distribution Line Ages

5.2.1 Current Overhead Line Asset Condition Overview

The present condition of any distribution line is largely a factor of its age, the quality of materials used and the environmental corrosiveness of the locations it traverses.

It is difficult to generalise about the condition of distribution lines. However, if we exclude those lines in severe environments, and look at the rest, then Westpower lines tend to fall into 3 broad groups.

5.2.1.1 Early Wood Poles

These lines are 11 kV single circuit and double circuit construction and many of them are around 40 years old. Few of the lines have had replacements of major components to keep them in service and overall they are generally in poor condition. Generally the conductors (usually copper) have some limited remaining life.

Because of the major replacement programme recently completed, wood-pole lines are generally limited to spur lines or the remote ends of rural feeders.

5.2.1.2 Concrete Pole Lines

These lines are mostly single circuit, wired in ACSR and AAAC conductor and are between 1 and 25 years old.

Two types of concrete poles were used

The earlier heavy-reinforced type manufactured by Westpower from the 1970's until the early 1980's. These are often referred to as "Hokitika" concrete poles because of where they were manufactured.

Pre-stressed concrete poles manufactured since the early 1980's by a local bridge-beam builder under license to Stresscrete

The poles are structurally sound and have an expected life of sixty years.

There has been some concern regarding the long-term effect of the leaching out of cement below ground level in the "Hokitika" concrete poles in certain soil conditions, however the extent to which this affects the structural integrity of the pole is still under investigation.

5.2.1.3 Treated Softwood Pole Lines

Construction of treated softwood pole lines began in 1992 for economic reasons, and continued through until 1994 for main lines, when the cost differential between concrete and treated softwood poles underwent a reversal. These lines are wired in ACSR or AAAC conductor.

5.2.2 Condition of Specific Line Components

5.2.2.1 Wood Poles

There are approximately 4000 distribution wood poles in service. An estimated 300 poles (7.5%) are assessed to be currently at replacement criteria, or to reach it within 5 years. Approximately another 300 are estimated as needing to be replaced between 2006 and 2011.

5.2.2.2 Conductors and Conductor Accessories

Copper conductor is fitted to the majority of older lines. Much of it is still in reasonable condition and can remain in service for a further 10-20 years. However vibration damage and corrosion has taken its toll.

Most of the conductor installed since the 1960's have been conventional ACSR with greased steel core. All conventional ACSR is prone to corrosion, especially where the line is subject to wind borne salt contamination. Much of the early ACSR in exposed areas has been identified for careful inspection over the next 10 years to determine what, if any, replacement programme should be undertaken.

5.2.2.3 Insulators and Insulator Fittings

There are a number of older porcelain discs now known to be unreliable due to inherent design faults plus in-service internal deterioration. In particular the relatively recent international discovery that older conventional porcelain can develop porosity during its service life (leading to punctures and mechanical separation) plus the known poor quality of much of the older porcelain insulation has provided added weight to the replacement programme.

Replacement insulators are either glass or a polymer disc insulator with round pins.

Problems have also been noticed with EPDM polymer insulators showing signs of chalking and even cracking. An investigation is currently underway to assess the seriousness of the problem at 11 kV and the risk, if any, that this apparent deterioration poses.

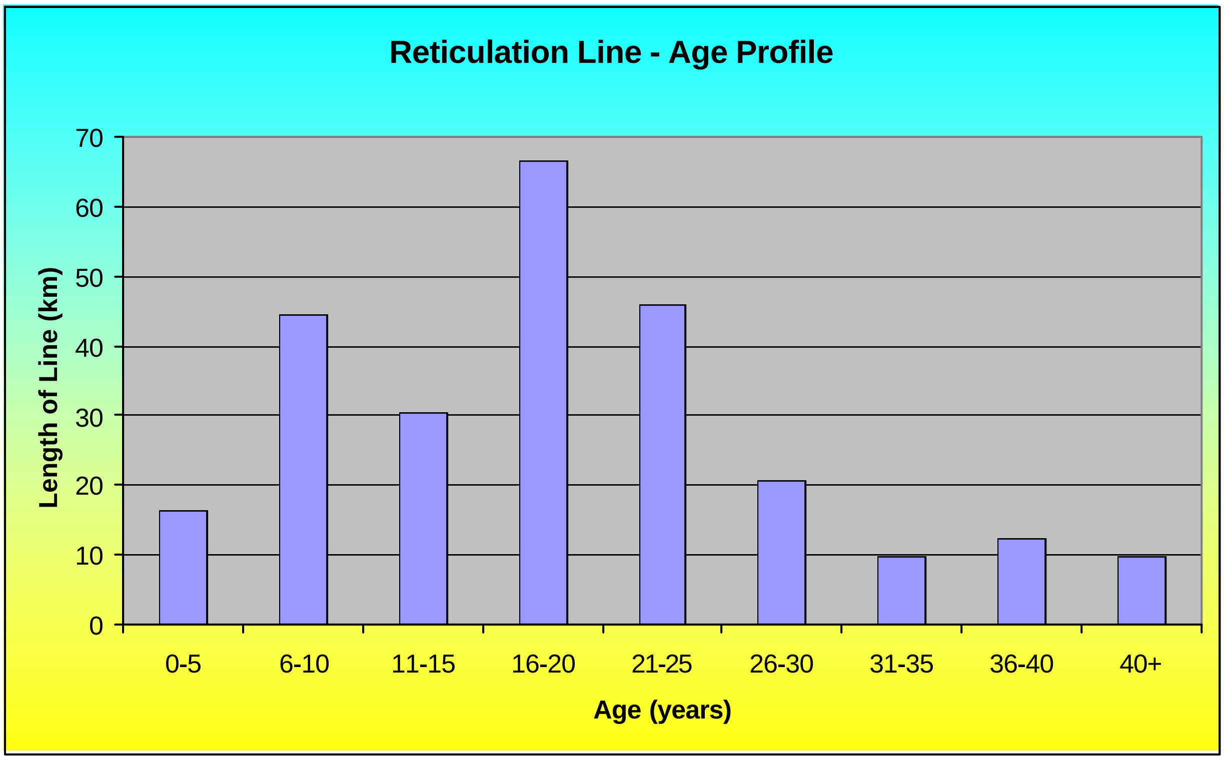
A condition assessment programme was begun to confirm the service life of a number of older NGK 33 kV porcelain pin-insulators used on the 33 kV sub-transmission line from Ngahere to Reefton.
Approximately 800 of these insulators were installed second-hand in the mid-1990's as a cost saving measure. Initially, they were installed in the 1960's on the line to Ruatapu south of Hokitika, but then removed about ten years later and placed in storage until being used on the line to Reefton

During commissioning of the line in 1999, two of these insulators failed resulting in spectacular earth faults. A further insulator failed in January 2000 following a severe lightning storm and these events, combined, raised some doubt as to the BIL and ongoing serviceability of this particular type of insulator. Subsequent analysis of a random sample of insulators confirmed that the general population of insulators is in good condition, however, and no further remedial action is required.

Corrosion problems have recently been identified with Dulmison pre-formed insulator ties used to attach aluminium conductors to insulators. When these are installed in coastal environments, severe corrosion occurs under the neoprene cover used to cushion contact between the Helitie and the insulator, leading to complete failure of the unit. All new Helities are purchased to an updated standard that overcomes these issues.

5.3 Low Voltage Reticulation Lines

Westpower currently owns 99 km of 400 V low voltage line assets, and this is not expected to change dramatically over the planning period. The largest single contribution to more LV lines is likely to come from new subdivisions, and in this case the reticulation will almost certainly be of underground construction because of the requirements of local District Plans.



5.3.1 Current Asset Condition

Many of the factors described in section 5.2 – *'Distribution Lines"* - applies equally to their low voltage counterparts.

In general, the age distribution of this asset is such that most of the asset is either very old or relatively new, with only a small proportion being constructed over the in between period.

The reason for this is that most of the LV construction was carried out at an early time in the town areas where the population density was the greatest. Over the years, this large population of assets aged together to the point where they reached the end of their service life. This, in turn, required a major refurbishment programme.

5.3.1.1 South Westland

The areas of Hokitika and South Westland have largely been rebuilt over the last 15 years. During this time, most of the urban reconstruction has been carried out using underground reticulation, which has a life of up to 50 years. Little further LV work is therefore planned in these areas.

5.3.1.1 Greymouth

In the Central Greymouth Area, some of the oldest lines were placed underground during the 1980's. The change in focus during the late 1980's to a more commercial footing led to the demise of undergrounding because of the substantially higher capital cost involved. From the early 1990's on, remaining refurbishment work has been carried out with overhead reticulation.

The LV networks in the satellite towns of Blaketown, Cobden and Runanga have been reconstructed overhead in the last ten years and are now in good condition.

5.3.1.2 Reefton

The Reefton area consists of mainly very old overhead LV lines which are in need of replacement. During the 1980's there was an undergrounding programme in place, which resulted in several streets, including the main business area, being undergrounded. In conjunction with Telecom, some areas will continue to be undergrounded where cost sharing can be achieved.

About 30% of the LV reticulation has an age of 15 years or less, while the rest of the network would be over 40 years old on average.

Several other small pockets of LV, such as Dobson and Blackball will also need attention during the planning period, and the required level of replacement for these areas will be identified during condition assessment of the asset. This will enable maintenance to be effectively targeted and provide a solid foundation for the move to a Condition Based Maintenance (CBM) programme.

5.3.2 Condition of Specific LV Line Components

5.3.2.1 Underground Network

With the exception of a small number of old 400 V feeder cables in the Central Greymouth business district, most of the underground LV reticulation throughout Westpower's area is less than 20 years old and in good condition.

The underground fittings used are also in good condition, mainly because of their age, however constant minor maintenance is still required to overcome problems due to corrosion or water ingress.

5.3.2.2 Wood Poles

Most of the LV wood poles are very old, predominantly hardwoods and range in condition from very poor to good. Their condition is best assessed through an objective testing programme.

5.3.2.3 Conductors and Conductor Accessories

All of the overhead lines constructed over the last twenty years consist mainly of PVC covered All Aluminium Conductor (AAC) and are in generally good condition.

For a further period of about twenty years prior to this, PVC covered copper conductors were used, and these also are in good condition. Where a LV line is replaced or refurbished, this type of conductor is reused if it is in good condition and of an adequate cross-sectional area.

All lines over forty years of age that have not been refurbished during their life still use original braid covered conductor. The major population of this type of conductor can be found in the Reefton Area where approximately 40% of the remaining overhead LV conductor is braid. The condition of this conductor is very poor and could become a significant safety hazard if not attended to in the short term.

Other accessories demonstrate a condition commensurate with the age of the line and are replaced as part of the overall replacement programme.

5.4.0 Service Lines

Service lines on customer's premises are owned and maintained by the individual customers.

Notwithstanding this, there are some service lines which are not of an acceptable standard due to insufficient clearance or other reasons. Westpower is responsible for bringing these up to standard before transferring them to the customer.

Most service lines are either PVC covered copper or neutral screened copper and should give good service for many years. A few of the very old services are still of the braid variety, and these are replaced as a matter of course and at Westpower's cost when a section of LV line is refurbished or replaced.

5.5.0 Zone Substations

5.5.1 General Condition

All of Westpower's Zone Substations are less than 25 years old and demonstrate a condition commensurate with their age. Two of the oldest substations at Whataroa and Kumara have since been substantially rebuilt over the last five years due to major enhancement projects and are in as new condition.

The enactment of new legislation in the areas of occupational health and safety and the Resource Management Act (1991) may require upgrading work at stations in the areas of fire protection station earthing and security fencing.

5.5.2 Transformers

Because of the proximity to a coastal environment, corrosion of tanks and fittings is a constant problem, which needs to be addressed by an ongoing painting programme.

The remaining population of transformers is now in a generally good condition, and no major maintenance will be required throughout the planning period.

Dissolved Gas Analysis (DGA), performed annually for the last few years, has allowed Westpower to monitor the internal condition of its power transformer population and demonstrate that in general there is little evidence of insulation ageing or deterioration.

In September 2000, a 1984 Tolley 5 MVA 33/11 kV transformer failed catastrophically after a series of heavy line faults. While the unit was successfully repaired, a failure mode analysis revealed a design fault whereby the windings were insufficiently braced to withstand strong short-circuit forces. This particularly affected the tertiary winding. As a result of this, both the faulted unit and a sister unit purchased at the same time were fully refurbished. Both units are now expected to give good service for at least another thirty years.

5.5.3 Switchgear

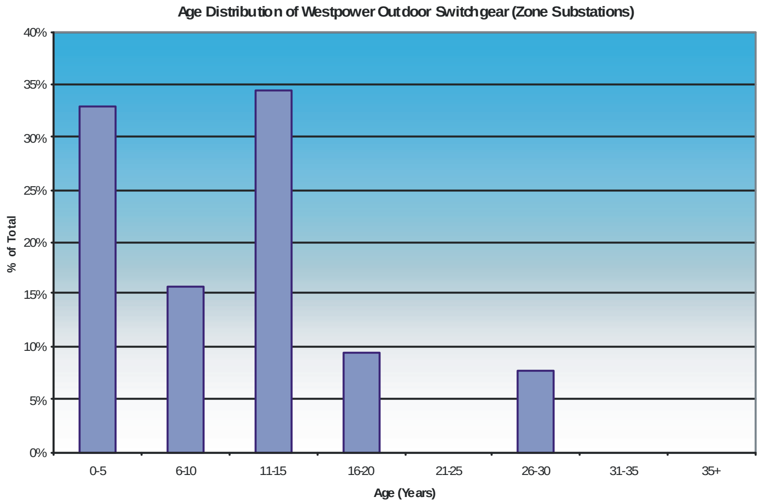
In general, all switchgear is in very good condition, partly due to Westpower's very low fault duty. Vacuum reclosers in particular have very low maintenance requirements and are expected to remain in service for at

least the next twenty years.

At Kumara Substation, new Siemens SF6 66 kV circuit breakers were installed in 1997 as part of an upgrade project along with an Areva SF6 66 kV circuit breaker installed in 2004 which are all in excellent condition.
A similar Areva SF6 circuit breaker was installed at the Greymouth substation in September of last year.

Disconnectors are constantly subject to corrosion of bolts and operating linkages and need continual minor maintenance to keep them in good order.

Figure 5.5.5c - Outdoor Switchgear Ages



5.5.4 Minimum Oil Switchgear

66 kV Minimum Oil Circuit Breakers were supplied during the late 1970's. They are physically smaller than Bulk Oil Circuit Breakers, containing a much lower volume of oil, which leads to high electrical stresses and their performance is more susceptible to maintenance standards. Rigorous maintenance schedules need to be strictly adhered to prevent failures from occurring.

Experience has shown that these units are susceptible to water ingress and need ongoing regular checks. Another problem encountered is seizing of the mechanism due to corrosion of exposed linkages. Apart from these points however, the units are in good condition.

Notwithstanding the above, experience from Transpower suggests that these units are reaching the end of their useful life and a replacement programme is indicated.

5.5.5 Outdoor Reclosers

There are 47 outdoor reclosers in Westpower's zone substations. This population has an age profile as shown in figure 5.5.5a. CIGRE studies indicate typical replacement ages of 40-45 years for circuit breakers rated at 80 kV and below.

5.5.6 Indoor Switchgear

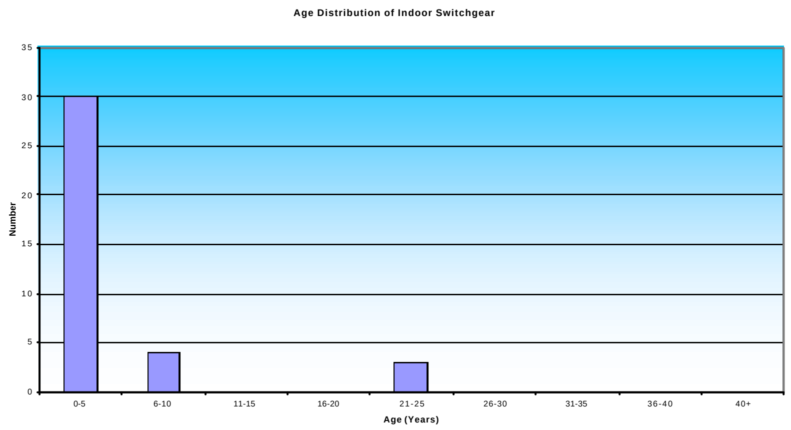
Westpower indoor switchgear installations comprise 31 switch units in 4 locations. These comprise the following types:-

- 4 SF6 circuit breakers
- 24 Vacuum circuit breakers
- 3 Bulk oil circuit breakers

In early 1999, Westpower's oldest 11 kV indoor switchgear at Kumara was upgraded with the retrofitting of SF6 circuit breaker trucks. A life expectancy of thirty years is now expected from this equipment

A potential reliability problem was identified with the indoor bulk oil switchgear at Greymouth after a series of catastrophic failures elsewhere in New Zealand. Prior to this the SO-HI type equipment used has had a chequered history, suffering from low internal clearances, resin insulation breakdown and poor immunity to water ingress. Furthermore, these indoor circuit breakers, while being relatively young at an average age of

22 years, have been subjected to a heavy-duty cycle throughout their lives. Accordingly this switchboard was replaced with new vacuum circuit breakers during 2003.



The only other bulk oil switchgear in use is GEC type BVP equipment installed at Rapahoe in 1984 and its good condition coupled with low fault levels means that it will not require major attention within the planning period.

5.5.7 Disconnectors

Disconnectors are high voltage switches, which are used to disconnect sections of overhead line or other primary plant.

Over recent years there was a particular make of disconnector installed on the system with faulty insulators. These have all now been identified and taken out of service. The insulators have been replaced and the disconnectors have been reused.

New disconnectors generally give satisfactory service, but older designs are unreliable, and very old models are now becoming electrically inadequate. The only effective remedy is replacement of these units.

Some of the older Canterbury Engineering type DA7 disconnectors have also had problems with failing insulators, but the occurrence of this type of failure has been infrequent enough not to require a special replacement programme.

5.5.8 Buswork

Most buswork systems have been constructed in the last ten years and consist of concrete poles and tubular aluminium bus. These items require virtually no maintenance throughout their lives.

At the Greymouth Substation, a galvanised steel lattice structure is in place and is in good condition. A concern with this type of construction occurs when they reach an age where rusting develops which requires continuous maintenance to contain. A common problem is advanced deterioration of bolts, which gradually reduces the overall strength of the structure. Severe structure corrosion is generally found at substations located near marine environments and where industrial works nearby give rise to a corrosive atmosphere. The proximity of Greymouth Substation to the coast means that a regular inspection programme will have to be maintained to counter this. Remedial maintenance may include periodic painting of the structure, if required, and replacement of older porcelain disc insulators.

Corrosion is also a problem in the metal parts of cap and pin insulators, which support buswork. On both post insulators and string insulators severe rusting of the pins, leads to cracking of the porcelain causing the insulator to fail. Also, the older type porcelain itself has been found to deteriorate. These are the same problems that affect line insulators. In the case of strung buswork a failure could result in collapse of the conductor. Replacement with modern insulators and general upgrading of other hardware components is necessary to reduce the risk of failures.

Cracking or spalling of concrete support structures and rusting of the reinforcing steel can be a problem that requires remedial action.

5.5.9 Instrument Transformers

Westpower has several outdoor oil filled instrument transformers, comprising current (excluding bushing types) and voltage units in the voltage range 11 kV to 66 kV. It is estimated that the average age is over fifteen years and only a small percentage is in excess of thirty years of age.

Generally they are in a good condition and require minimal maintenance. The cost of refurbishment and regular monitoring is such that in most instances it is more economic to replace the units if they fail.

The most common form of failure is due to stone damage by vandals, and this is handled as required.

At Greymouth Substation, condsideration is being given to replacing these transformers with modern equivalents using vandal resistant composite insulators.

5.5.10 Oil Containment

Oil containment facilities have been installed at most major Zone Substations within the last four years and are in excellent condition.

5.5.11 Earthing Systems

Earthing systems in substations constructed within the last 15 years were designed to a high standard and meet current industry guidelines.

All of the older Zone Substations that did not comply, including Greymouth, Kumara and Whataroa, underwent major upgrades of their earthing systems contemporaneous with other substation enhancement work completed within the last six years.

A review is currently underway to check the impact of Earth Potential Rise (EPR) on adjacent Telecom plant.

5.5.12 SCADA Remote Terminal Units

The existing Remote Terminal Units (RTU) installed at each remote site received a life extending upgrade in early 1995, but are now technically obsolete, with spares and ongoing support no longer available. Complete replacement during the early stages of the planning period will be required. In conjunction with the digital radio project, it is likely that local protection relays will take over the role of RTU's in future designs, and where possible, this will be included in the replacement programme.

5.5.13 Protection Relays

Most protection relays are in resonable condition and will only require minor inspection and servicing throughout the planning period.

A minor problem has been identified with sealed batteries in Cooper Form 4C and Form 3A recloser control units whereby the units succumb to a high rate of battery failure after three years of service. The interim solution has been to carry out a cyclic battery replacement program of all recloser batteries after three years, but even this has proved ineffective in isolated circumstances. The net result has been some loss of discrimination during fault events leading to wider power outages than would have been expected.

Accordingly, all critical protection relays at Zone Substations will be brought up to the current Westpower standard, which includes modern numerical Schweitzer Protection Relays, over the next three years. At the same time, distance elements are now being used as the primary protection for 33 kV feeders.

Some replacement of protection relays due to obsolescence reasons is scheduled within the planning period.

5.5.14 Other Station Equipment

Battery banks at stations were originally fitted with automotive lead-acid type cells, which typically give a life of about 10 years. These have now been progressively replaced with sealed lead acid type batteries, which have a higher initial cost but give a far greater life (up to 20 years) and also have low maintenance requirements.

Notwithstanding the above, a number of unexplained internal high impedance faults on these sealed units has led Westpower to recently review its policy for future new or replacement banks. The current accepted standard has been to use Faure-X wet cells which have proven lives of at least 16 years, and are currently in use in many Westpower substations. Recent problems with availability of these units, however has forced Westpower to move back to the sealed units.

With the introduction of new safety regulations (SR-EI), it has been necessary to add safety authorisation rope and stands to station inventories.

5.6.0 Distribution Substations

Within Westpower's network there are around 1900 distribution substations comprising single and three phase units ranging from 5 kVA to 1 MVA, in the voltage range of 33 kV to 11 kV.

The condition of these assets covers the whole range from being in need of immediate replacement to brand new.

All main line substations have been rebuilt over the last 20 years as part of Westpower's refurbishment programme and are generally in very good condition. There are still some very old substations on some spur lines however, which will need ongoing refurbishment throughout the planning period.

5.6.1 Dominion Drop Out (DDO) Fuses

As a standard design policy, a DDO fuse unit fuses all the distribution transformers, which are fed directly from an overhead High Voltage Line.

Up until 1996, all fuse units were of the "E C Gough" type manufactured locally for many years. A major reliability problem with these units caused Westpower to move to the AB Chance style of DDO. However these units were found not to pivot open properly when exposed to a corrosive environment for a period of time. AEM type dropouts imported from Austrailia are now being implemented with the Gough and Chance units being replaced as scheduled maintenance takes place on distribution substations.

5.6.2 Earthing Systems

The Electricity Regulations suggest that all substation-earthing systems should be brought up to a standard of 10 ohms. In Westpower's situation, because of the very high soil resistivity that is often encountered, a desired earth resistance of 10 ohms is not practically achievable in all cases.

Nevertheless, the regulations do require that earthing systems be tested every five years, and Westpower is now addressing this issue in earnest. To meet the requirements, a programme of regular five-yearly tests has been instituted.

Based on experience, it is expected that during the testing phase, several substandard earthing installations will be identified that are capable of being practically upgraded. A programme of upgrading these earth

systems using driven rods and extra copper conductor will follow on directly from the earth testing exercise.

5.7 Medium Voltage Switchgear

Most of Westpower's MV switchgear is relatively modern and in good condition. However a recent series of faults on the Andelect Outdoor type Ring Main Unit has given cause to these units being replaced over the next ten years using the new SF6 or Vacuum units. Westpower no longer use Series I oil insulated ABB Ring Main Units to close onto expected faults.

Other exceptions to this are the large and diverse population of disconnectors, which will need to be managed on an asset-wide basis. See section 5.7.4 below.

5.7.1 Regulators

The line regulator at Cronadun, is an old tap-changing unit purchased second-hand from Transpower. This unit is reaching the end of its economic life and requires constant maintenance. Spare parts are hard to source and the unit is costly to maintain. A remaining life of at least five years should be attainable however if the unit is carefully maintained.

A moving coil three phase regulator is installed at Longford Corner and is about 30 years old. The 2 MVA unit is in good condition having experienced a relatively easy service life and will remain serviceable throughout the planning period.

In the early 1980's six Cooper SR32 single phase 32 step regulators were purchased for Fox and Kokiri. The three installed in Fox were moved to the new substation site from Cook Flat Rd. in 2003 and the three at Kokiri were moved to Harihari when the 33/11 kV substation was developed there and Kokiri's function replaced with the Arnold 33/11 kV substation. Last year one of the Fox units failed (lightning suspected) so a new Cooper unit was purchased to replace it. The SR32's are in relatively good condition though the paint work will need attention soon.

With the increasing load at Fox, present peak at about 50 A, the 100 A regulators capacity will be limited. It is planned to upgrade these with 200 A regulators within this planning period. Timing is dependant on some of the tourism projects occuring. When the 100 A regulators are withdrawn from Fox they will be installed in another part of the network.

At the end of the 2003 dairy season it was identified that the Haupiri area needed a voltage regulator to compensate the ongoing developments. A set of two GE 100 A regulators were bought and installed near the old Miers Mill site.

The South Westland Potential Support project was carried completed in 2005 to install a 10 MVA 33 kV voltage regulator at Harihari. This was purchased second hand off Aurora ex Queensberry. Its function is to provide support to the South Westland area for periods when Wahapo is not generating. This will be removed from service when 66 kV is returned to South Westland from Hokitika.

Each of the Ross, Waitaha and Whataroa substations have a 1 MVA induction regulator installed. They are all similar and were purchased secondhand ex the NZE/Transpower. Their manufacture date is unknown but they are thought to be in excess of 60 years old. Two have had paint work refurbished lately and the third is programmed. These all work well at present and would not be worth fixing if a major fault occured within them. Their condition and operation is being monitored.

5.7.2 Circuit Breakers

Aged indoor bulk-oil circuit breakers have reached the end of their economic lives. These will be replaced with fused switch units or modern equivalents over the next five years.

5.7.3 Pole Mounted Reclosers

All pole mounted circuit breakers are of the modern vacuum type and should give many years of acceptable service.

5.7.4 Disconnectors

The most diverse asset type is that of disconnectors and these are constantly prone to corrosion damage. Most main line disconnectors have been replaced with new units during the recent feeder upgrade programme.

As older two-insulator models without “flicker” or “wiping “ arcing horns are not suitable for use on main lines, a programme for replacement has begun. Other three insulator models are also unsuitable on some lines because of system loadings and an effort will be made to identify and replace these units within the next five years.

Some very old substations still use disconnectors in addition to the Dominion Drop Out (DDO) fuse unit as a means of isolation for a fault on a DDO base. The intention is to replace these substation disconnectors with live-line taps.

Other newer units do not have sufficient current breaking capacity because of individual line loadings and the only solution in this case is to fit suitable load break heads.

5.8 SCADA, Communications and Protection

5.8.1 Supervisory Control and Data Acquisition (SCADA)

Westpower’s Master SCADA Station is based upon the RealFlex 4 product supplied by DATAC running on standard PC hardware with a QNX operating system.

In 2004, a major upgrade of the Human Machine Interface took place which involved windows based clients running on standard desktop networked pc’s. Additionally, storage of historical data was moved from the proprietary QNX file structure to the more open MySQL DBMS. Both of these changes led to significant improvements in both the flexibility and reliability of the system, however, the main SCADA engine was still based on very old hardware and an operating system of a similar vintage. As a result, both the hardware and operating system were no longer well supported and Westpower was exposed to a significant risk if this equipment were to fail.

The solution chosen, after reviewing various options for replacement, was to upgrade the hardware, operating system and main application to the latest versions in a concurrent fashion. Accordingly Westpower decided to stay with the RealFlex product, but moved to RealFlex v6.

The upgrade discussed above was started in 2005/6 with the specification and procurement of the necessary hardware and software, with file conversion, testing and commissioning planned for 2006/7.

5.8.2 Communication System

All VHF communication equipment is in excellent condition after a complete replacement programme that took place in the early 90’s. Tait 2000 series equipment is now used throughout the network and rarely gives trouble.

The UHF network has equipment dating back to the mid 80’s, which, although still running well, is now getting toward the end of it’s economic life. Regular maintenance is required, however contractors are very familiar with the equipment and a good stock of spares are held meaning that repair times are kept to a minimum. Nevertheless, the equipment is now technically obsolete, and unable to handle the automation and data collection needs of the modern transmission substations that Westpower are now constructing. For this

reason, a digital radio backbone running at a minimum speed of 64 kbps is currently being installed to support these new sites. Over the coming three years, this network will gradually be extended to cover all major Zone Substations, excluding South Westland, replacing the existing UHF radios.

The existing UHF analogue system in South Westland will be maintained for several years with spares won from the upgrade project.

5.9 Distribution Transformers

The majority of transformer capacity is less than 30 years old, with a median age just over 20 years and negligible capacity beyond 50 years old (3%). This coincides with the period of system development in the 1960's and early 1970's.

Transformers are generally in good condition, although for some of the older painted transformers refurbishment and/or replacement is required rather than general maintenance.

A problem has been identified with deterioration of bushing gaskets on smaller units in the 6-10 year age bracket where these are installed near the coast. It appears that the surface leakage current attacks the gasket material, eventually leading to failure of the gasket and water ingress resulting in electrical failure of the transformer. To address this issue, a refurbishment programme has begun to replace at risk gaskets, and to install replacement bushings with a partial semi-conductive coating around the flange area.

5.10 Ripple Control

Westpower sold all of its ripple relays to the new incumbent retailer on 31 March 1999 along with exclusive use of channels existing at that time. The ripple injection plants were retained for the purpose of load control as well as providing a load switching service to retailers under contract.

5.10.1 Ripple Injection Plants

All ripple injection plants are in good order as would be expected from their age profile. Nevertheless they are reaching the end of their useful life, with spare parts becoming increasingly difficult to obtain.

Because of their solid state construction, however, faults are unlikely to occur frequently.

It is, however, planned to replace the older units at Greymouth, Reefton and Hokitika substations with new plants over the following 3 years.

6.0 LIFECYCLE MANAGEMENT PLAN

6.0.1 Replacement v Maintenance Trigger

Westpower has a policy of retiring older assets that have reached the end of their economic life where there is no economic means of providing life extension. Some of the triggers which would suggest a replacement strategy be employed rather than ongoing maintenance would include:-

- More than 50% of a line section reaching replacement criteria within the following five year period when other work has to be carried out on that line
- Technical obsolescence
- Health and Safety Concerns (e.g. Series I Andelect Oil Filled Ring Main Units)
- Difficulty in obtaining spare parts
- Inability to meet current needs

Westpower also experiences severe corrosion in areas bear to the sea coast, and it is often more cost effective to install new corrosion resistant fittings, for instance, rather than continuing to repair existing fittings.

There is a natural business driver to maintain rather than replace in the form of tax benefits, and this provides a countervailing force which ensures that a reasonable balance is maintained between these two approaches.

6.1 Overview

This section outlines the lifecycle management plan required to maintain, enhance and develop the operating capability of the system. The programmes are outlined by asset type and, within this, according to area and then by maintenance activity.

- **Maintenance**
  – servicing, inspections and testing
  – fault repairs
  – planned repairs and refurbishment (including replacement at the component level)

- **Replacement**
  – planned replacement programmes (at the asset level)

- **Enhancement**

- **Development**

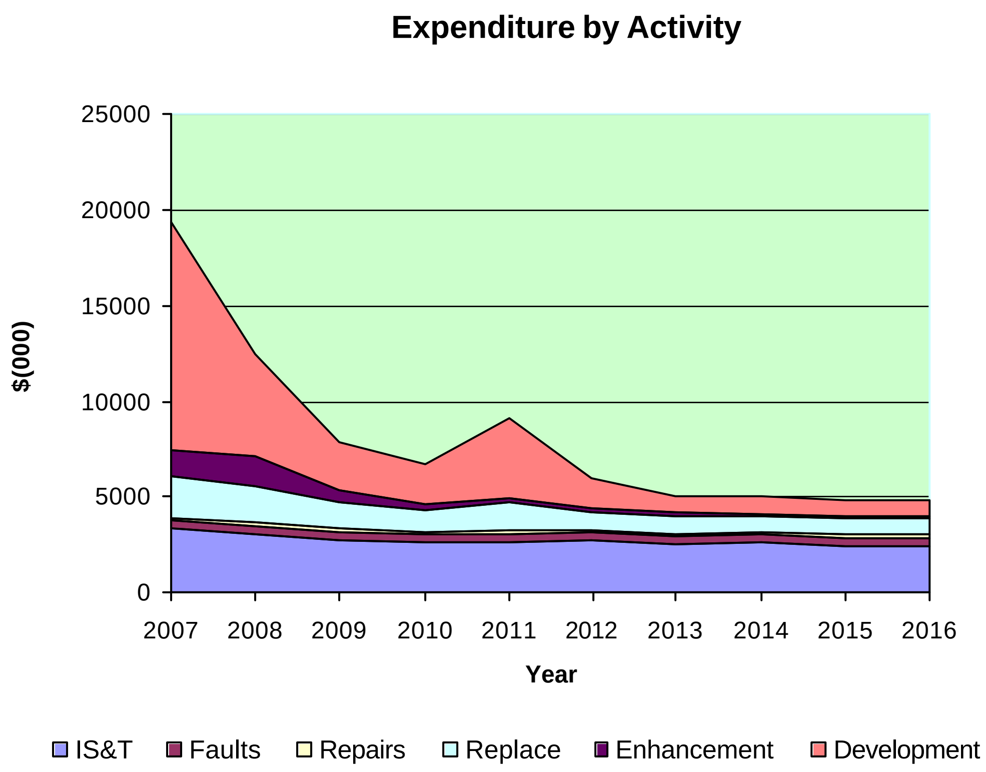
6.1.1 Maintenance

Maintenance Projects and Programmes ($'000)										
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Inspect Service & Test	3286	3062	2740	2570	2655	2690	2455	2575	2420	2410
Faults	412	412	412	412	412	412	412	412	412	412
Repairs	191	175	175	175	175	175	175	175	175	175
Total	**3890**	**3650**	**3328**	**3158**	**3243**	**3278**	**3043**	**3163**	**3008**	**2998**

Maintenance work is largely based on the condition of the assets, as outlined in section 5.

The scope of work planned under each maintenance activity is quantified wherever possible to assist in reviewing Westpower's achievement in future years. The estimated maintenance expenditure is projected in this section and where relevant, the consequences of the proposed maintenance programmes are noted. It should be noted that analysis of maintenance strategies and programmes is an ongoing process and the most cost-effective means of maintaining the system is constantly under review. In some instances (e.g. pole replacement) further investigation and analysis is required to determine a suitable strategy.

The maintenance requirements are influenced by development projects, many of which, if they proceed, will lead to dismantling and decommissioning of assets which would otherwise require significant repairs.



The base-line planned maintenance expenditure projections assume, for consistency within this plan, that development projects take place as projected in this section. It will be necessary to monitor closely the likelihood of each project proceeding and additional remedial work will need to be programmed if certain projects do not proceed or are significantly delayed.

(i) Repairs and Refurbishment

All line repairs are carried out to the requirements laid down in Westpower's line maintenance standards. These are based on international practice combined with local knowledge and New Zealand legislative requirements.

6.1.2 Replacements

Replacement Projects and Programmes ($'000)										
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Replacements	2169	1823	1380	1102	1400	890	930	845	815	815

(i) Major Refurbishment's

It is necessary to retain in service some older lines, which are in poor overall condition, and these lines require ongoing repairs and refurbishment.

Major refurbishment on all line types is estimated to absorb only a small proportion of the total money proposed to be spent on line work in any year.

(ii) Wood Poles and Crossarms

It is currently projected that approximately **250 poles would need changing** over the next year in order to cope with defects arising on the existing wood pole lines.

Wood poles are being changed to concrete or treated softwood wherever possible, due to the increasingly poor quality and increasing price of imported hardwoods from Australia. Local softwoods of the height and strengths needed are beginning to become more expensive and may require ground line preservation techniques to extend their in service life.

The use of concrete poles, providing they can be sourced at the right price from the local supplier, can result in significant savings in ongoing maintenance, increase line reliability, and increase line worker safety.

(iii) Conductors and Accessories

As a policy, all replacement Aluminium Conductor Steel Reinforced (ACSR) is being purchased with a greased core wire. Where corrosion resistance is critical in coastal areas, All Aluminium Alloy Conductor (AAAC) is used for its superior corrosion resistance properties

For larger conductors, with an aluminium cross-sectional area of over 95 mm2, Westpower policy is to use AAAC exclusively.

(iv) Insulators and Insulator Fittings

From the condition assessment programme it is estimated that there are approximately 300 33 kV EPDM strain insulators requiring replacement over the next 5 years to avoid an unnecessary risk of line drop or fault outages. These insulators have been proven to deteriorate rapidly after 10 years therefore a proactive approach is required to manage the risk of failure.

The replacement of such insulation is being afforded a high priority because of its immediate impact on system reliability, and because of the safety risk of line drops if the work is not attended to.

6.1.3 Enhancement

Enhancement Projects and Programmes ($'000)										
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Enhancements	1325	1605	610	375	225	155	145	105	105	105

This activity outlines work which is planned to enhance the system. By this, it means that this increases to the capacity of the system:

- provide more load
- enhance voltage regulation
- improve security and reliability

It includes projects (at specific sites) and programmes of related work covering a number of sites.

6.1.4 Development

Development Projects and Programmes ($'000)										
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Development	11960	5472	2445	2060	4190	1640	840	840	840	840

This section outlines the projects currently anticipated over the planning period. The nature of each project is briefly described along with the reason why it appears to be required. The justifications for including each of the projects in the plan are categorised as described in section 6, ie:

- specific customer requests (and commitment to incur project-related charges)
- anticipated demand growth
- to meet security planning guidelines
- economics (ie where the project produces overall cost savings)

The projects described in this section represent an indicative plan based on the best information currently available. There is currently no commitment by Westpower to undertake all or any of the specific projects listed, nor should customer commitment be inferred from the inclusion of any project in this plan, except where they are described as being already committed. Further, it should be noted that more detailed investigations will undoubtedly lead to changes in the scope of projects that do proceed. There may be considerable scope for integrated transmission/distribution system planning to achieve the required results by somewhat different means.

Because of the need for customer consultation and, in many cases, agreement, it is likely that some projects in the first half of the planning period will not proceed or will proceed later than indicated in this plan. Secondly, because investigations tend to be more focused on the short-to-medium term, it is likely that additional required projects will arise, particularly towards the end of the planning period.

Four of the larger industrial consumers have indicated they will draw more load as follows:

1. Solid Energy will increase load at the new Spring Creek mine. This load will be met by existing infrastructure.

2. Oceana Gold Ltd (OGL) have begun construction of the Globe Progress mine at Reefton with a projected 7 MW demand. This will require the construction of a new 33/11 kV zone substation at Globe and completion of the 33 kV line fmo Reefton Substation to Globe, much of which was completed by October 2005.

3. Pike River Coal are opening a new coal field at Pike River with an estimated demand of 14 MW. This will be supplied off the Dobson to Inangahua 110 kV transmission line via a new GXP teed off at Ahaura.

4. Westland Dairy Company have indicated an expansion of their current operations to include a new dryer as part of a protein extraction plant in 2006. This expansion will require an additional 4 MW of load.

Besides the above loads there has been considerable demand increase within the tourism industry. With all of the above activity there will also be multiplier effects flowing on into the residential and service sectors.

There are two specific projects anticipated however depending on the commitment of possible major new industrial projects

Project 07-6002 West Coast Grid Reinforcement 110 kV Line Dobson - Reefton

The West Coast has reached the end of its secure supply of electricity (measured by a single contingency or *n-1* scenario) presently supplied from Transpower's Coleridge and Inangahua substations and TrustPower's local generation. In other words, the load in the area often exceeds the maximum available supply under certain single contingencies such as the outage of Tranmspower's Inangahua-Dobson 110 kV line.

WCGR 110kV Lines and Substations

Studies have determined the most economical transmission enhancement is for a second single circuit 110 kV line to be built from Inangahua to Dobson and for Transpower to establish a second 110 to 66 kV interconnecting transformer at Dobson. The first stage of this line, from Inangahua to Reefton was completed in October 2005 to supply the new Reefton GXP, and the second stage from Reefton to Dobson will proceed once Transpower receive permission from the Electricity Commission to carry out the investment. As part of this approval process, the project will need to pass the Grid Investment Test and then be included in an approved Grid Upgrade Plane.

Further details of this project are included in Transpower's Annual Planning Report.

As there is still some uncertainty as to who will be building this infrastructure, it has been kept in this AMP for the time being.

Project 07-6001 Pike River Coal – Build new 33 kV sub transmission line

Pike River Coal are opening a new coal field at Pike River with a forecast demand of 14 MW. This will be supplied via a tee off to Transpower's Inangahua to Reefton 110 kV line at Atarau and involve a new GXP.

A switching station will be required at Atarau and this will become a new GXP.

Westpower is to construct a new 8 km 110 kV line from Atarau to the 110/33/11 kV 20/30 MVA Logburn Substation, and then a further 8 km of 33 kV line to a 33/11 kV 15/20 MVA substation at the Pike mine site. The key details are shown in Fig 4.14(b) below

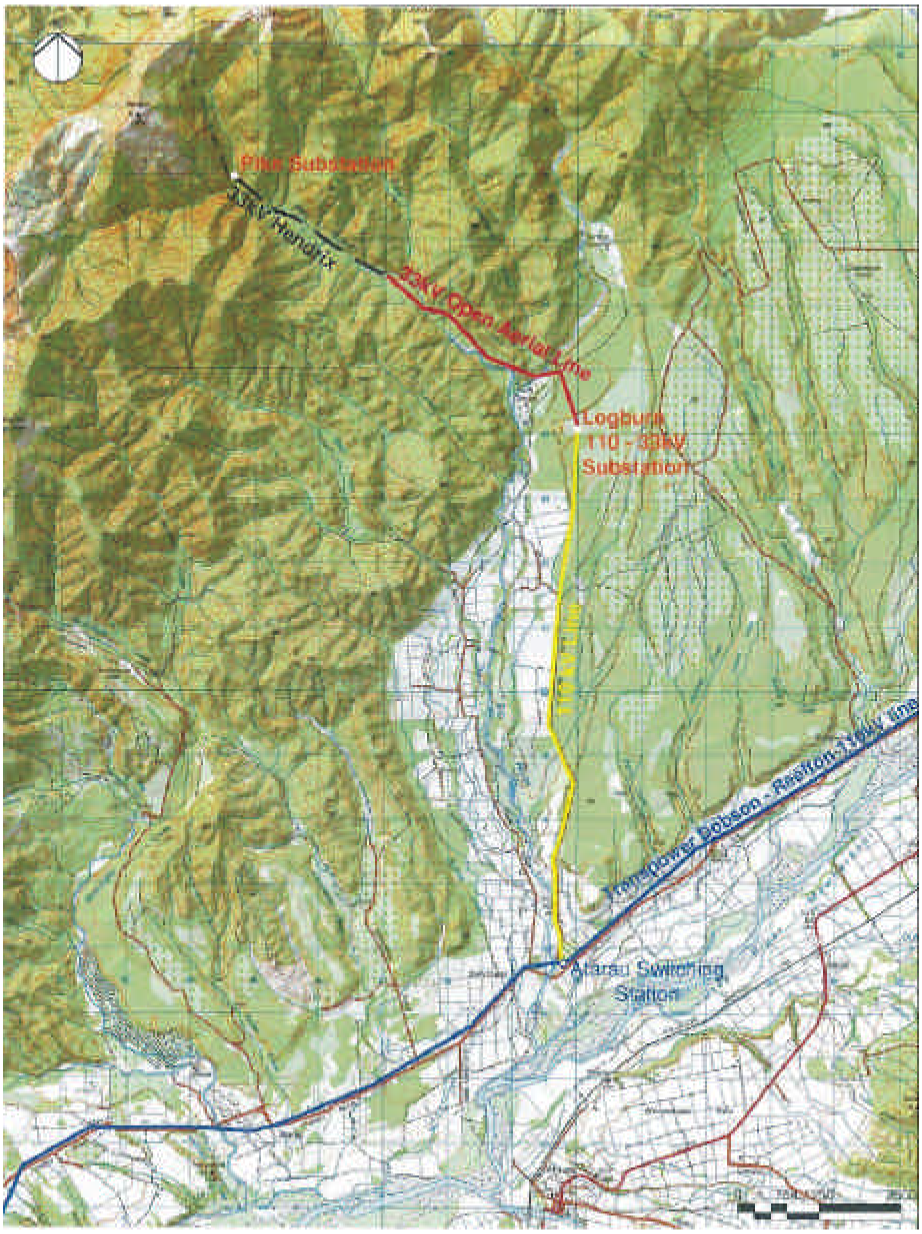


Figure 4.14(b) Pike River Line Details

6.2 Sub-Transmission Assets

As discussed in section 4, this asset class involves 33 kV and 66 kV power lines. The 66 kV assets are leased to Transpower and are a critical factor in the reliability of the national grid in the area. Accordingly, a higher standard of care and maintenance is required.

6.2.1 Greymouth-Kumara 66 kV Line

The age of this asset is approaching mid-life requiring increased levels of inspection to manage risk and identify early signs of deterioration.

Sub-Transmission Replacement Projects and Programmes ($'000)										
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Inspect Service & Test	3286	3062	2740	2570	2655	2690	2455	2575	2420	2410
Faults	412	412	412	412	412	412	412	412	412	412
Repairs	191	175	175	175	175	175	175	175	175	175
Replacements	2169	1823	1380	1102	1400	890	930	845	815	815
Enhancements	1325	1605	610	375	225	155	145	105	105	105
Development	11960	5472	2445	2060	4190	1640	840	840	840	840
Total	**19344**	**12550**	**7763**	**6695**	**9058**	**5963**	**4958**	**4953**	**4768**	**4758**

6.2.1.1 Maintenance

(i) Routine Patrols and Inspections

An aerial and ground patrol of this line is performed annually. Fault patrols and fault repairs are carried out on an as required basis.

In addition to patrols, a detailed inspection of the entire line was carried out in 2003. During this inspection every aspect of the line was checked and recorded. The results will determine the extent of maintenance to be carried out in the coming years.

A full 100% ground line inspection, including ultrasonic pole density analysis was carried out in 1998 to give a baseline for future inspections.

Thermographic surveys are carried out on an annual basis to check for hot joints that could lead to later failure.
These surveys are normally carried out at times of high load such as the winter period to increase the chances of detecting a marginal joint.

A tree trimming regime has been established due to the high growth experienced on the West Coast. This entails the sub-transmission lines being cleared of vegetation every two years so as to reduce the incidence of accidental contact during storm conditions.

Project 07-1002: GYM-KUM 66 kV Line General Maintenance

The Greymouth - Kumara cct is a vital component within the Westpower network. With the line nearing 30 years old, more general maintenance is required. Funds shall be allocated for work such as pole straighten-

ing, earth bracket maintenance, insulator maintenance etc.

Project 07-1003: GYM - KUM Porcelain Strain Disc Replacement

In the 2003-04 financial year a number of existing porcelain discs on the GYM-KUM cct were removed for inspection. This inspection revealed that the steel work has corroded to the point replacement is nessessary. All porcelain discs shall be replaced over a five year period, starting at Grey Substation and working through to Kumara.

(ii) Faults

The level of fault occurrence is closely linked to condition of the asset and to external factors such as climatic conditions.

As far as climatic conditions are concerned, lightning and windstorms are usually the greatest sources of problems. This line has also at times developed transient earth faults during wet weather after long dry spells, possibly symptomatic of insulator contamination, but this is very rare.

It is very difficult to predict the number of faults from year to year due to climatic conditions. An estimate for fault work is provided based on information in the Job Costing and Service Maintenance Management systems now used by the Asset Management Division.

(iii) Repairs and Refurbishment

All line repairs are carried out to the requirements laid down in Westpower line maintenance standards. These are based on international practice combined with local knowledge and legislative requirements.

A decision will be made on possible insulation replacement toward the middle of the planning period once quantitative data has been gathered on the actual condition of the current insulators.

(iii) Replacement

Project 07-4001: GYM-KUM 66 kV Pole Replacement

The Condition Assessment programme has revealed several poles and crossarms require replacement. Funds have been made available to replace any of these line components on an ongoing basis.

6.2.1.2 Enhancement

As a condition of the lease of this asset to Transpower, a circuit rating of 35 MVA must be maintained. The current Dog ACSR conductor has a summer time rating slightly below this value and re-conductoring may be required in the future.

Notwithstanding this, Transpower have accepted the current circuit rating until the full rating is required and it is very unlikely that load growth within the planning period will require the extra capacity.

6.2.2 Kumara-Kawhaka 66 kV Line

6.2.2.1 Maintenance

(i) Routine Patrols and Inspections

Fault patrols and fault repairs are carried out on an as required basis.

This line, although only 7 years old, will be included in the condition assessment programme , with 20 percent

of the line thoroughly inspected annually. This will be in additional to a full ground and aerial patrol annually.

All joints used are of the compression type and were carefully tested by micro-ohmmeter during installation. As a result, thermograph surveys are unlikely to be of any benefit throughout the planning period and are not planned for.

(ii) Faults

The level of fault occurrence is closely linked to condition of the asset and to external factors such as climatic conditions.

As far as climatic conditions are concerned, lightning is the most likely cause of problems. In the time that the line has been in service, it has only sustained one transient fault, and this was during a severe lightning storm.

(iii) Repairs and Refurbishment

No repairs or refurbishment is planned for this line. Trees likely to cause a problem were cleared from the route prior to construction and will not impact on the reliability of the line during the first half of the planning period

6.2.2.2 Enhancement

With the exception of the possible installation of enhanced lightning protection, should this prove necessary, no enhancement programmes are planned for this asset.

6.2.3 North Westland 33 kV Network

With the exception of the Dobson-Arnold Line, all of the lines in this area were constructed since 1984 giving a maximum age of only 21 years. The median age of this asset group is less than ten years.

The age of the Dobson-Arnold line at around 60 years warrants higher levels of inspection and refurbishment In addressing this matter, a programme has been implemented to renew any pole identified as defective over a five year period.

6.2.3.1 Maintenance

(i) Routine Patrols and Inspections

Fault patrols and fault repairs are carried out on an as required basis.

In addition to patrols, a detailed inspection of this line is to be carried out on a rolling 5-year basis, covering 20% of the route length per year. During the inspection every aspect of the line is checked. The aim is to identify and document all components that do not meet Westpower standards.

The Dobson-Arnold line had a major inspection completed in 1997 which included an assessment of pole and hardware condition as well as an estimate of the pole safety factors in terms of bending moment. All poles were shown to be adequate at the time, however the age of the line means that annual general inspections will continue to be carried out.

All pole hardware will be included in the inspections.

Project 07-1001: ALD-DOB 33 kV Line Pole Replacement

With some sections of the 33 kV line between the Dobson Substation and the Arnold Substation being part of the original line built in 1932, it is imperative poles which have reached replacement criteria be renewed. A condition assessment programme on the line has indicated another eight poles will require replacement this

year.

A regular annual thermographic survey will be carried out on these lines to monitor the condition of joints.

(ii) Faults

The level of fault occurrence is closely linked to condition of the asset and to external factors such as climatic conditions.

As far as climatic conditions are concerned, lightning and windstorms are usually the greatest sources of problems.

It is very difficult to predict the number of faults from year to year, due to climatic conditions. An estimate for fault work is provided based on information gathered in the Job Costing system and Service Maintenance Management system and Lightning Tracking software now used by the Asset Management Group.

(iii) Repairs and Refurbishment

All line repairs are carried out to the requirements laid down in Westpower's line maintenance standards. These are based on international practice combined with local knowledge and legislative requirements.

With the above exceptions, no repair or refurbishment work is required on the concrete pole lines because of the low average age.

The Arnold-Dobson line will require individual pole replacement as well as re-conductoring and re-insulation within the next ten years unless a planned enhancement project proceeds.

(iv) Replacement

If the level of refurbishment on the Arnold-Dobson line becomes greater than 50% of the asset, complete line replacement may be more cost effective. This will be reviewed toward the end of the planning period.

No replacement is foreseeable on the concrete pole lines.

6.2.3.2 Enhancement

Enhancement of any of the concrete pole sections is not envisaged unless driven by a major load increase. In this case, re-conductoring is the most likely activity.

The capacity of the existing Arnold-Dobson line is sufficient for the 3 MW Arnold Power Station to connect into the grid, but has no spare capacity. Any significant increase in the injection demand at this site up to approximately 5 MW will require the Arnold-Dobson line to be upgraded by re-conductoring and partial re-poling.

6.2.3.3 Development

Project 07-6001: Atarau - Logburn Road, Construct 110 kV Line

Project 07-6006: RFT-GLB - RGSP Macraes 33 kV Line to Globe Hill

6.2.4 South Westland 33 kV Network

Projected Sub-Transmission Expenditure

I,S&T Sub-Transmission - Tree Trimming ($'000)											
	Area	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Atarau - Logburn Road 110 kV Tree Timming	ATU-LGN	15	15	15	15	15	15	15	15	15	15
Dobson Arnold 33 kV Line Tree Trimming	DOB1382	15	15	15	15	15	15	15	15	15	15
Dobson Rapahoe 33 kV Line Tree Trimming	DOB1322	13	13	13	13	13	13	13	13	13	13
Dobson Reefton 33 kV Line Tree Trimming	DOB1362	13	13	13	13	13	13	13	13	13	13
Franz - Fox 33 kV Line Tree Trimming	HKK1012	20	20	20	20	20	20	20	20	20	20
Franz-Fox 33 kV Tree Trimming	HKK1012	10	10	10	10	10	10	10	10	10	10
Greymouth Kumara 66kV Line Tree Trimming	GYM-KUM	15	15	15	15	15	15	15	15	15	15
Harihari Wahapo 33 kV Line Tree Trimming	HKK1012	7	7	7	7	7	7	7	7	7	7
Hokitika Harihari 33kV Line Tree Trimming	HKK1012	20	20	20	20	20	20	20	20	20	20
IGH-RFT 110 kV Line Tree Trimming	IGH1372	13	13	13	13	13	13	13	13	13	13
Kumara Kawhaka 66kV Tree Trimming	KUM-KAW	13	13	13	13	13	13	13	13	13	13
Logburn Road - Pike River 33 kV Tree Trimming	LGN-PIK	13	13	13	13	13	13	13	13	13	13
Reefton - Globe Hill 33 kV Tree Trimming	RFT-GLB	13	13	13	13	13	13	13	13	13	13
Two Mile Road Hokitika 66kV Tree Trimming	HKK1012	7	7	7	7	7	7	7	7	7	7
Wahapo Franz 33 kV Line Tree Trimming	HKK1012	10	10	10	10	10	10	10	10	10	10
Total		197	197	197	197	197	197	197	197	197	197

I,S&T Sub-Transmission - Condition Assessment ($'000)											
Sub-Transmission	Area	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Dobson Arnold 33 kV Line Condition Assessment	DOB1382	10	10	10	10	10	10	10	10	10	10
Dobson Rapahoe 33 kV Line Condition Assessment	DOB1322	10	10	10	10	10	10	10	10	10	10
Dobson Reefton 33 kVLine Condition Assessment	DOB1362	10	10	10	10	10	10	10	10	10	10
General Sub-Transmission Condition Assessment	SYS	10	10	10	10	10	10	10	10	10	10
Greymouth Kumara 66kV Line Condition Assessment	GYM-KUM	0	0	10	10	10	10	10	10	10	10
Harihari Franz 33 kVLine Condition Assessment	HKK1012	10	10	10	10	10	10	10	10	10	10
Hokitika Harihari 66kV Line Condition Assessment	HKK1012	0	0	0	10	10	10	10	10	10	10
IGH-RFT 110 kV Line Condition Assessment	IGH1372	0	0	0	5	0	0	0	0	0	0
Two Mile Hokitika 66kV Line Condition Assessment	HKK1012	2	2	2	2	2	2	2	2	2	2
Total		**52**	**52**	**62**	**77**	**72**	**72**	**72**	**72**	**72**	**72**

		Sub-Transmission Projects ($'000)											
ID	Act	Project Description	Area	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
07-6001	D	Atarau - Logburn Road, Construct 110 kV Line	ATU-LGN	800	0	0	0	0	0	0	0	0	0
07-1001	I	Arnold Dobson 33 kV Line Pole Replacement	DOB1382	25	25	25	25	25	0	0	0	0	0
-	E	GYM - KUM 66 kV cct Reconductor	GYM-KUM	0	0	0	0	100	100	50	50	50	50
07-1002	I	GYM-KUM 66 kV Line General Maintenance	GYM-KUM	20	20	20	20	20	20	20	20	20	20
07-1003	I	GYM - KUM Porcelain Strain Disc Replacement	GYM-KUM	18	18	18	0	0	0	0	0	0	0
07-4001	RPL	GYM-KUM 66 kV cct Pole Replacement	GYM-KUM	30	60	20	20	20	20	60	20	20	20
07-1004	I	HKK-HHI Porcelain Disc Replacement	HKK1012	60	60	60	60	60	0	0	0	0	0
07-1005	I	Mount Hercules 33 kV Line Pole Replacement	HKK1012	40	40	60	15	0	0	0	0	0	0
07-1006	I	HKK-HHI Condemned pole replacement	HKK1012	100	100	100	100	100	100	100	100	100	100
07-1007	I	Franz Josef - Fox Glacier 33 kV Line Maintenance	HKK1012	4	4	15	15	15	15	15	15	15	15
07-1008	I	HHI-HKK - Maintenance of Tower Legs	HKK1012	80	10	10	0	0	0	0	0	0	0
-	I	Hendrix Line Pole Replacement	HKK1012	0	0	0	30	30	0	0	0	0	0
07-4002	RPL	Replace ABC with Hendrix Cable - Wahapo	HKK1012	150	0	0	0	0	0	0	0	0	0
07-6002	D	WCGR 110 kV Line Dobson-Reefton	IGH	3000	4500	0	0	0	0	0	0	0	0
07-6003	D	WCGR 110 kV Line Inangahua Reefton	IGH372	50	0	0	0	0	0	0	0	0	0
07-6004	D	Pike River Coal - Communications	PIK	100	0	0	0	0	0	0	0	0	0
07-6005	D	Pike River Coal – Build new 33 kV sub transmission line	PIK	800	0	0	0	0	0	0	0	0	0
07-6006	D	RFT-GLB - RGSP Macraes 33 kV Line to Globe Hill	RFT	30	0	0	0	0	0	0	0	0	0
-	D	SWGR Build New 33 kV Line Butlers - Kokatahi	RSS	0	0	0	0	0	350	0	0	0	0
-	D	SWGR Build New 33 kV Line to Ross	RSS	0	0	0	0	700	0	0	0	0	0
-	D	Construct New 66 kV line, Dobson to Kumara	SYS	0	0	1000	1000	0	0	0	0	0	0
07-1009	I	River Protection Works for Subtransmission Lines	SYS	20	20	20	20	20	20	20	20	20	20
07-1010	I	Carry out thermovision inspections of subtransmission lines	SYS	10	10	10	10	10	10	10	10	10	10
07-1011	I	Weed Spray Access Tracks and Various Line Routes	SYS	15	15	15	15	15	15	15	15	15	15
07-1012	I	General Maintenance of subtransmission lines	SYS	15	15	15	15	15	15	15	15	15	15
07-1013	I	Corona Discharge Testing at Various Subtransmission Lines	SYS	15	15	10	10	10	10	10	10	10	0
07-1014	I	Access Road Maintenance	SYS	30	30	30	30	20	20	20	20	20	20
07-4003	RPL	Replace All 33 kV EPDM Strain Insulators	SYS	25	25	25	0	0	0	0	0	0	0
		Total		5437	4967	1453	1385	1160	695	335	295	295	285

Much of the network in South Westland was constructed at the same time as that in North Westland and the same comments apply to both areas.

South Westland does have some unique features, though, in the wood pole Mt Hercules section of the Harihari-Whataroa line and the fully insulated overhead cable routes around Lakes Wahapo and Mapourika, which require special management

The Mount Hercules line, with an age of 34 years, is to be refurbished over the next five years due to the deterioration of poles and conductor. This line provides an essential link to South Westland, therefore demanding priority within maintenance programmes.

With the addition of the Fox Glacier 33/11 kV substation on the network in 2003, the 11 kV line from Franz Josef to Fox Glacier was uprated to 33 kV. This line had major refurbishment work carried out at this time and should not need any further major maintenance work for some time.

6.2.4.1 Maintenance

(i) Routine Patrols and Inspections

Fault patrols and fault repairs are carried out on an as required basis.

In addition to patrols, a detailed inspection of this line is to be carried out on a rolling 5-year basis, covering 20% of the route length per year. During the inspection every aspect of the line is checked. The aim is to identify and document all components that do not meet Westpower standards.

All pole hardware will be included in the inspections.

A regular annual thermographic survey will be carried out on these lines to monitor the condition of joints.

Project 07-1004: HHI-HKK Porcelain Disc Replacement

Many of the 6300 suspension insulators on the HHI-HKK cct are porcelain pre 1970 type insulators. To ensure network security to the South Westland area these discs will need to be replaced with the glass type disc insulator. This project involves replacing these discs and will also include the insertion of an additional glass disc where any insulator strings are found to only have four discs per string.

Project 07-1006: HKK-HHI Condemned Pole Replacement

This project will see approximately 10 poles, which have been identified as reaching replacement criteria, being replaced on an on-going basis. This is a risk mitigation exercise and any work carried out will be appropriate for future operation of 66 kV.

Project 07-1005: Mount Hercules 33 kV Line Pole Replacement

The continuation of the Mt Hercules 33 kV Line Pole Replacement project will see a further 7 poles be replaced in the 06-07 financial year. This is a risk mitigation exercise and will be an ongoing project, which when complete will see complete pole replacement across the entire Mt Hercules section of line.

Project 07-1007: Franz Josef - Fox Glacier 33 kV Line Maintenance

The Fox-Franz 33 kV line was given a large refurbishment in 2003/04 year, the criteria was to replace any component that did not have five years life in it, unless a pole or component could be replaced live. Little maintenance should be required on the line itself for five years. In the mean time $4k per year shall be allowed for minor works or the occasional live line pole replacement.

Project 07-1008: HHI-HKK - Maintenance of Tower Legs

A recent condition assessment on the towers near Evans Creek and the Wanganui River crossing has determined the tower legs are deteriorating and require remedial work. There are four towers on the HHI-HKK circuit. 2005-06 has seen a design of new tower footings for 70419 - 70420 (Evans Creek) complete and this financial year will see this design carried out. These towers shall be painted at the same time. Included this year will be an inspection of towers 70459 and 70460, with the intention of forecasting maintenance required for next year.

(ii) Faults

The level of faults in this area is similar to that in North Westland. It may be reasonably argued however that the incidence of heavy rain, strong winds and lightning is slightly higher than in other areas.

(iii) Repairs and Refurbishment

All line repairs are carried out to the requirements laid down in Westpower line maintenance standards. These are based on international practice combined with local knowledge and legislative requirements.

(iv) Replacement

Project 07-4002: Replace ABC with Hendrix Cable - Wahapo

The extensive fault recovery duration coupled with lack of available spares has deemed the Aerial Bundled Cable at Wahapo an undesirable network component. The prefered replacement is the Hendrix system, which has proved to be very reliable with a short repair time. Spares are readily available. The existing ABC to be replaced in the current year is approximatley 1.5 km in length.

6.2.4.2 Enhancement

As the load in South Westland rises, it will be necessary to provide more capacity between Harihari and Whataroa to meet the substantially increased load being supplied south of Whataroa substation. The maximum acceptable load on this circuit without incurring excessive volt drop is 2.0 MVA. This gives little margin when supplying the present tourist season peak load of 1.6 MVA. Additional reactive support has been installed along with the installation of 33 kV regulators at Harihari in 2004 to overcome unacceptable voltage regulation, particularly when Wahapo Power Station is not running. As the load continues to grow in South Westland, a decision will need to be made on when to increase the sub-transmission voltage from 33 kV to 66 kV. The line from Arahura to Harihari was originally built as a 66 kV line by the New Zealand Electricity Department in the mid-1960's, and was then leased to Westpower for operation at 33 kV in 1993 before finally being sold to Westpower in 2001. It is therefore relatively easy to re-liven the line at 66 kV in the future.

Of course, this will also mean that Zone Substations at Ross and Waitaha need to be upgraded to run at 66 kV and a new 66/33 kV substation must be established at Harihari.

Based on current load growth projections, it is likely that the conversion will need to take place around 2007. Additional reactive support has been installed along with installation of 33 kV regulators at Harihari in 2004 to overcome unacceptable voltage regulation, particularly when Wahapo Power Station is not running.

6.2.4.3 Development

No major development work is planned on this network within the planning period. Any development that does come about will likely be driven by customer requirements.

6.2.45 Other 33 kV Network Projects

Project 07-1009: Protection Works for Sub transmission Lines

In recent times it has been nessessary to install river protection works for subtransmission lines, particually near major rivers. Erosion around structures has been an ongoing problem therefore a contingency sum will be allocated in the AMP for such protection works.

Project 07-1010 Carry out thermovision inspections of subtransmission lines

To identify high resistant joints present on sub-transmission lines, a thermovision inspection programme is to be carried out. Strategic lines shall be inspected on a rotational basis, with each line being reviewed every three years.

Project 07-1011 Weed Spray Access Tracks and Various Line Routes

To avoid brush and scrub regrowth along access tracks and under sections of subtransmission lines, a weed spraying programme shall be initiated. Annual subtransmission line patrols shall identify areas requiring such work.

Project 07-1012 General Maintenance of subtransmission lines

The condition assessment programme has highlighted the need for general minor maintenance to be carried out annually on Westpower's sub transmission circuits. Such maintenance may include earth repairs, pole step replacement and stay repairs.

Project 07-1013 Corona Discharge Testing at Various Subtransmission Lines

To identify any failing insulation on subtransmission lines, a corona discharge inspection programme is to be carried out. Strategic lines shall be inspected on a rotational basis, with each line being reviewed every three years.

Project 07-1014: Access road maintenance

To assist in the swift restoration of faults in the area it is imperative that access to lines are kept open and clear. Westpower administers many access roads, particularly roads adjacent to sub-transmission lines.

Project 07-4003: Replace all 33 kV EPDM strain insulators

The rapid deterioration of the EPDM type strain insulators has forced the replacement of this type of insulator system wide. Glass strain type insulator strings will be used as replacement discs. This is an on going project until all 33 kV EPDM strain insulators are replaced. This financial year will see the "Dobson-Stillwater Triangle" area targeted for replacement.

6.3 Distribution Assets

These assets comprise the majority of Westpower's network by distance and value. As a logical result of this, the asset type also accounts for the greatest share of maintenance and enhancement expenditure.

6.3.1 Reefton Area

The main feeders in the Reefton Area have been completely replaced over the last ten years with the exception of Reefton Township itself, Inangahua to the Iron Bridge and the line to Garvey's Creek.

6.3.1.1 Maintenance

(i) Routine Patrols and Inspections

The 2006-07 financial year will see the continuation of the condition assessment programme. Each line (feeder) is to be inspected on a rolling 5-year basis, covering 20% of the route length per year. During the inspection every aspect of the line is checked.

Fault patrols and fault repairs are carried out on an as required basis.

(i) Faults

Faults in the Reefton area, like many others, are dependent on climatic conditions.

Trees have been a major problem in this area, particularly on the Garvey's Creek line, which runs through heavily forested areas including a pine plantation. A major tree-trimming project in 1998 coupled with harvesting of mature pine trees in the pine plantation has reduced this risk, but it is still considerable.

A fault base will be maintained in the Reefton area contracted to ElectroNet Services for the foreseeable future to minimise the repair times that are involved during outage.

(ii) Repairs and Refurbishment

The condition assessment project discussed previously is likely to highlight several components requiring replacement on those lines. This will be handled by a live-line refurbishment programme including individual pole, crossarm, insulator and conductor replacement where required.

Project 07-1101: Upper Buller Gorge 11 kV pole replacement

Pole replacement through the Upper Buller Gorge is to take place on a priority basis. Five poles have been identified as requiring replacement this year.

(iii) Replacement

Project 07-4126: Mawheraiti Thompsons Road, 11 kV Pole Replacement

Continuing from last years project, a further 10 poles shall be replaced along Thompsons Road. Hardwood poles 9946-9958 shall be replaced, along with the replacement of 1900 m of Mullet with Ferret ACSR.

Project 07-4129: Hukarere, Mossy Creek Rd, 11 kV Line Replacement

Built in 1962, the section of line traversing Mossy Creek Road from Snowy River Road to Lemons property (S211) is beyond it's serviceable life. This project will eventually include the replacement of all substandard hardwood poles and associated fittings with 4-5 poles replaced per year. This financial year will see the continuation of pole replacement.

Project 07-4134 Inangahua Junction T Lees, 11 kV Line Replacement

With sections of the line between the Railway at Inangahua Junction and T Lees, Browns Creek Road exceeding 30 years old, replacement of the poles is due. This year will see four hardwood poles replaced, from pole 08925 to S573 on pole 08929 inclusive. The existing Mullet ACSR conductor shall be replaced with Ferret next year.

Project 07-4135: Lower Buller Gorge, 11 kV Pole Replacement

As with the previous financial year, 2006-07 will see the replacement of hardwood poles in the Lower Buller Gorge area carried out on a priority basis. Ten poles, along with associated fittings have been identified as reaching replacement criteria.

Project 07-4136: Maimai Valley, Replace 11 kV Poles

The vast majority of hardwood poles on the Maimai Valley 11 kV line have been replaced in the past with concrete poles. One of the final sections, originally built in 1956, shall be replaced in this financial year. The project consists of the replacement of six hardwood poles and associated fittings. Poles 09780 - 09785 (incl) are the poles tagged for replacement.

Project 07-4137: Hinau, Replace 11 kV Poles

much of the 11 kV line at Hinau has been replaced over recent years. Easement agreements will see a section of line relocated away from the shelterbelt.

Project 07-4138 Crushington-Garveys Creek, 11 kV Line Replacement

The 11 kV line from disconnector WR15 to the Garvey's Creek spur is now 44 years old and reached the end of it's serviceable life. Many of the hardwood poles are showing signs of rot and general deterioration. Carried out over three years, this project will see the eight hardwood poles and associated hardware from WR12 to pole 09415 (incl) replaced in this financial year,ten poles from 09143 to 09404 replaced in the 07-08 financial year and the remaining eight hardwood poles from 09403 to WR15 replaced the following year. The existing 7/092 conductor will also be replaced with Iodine AAAC, with 1700 m strung each year, over the final two years.

6.3.1.2 Enhancement

Project 07-5104: Reefton Ring, Upgrade 11 kV Line

A continuation of the project begun late last financial year, this project will see the completion of the 11 kV line upgrade in the Sheil and Times Street area.

6.3.1.3 Development

Project 07-6101: RGSP Globe Hill - Build Distribution Lines for Mine Site

As a part of the Globe Mine reopening, the mine will require 11 kV site services. A reticulation plan is being formed for construction.

6.3.2 Greymouth Area

This is the largest area within Westpower's district and also involves the greatest diversity of line types and condition.

6.3.2.1 Maintenance

(i) Routine Patrols and Inspections

The 2006-07 financial year will see the continuation of the condition assessment programme. Each line (feeder) is to be inspected on a rolling 5-year basis, covering 20% of the route length per year. During the inspection every aspect of the line is checked.

As for the Reefton area, it is expected that this will form the basis of a repair programme involving individual component replacements throughout the planning period.

Fault patrols and fault repairs are carried out on an as required basis.

A regular annual thermograph survey will be carried out on selected high-density lines to monitor the condition of joints.

(ii) Faults

Faults in the Greymouth area, are normally caused by wind and lightning

Distribution Projects and Programmes ($'000)										
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Inspect, Service & Test	1107	1107	1090	1070	1070	1070	1070	1070	1070	1070
Faults	285	285	285	285	285	285	285	285	285	285
Repairs	71	55	55	55	55	55	55	55	55	55
Replacements	1285	963	830	742	780	690	690	615	615	615
Enhancement	185	180	160	30	30	0	0	0	0	0
Development	845	242	245	60	0	0	0	0	0	0
Total	**3778**	**2832**	**2665**	**2242**	**2220**	**2100**	**2100**	**2025**	**2025**	**2025**

Inpection, Service and Testing - Condition Assessment ($'000)											
	Area	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Arnold Feeder 3 Condition Assessment	ALD3	1	1	1	1	1	1	1	1	1	1
Arnold Feeder 4 Condition Assessment	ALD4	5	5	5	5	5	5	5	5	5	5
Dillmans Feeder 4 Condition Assessment	DIL4	2	2	2	2	2	2	2	2	2	2
Dobson Feeder 1 Condition Assessment	DOB1	2	2	2	2	2	2	2	2	2	2
Dobson Feeder 3 Condition Assessment	DOB3	2	2	2	2	2	2	2	2	2	2
Franz Feeder 1 Condition Assessment	FRZ1	2	2	2	2	2	2	2	2	2	2
Franz Feeder 3 Condition Assessment	FRZ3	1	1	1	1	1	1	1	1	1	1
Greymouth Feeder 11 Condition Assessment	GYM11	2	2	2	2	2	2	2	2	2	2
Greymouth Feeder 12 Condition Assessment	GYM12	1	1	1	1	1	1	1	1	1	1
Greymouth Feeder 13 Condition Assessment	GYM13	1	1	1	1	1	1	1	1	1	1
Greymouth Feeder 6 Condition Assessment	GYM6	1	1	1	1	1	1	1	1	1	1
Greymouth Feeder 7 Condition Assessment	GYM8	2	2	2	2	2	2	2	2	2	2
Harihari Feeder 1 Condition Assessment	HHI1	1	1	1	1	1	1	1	1	1	1
Harihari Feeder 3 Condition Assessment	HHI3	1	1	1	1	1	1	1	1	1	1
Hokitika Feeder 10 Condition Assessment	HKK10	8	8	8	8	8	8	8	8	8	8
Hokitika Feeder 12 Condition Assessment	HKK12	1	1	1	1	1	1	1	1	1	1
Hokitika Feeder 4 Condition Assessment	HKK4	2	2	2	2	2	2	2	2	2	2
Kumara Feeder 1 Condition Assessment	KUM1	2	2	2	2	2	2	2	2	2	2
Kumara Feeder 2 Condition Assessment	KUM2	1	1	1	1	1	1	1	1	1	1
Ngahere Feeder 1 Condition Assessment	NGH1	2	2	2	2	2	2	2	2	2	2
Ngahere Feeder 3 Condition Assessment	NGH3	5	5	5	5	5	5	5	5	5	5
Otira Feeder 1062 Condition Assessment	OTI1062	1	1	1	1	1	1	1	1	1	1
Rapahoe Feeder 1 Condition Assessment	RAP1	2	2	2	2	2	2	2	2	2	2
Rapahoe Feeder 3 Condition Assessment	RAP3	2	2	2	2	2	2	2	2	2	2
Reefton Feeder 4 Condition Assessment	RFN4	2	2	2	2	2	2	2	2	2	2
Reefton Feeder 5 Condition Assessment	RFN5	2	2	2	2	2	2	2	2	2	2
Ross Feeder 1 Condition Assessment	RSS1	0.3	0	0	0	0	0	0	0	0	0
Ross Feeder 3 Condition Assessment	RSS3	0.8	1	1	1	1	1	1	1	1	1
Wahapo Feeder 1 Condition Assessment	WAH1	0.8	1	1	1	1	1	1	1	1	1
Whataroa Feeder 1 Condition Assessment	WAT1	1.5	2	2	2	2	2	2	2	2	2
Waitaha Feeder 1 Condition Assessment	WTH1	0.8	1	1	1	1	1	1	1	1	1
Total		**51**	**51**	**51**	**51**	**51**	**51**	**51**	**51**	**51**	**51**

Trees have been a major problem in this area, and a regular tree-trimming programme carried out at a feeder level will contain this.

The base for Westpower's contractor ElectroNet Services is located in Greymouth, and this will continue to serve as a fault base for the area.

(iii) Repairs and Refurbishment

Previous inspection projects have highlighted several components requiring replacement on the Nelson Creek, Blackball, Haupiri and Kopara lines. This will be handled, where possible, by a live-line refurbishment programme including individual pole, crossarm, insulator and conductor replacement where required.

An ongoing programme to replace very old service poles will continue as required.

(iv) Replacement

With several lines within the Greymouth area and surrounding districts reaching the end of their economic lives, projects have been initiated to replace these lines. Some projects involve the replacement of conductor and poles, while others will see only the poles being replaced.

Project 07-4101: Blair Block 11 kV Line Replacement

The 2006-07 financial year will see the continuation of the Blair Block 11 kV line replacement programme. The line will be upgraded from the final pole of the 03-04 project to the end of the line. All existing hardwood poles along with associated fittings and conductor are to be replaced over a two year period. Timing of the project will depend on Land Corp requirements.

Project 06-4102: Haupiri Line 11 kV Line Upgrade

An ongoing project, the 11 kV Upgrade - Haupiri Line project will eventually see the entire Haupiri line replaced. Much of this work has been completed previously, however a substantial amount has yet to be done. The 06-07 financial year will see the continuation of the line replacement from Simpsons Hill to Birchfields. The line through the tram past Birchfileds to the Gloriavale Christian Community will be replaced in the 07-08 period with the remainder of the line requiring replacement to the Ahaura-Kopara being completed in the following 5 years.

Project 07-4103: Moana-Ruru, 11 kV Pole Replacement

This project will see the continuation of the 03-04 stage of the 11 kV line replacement along Arnold Valley Road, from Moana to Ruru. This year will see the 7 hardwood poles between pole 01827 and 22413 replaced along with 750 m Iodine AAAC strung. Several of these poles are in very inhospitable postions, increasing costs for installation.

Project 07-4104: Inchbonnie - McArthur Road, replace Squirrel conductor with Mink

To continue the strengthening of the section of line between DIL4 and ALD4 feeders, a 500m section of line between XD20 and XD41 will require the conductor uprated. The existing Squirrel shall be replaced with Mink.

Project 07-4105: Duffers - Wainihinihi River, 11 kV Line Replacement

This project, will see the eventual replacement of approximately 40 substandard 11 kV poles from the Duffers Power Station through to the Wainihinihi River.

Project 07-4106: Mt Sewell, 11 kV Pole Replacement

With the extremely rugged terrain on the Mt Sewell line impeding any fault recovery following pole failure, it is imperative that steps are taken now to ensure pole failure does not occur. It is planned to replace 3 poles per year, with a condition assesment of the line determining the priority of each replacement.

Project 07-4107: Dobson Straight, 11 kV Line Replacement

Recent years have seen the 11 kV line from Greymouth to Dobson progressivley upgraded. The 06-07 financial year will see this project continue with the substandard hardwood poles replaced from the end of the previous upgrade at pole 01375 to pole 01367, the takeoff to Nolans. Pole placement can become difficult in this area with the need to use culverts in the drain adjacent to the line increasing costs. Poles shall be no less than 12 m in length. Iodine conductor shall be strung after each section of pole replacement.

Distribution Tree Trimming ($'000)											
	Area	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Arnold Feeder 3 Tree Trimming	ALD3	10	10	10	10	10	10	10	10	10	10
Arnold Feeder 4 Tree Trimming	ALD4	20	20	20	20	20	20	20	20	20	20
Dillmans Feeder 4 Tree Trimming	DIL4	15	15	15	15	15	15	15	15	15	15
Dobson Feeder 1 Tree trimming	DOB1	7	7	7	7	7	7	7	7	7	7
Dobson Feeder 3 Tree Trimming	DOB3	7	7	7	7	7	7	7	7	7	7
Fox Glacier Feeder 1 Tree Trimming	FOX1	13	13	13	13	13	13	13	13	13	13
Franz Feeder 1 Tree Trimming	FRZ1	3	3	3	3	3	3	3	3	3	3
Franz Feeder 3 Tree Trimming	FRZ3	13	13	13	13	13	13	13	13	13	13
Greymouth Feeder 11 Tree Trimming	GYM11	7	7	7	7	7	7	7	7	7	7
Greymouth Feeder 12 Tree Trimming	GYM12	7	7	7	7	7	7	7	7	7	7
Greymouth Feeder 13 Tree Trimming	GYM13	7	7	7	7	7	7	7	7	7	7
Greymouth Feeder 6 Tree Trimming	GYM6	20	20	20	20	20	20	20	20	20	20
Greymouth Feeder 7 Tree Trimming	GYM7	7	7	7	7	7	7	7	7	7	7
Harihari Feeder 1 Tree Trimming	HHI1	13	13	13	13	13	13	13	13	13	13
Harihari Feeder 3 Tree Trimming	HHI3	7	7	7	7	7	7	7	7	7	7
Hokitika Feeder 10 Tree Trimming	HKK10	20	20	20	20	20	20	20	20	20	20
Hokitika Feeder 12 Tree Trimming	HKK12	7	7	7	7	7	7	7	7	7	7
Hokitika Feeder 4 Tree Trimming	HKK4	10	10	10	10	10	10	10	10	10	10
Kumara Feeder 1 Tree Trimming	KUM1	10	10	10	10	10	10	10	10	10	10
Kumara Feeder 2 Tree Trimming	KUM2	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Ngahere Feeder 1 Tree Trimming	NGH1	13	13	13	13	13	13	13	13	13	13
Ngahere Feeder 3 Tree Trimming	NGH3	13	13	13	13	13	13	13	13	13	13
Otira Feeder 1062 Tree Trimming	OTI1062	7	7	7	7	7	7	7	7	7	7
Rapahoe Feeder 1 Tree Trimming	RAP1	13	13	13	13	13	13	13	13	13	13
Rapahoe Feeder 3 Tree Trimming	RAP3	13	13	13	13	13	13	13	13	13	13
Reefton Feeder 4 Tree Trimming	RFN4	13	13	13	13	13	13	13	13	13	13
Reefton Feeder 5 Tree Trimming	RFN5	13	13	13	13	13	13	13	13	13	13
Ross Feeder 1 Tree Trimming	RSS1	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Ross Feeder 3 Tree Trimming	RSS3	7	7	7	7	7	7	7	7	7	7
Tree Register Administration	SYS	10	10	10	10	10	10	10	10	10	10
Wahapo Feeder 1 Tree Trimming	WAH1	10	10	10	10	10	10	10	10	10	10
Whataroa Feeder 1 Tree Trimming	WAT1	13	13	13	13	13	13	13	13	13	13
Waitaha Feeder 1 Tree Trimming	WTH1	7	7	7	7	7	7	7	7	7	7
Total		**338**	**338**	**338**	**338**	**338**	**338**	**338**	**338**	**338**	**338**

Project 07-4109: Milton Road, Upsize Squirrel Conductor from RMU5

The Squirrrel conductor strung in 1988 at the southern end of Milton Road to supply Arnotts Heights is inadequate for the fault level present. 170 m of Iodine conductor will need to be installed.

Project 07-4110: Murray St to Herbert Street, 11 kV Line Replacement

The majority of the line between the Greymouth Substation and RA5 in Herbert Street has been upgraded in recent years. Three remaining hardwood poles however are in need of replacement. The 11 kV hardwood line along Murray Street to RA5 includes poles 01447, 01448 and 01149 will require replacement.

Project 07-4112: Welshmans Road, Reconductor 11 kV Line

The conductor on the section of line from Pine Tree Hill to S6, Fairhalls at Welshmans has deteriorated to the point where replacement is required. This work will be carried out in 3 stages with the first being the 1 km section of line between Pine Tree Hill and S1025, Pinnock. This Mullet conductor is strung under the GYM-KUM 66 kV cct and to be replaced with Ferret ACSR.

Project 07-4113: Cobden Bridge - Kaiata 11 kV Line Replacement

The hardwood poles between the Cobden Bridge and Kaiata have been identified as in urgent need of replacement. In all, 35 poles and 2700m of conductor will be included in this project, which will see the double circuit line replaced with a single circuit. Permission has been granted to place the line along the Grey River bank for the first section, and construction will commence when the new rail bridge is finished.

Project 07-4117: Kumara Junction to Kumara, 11 kV Line Replacement

The 2006-07 financial year will see the line from Greenstone Road to XD1, at the Kumara Power Station, be re-routed through Kumara township. The project will entail the re-routing of the line along Greenstone Road to Tui Street where it will follow Tui Street to Fifth Street. This section of 400 V line will be converted to 11 kV via either the fitting of 11 kV brackets or complete pole replacement (prices will be required for both options) A new section of 11 kV line will then be constructed from the State Highway to XD1. 2120 metres of 11 kV Iodine AAAC will be strung the entire length of the project. The existing line from Greenstone Road to the Taramakau Settlement takeoff shall be dismantled.

Project 07-4118: Taramakau Settlement, 11 kV Pole Replacement

This project will see more of the 11 kV line to Taramakau Settlement upgraded. The existing hardwood pole line was originally constructed in 1954 and will require progessive replacement over the next 4 years. The 2006-07 financial year will see some 20 poles replaced from pole 02958 to 02976.

Project 07-4119: Kumara Jnct Old School to Serpentine

This line, originally constructed in 1965, will be gradually be replaced over a period of 5 years. This will see 4 poles per year replaced, on a worst case priority basis. The existing 7/.064 conductor shall be replaced at year 5 with Ferret.

Project 07-4120: Blackball-Atarau Rd, 11 kV Pole Replacement

Last years AMP identified the section of 11 kV line passing Berrys property, and replaced poles accordingly. This year will see a continuation of this project with substandard poles progressively being replaced.

Project 07-4121: Blackball - Taylorville Rd, 11 kV Pole Replacement

Continuing on from the 2004-2005 financial year, this year willl see the pole replacement of the 11 kV line between Taylorvillle and Blackball.

Project 07-4123: Ngahere, Red Jacks, 11 kV Line Replacement

First commissioned in 1962, the 11 kV line in Red Jacks Road, Ngahere, has reached the end of it's serviceable life. The poles in the section of line to be replaced is from pole 04240 to the end of the hardwood pole line at pole 04249. The replacement of these poles will complete the line upgrade to the entire length of the line. In addition 900m of Ferret ACSR conductor shall be strung from disconnector site DD13 to pole 04249.

Project 07-4124: Rough River, Replace 11 kV Line

Continuing on from the previous 11 kV pole replacement program, this year will see the replacement of a further six hardwood poles and associated fittings from pole 13493 to pole 13498 on Mirfin Road. This will include one sub pole, S188.

Project 07-4122 Blackwater, 11 kV Line Replacement

Many poles on the Blackwater 11 kV line require replacement. The condition assessment programme will determine which of these poles will take a priority, with a contingency sum allowed for the replacement of 4 poles per year, for the next 5 years.

Project 07-4125: Slatey Creek, 11 kV Line Replacement

With the first section built in 1966, the 11 kV line at Slatey Creek has reached the end of it's serviceable life. Sections of line shall be replaced over the next 5 years until the entire line is completely replaced. This year will see work carried out at the Van der geest cowshed end of the line. The replacement of 26 hardwood poles will allow the conductor to be upgraded to Iodine within 4 km of the Logburn Road substation.

Project 07-4127: Nelson Creek, 11 kV Pole Replacement

The 11 kV line replacement from Potters Creek to Moores, Nelson Creek was started in the 03-04 financial year and was continued last year. This year will see the continuation of this project with a further 5 poles and associated hardware replaced. This will also serve to ensure the line is capable of carrying heavier conductors when the 11 kV tie is built between Ngahere 3 feeder and Arnold 4 feeder. The existing conductor shall remain until the planned tie is constructed.

Project 07-4128: Nelson Creek Road, Replace 11 kV Line

The 11 kV line between SH7 and the Nelson Creek township has been identified as requiring replacement. Over a five year period 40 poles and 6 km of Mullet conductor shall be replaced with Iodine. This year will see the replacement of 9 hardwood poles from DD18 to pole 04389 on Nelson Creek road. The 650 m of Mullet conductor shall be replaced from DD18 to recloser L61.

Project 07-4131: Punakaiki Razorback, Replace H-Structure

The H-Structure and its preceding pole positioned on top of the Razorback, Punakaiki, are condemned and require replacement. Access to these structures is very difficult, with motel units preventing vehicles or excavators from being used to replace the poles.

6.3.2.2 Enhancement

Project 07-5101: Iveagh Bay Underground

There are a number of subdivisions planned for the Iveagh Bay area, although the full extent is not yet known. The existing 11 kV and 400 V assets in the bay are at the end of their ecomonic life and may not be positioned correctly for the future. With the increased load that is likely to come on and the new layout some funds will be required to bring new supply to the subdivisions. A provisional sum is included.

Distribution Projects ($'000)													
ID	Act	Description	Area	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
07-4101	RPL	Blair Block 11 kV Line Replacement	ALD3	20	20	0	0	0	0	0	0	0	0
07-5101	E	Iveagh Bay Underground	ALD4	30	30	0	0	0	0	0	0	0	0
07-4103	RPL	Moana-Ruru, 11 kV Pole Replacement	ALD4	25	25	0	0	0	0	0	0	0	0
07-4102	RPL	Haupiri Line 11 kV Line Upgrade	ALD4	65	70	75	75	75	75	75	0	0	0
07-4104	RPL	Inchbonnie - McArthur Road, replace Squirrel conductor with Mink	DIL4	6	0	0	0	0	0	0	0	0	0
07-4105	RPL	Duffers - Wainihinihi River, 11 kV Line Replacement	DIL4	30	30	30	0	0	0	0	0	0	0
07-4106	RPL	Mt Sewell, 11 kV Pole Replacement	DOB1	15	15	15	15	0	0	0	0	0	0
07-4107	RPL	Dobson Straight, 11 kV Line Replacement	DOB3	35	35	35	0	0	0	0	0	0	0
07-3101	RPR	Paringa River to Lake Paringa, Retension Conductor	FOX1	16	0	0	0	0	0	0	0	0	0
07-4108	RPL	North of Franz Sub to Molloy's, Replace 11 kV conductor	FRZ3	40	20	20	0	0	0	0	0	0	0
07-6101	D	RGSP Globe Hill - Build Distribution Lines and substations for mine site	GLB	700	0	0	0	0	0	0	0	0	0
07-6102	D	Grey Hospital to New World, New feeder cable	GYM11	10	10	10	10	0	0	0	0	0	0
07-4109	RPL	Milton Road, Upsize Squirrel Conductor from RMU5	GYM11	4	0	0	0	0	0	0	0	0	0
-	E	Replace overhead line with underground, Arney Street	GYM12	0	60	70	0	0	0	0	0	0	0
07-4110	RPL	Murray St to Herbert Street, 11 kV Line Replacement	GYM12	15	15	0	0	0	0	0	0	0	0
07-6103	D	Alexander Tce - Alternative feed to Greymouth CBD	GYM13	20	0	0	0	0	0	0	0	0	0
07-4111	RPL	Clough Road Paroa, 11 kV Conductor Replacement	GYM6	6	0	0	0	0	0	0	0	0	0
07-4112	RPL	Welshmans Road, Reconductor 11 kV Line	GYM6	5	5	5	0	0	0	0	0	0	0
-	D	Cobden Bridge-Coal Creek, Install 11 kV Alternate Feed	GYM8	0	90	40	0	0	0	0	0	0	0
07-4113	RPL	Cobden Bridge - Kaiata 11 kV Line Replacement	GYM8	50	50	0	0	0	0	0	0	0	0
-	D	Robertson Road - Peterson Road 11 kV Ring Construction	HHI1	0	32	0	0	0	0	0	0	0	0
07-4114	RPL	Harihari La Fontaine Rd, Upgrade 11 kV Line	HHI3	45	45	0	0	0	0	0	0	0	0
07-6104	D	Kowhitirangi Ring Feed	HKK10	40	0	0	0	0	0	0	0	0	0
07-4116	RPL	Hokitika to Ruatapu, 11 kV Line Replacement	HKK10	50	50	50	50	50	0	0	0	0	0
07-4115	RPL	Lake Kaniere Lodge 11 kV Line Upgrade	HKK10	9	11	0	0	0	0	0	0	0	0
-	RPL	Awatuna, 11 kV pole replacement (larch poles)	HKK10	0	20	20	0	0	0	0	0	0	0
-	D	Serpentine, Construct 11 kV Tie Line	KUM1	0	0	0	50	0	0	0	0	0	0
07-5105	E	Kumara Area, Upgrade Conductor /Relocate Fuses	KUM1	10	0	0	0	0	0	0	0	0	0
-	RPL	Reconstruct 11 kV Line Bundi Road	KUM1	0	20	20	20	0	0	0	0	0	0
07-4118	RPL	Taramakau Settlement, 11 kV Pole Replacement	KUM1	60	30	30	30	0	0	0	0	0	0
07-4119	RPL	Kumara Jnct Old School to Serpentine	KUM1	10	10	10	15	0	0	0	0	0	0
07-4117	RPL	Kumara Junction to Kumara, 11 kV Line Replacement	KUM1	60	60	60	0	0	0	0	0	0	0
07-6105	D	Logburn Road 11 kV Line Construction	NGA1	75	0	0	0	0	0	0	0	0	0
07-4121	RPL	Blackball - Taylorville Rd, 11 kV Pole Replacement	NGA1	30	30	0	0	0	0	0	0	0	0
07-4120	RPL	Blackball-Atarau Rd, 11 kV Pole Replacement	NGA1	30	30	30	30	0	0	0	0	0	0
-	D	Bell Hill 11 kV Alternative feed	NGA3	0	110	0	0	0	0	0	0	0	0
07-4123	RPL	Ngahere, Red Jacks, 11 kV Line Replacement	NGA3	28	20	0	0	0	0	0	0	0	0
-	RPL	Orwell Creek Rd, 11 kV Pole Replacement	NGA3	0	10	10	0	0	0	0	0	0	0
07-4124	RPL	Rough River, Replace 11 kV Line	NGA3	15	15	0	0	0	0	0	0	0	0
07-4122	RPL	Blackwater, 11 kV Line Replacement	NGA3	15	15	15	15	15	0	0	0	0	0
-	RPL	Waipuna M Ferguson, 11 kV Pole Replacement	NGA3	0	11	0	0	0	0	0	0	0	0
-	D	Atarau - Ikamatua Construct an 11 kV Tie	NGH1	0	0	195	0	0	0	0	0	0	0
07-4125	RPL	Slatey Creek, 11 kV Line Replacement	NGH1	75	22	22	22	0	0	0	0	0	0
07-4130	RPL	Ahaura, 11 kV Line Replacement	NGH3	15	15	15	0	0	0	0	0	0	0
07-4126	RPL	Mawheraiti Thompsons Road, 11 kV Pole Replacement	NGH3	35	20	0	0	0	0	0	0	0	0
07-4129	RPL	Hukarere Mossy Creek Rd, 11 kV Line Replacement	NGH3	23	23	0	0	0	0	0	0	0	0
07-4127	RPL	Nelson Creek, 11 kV Pole Replacement	NGH3	10	10	10	0	0	0	0	0	0	0
07-4128	RPL	Replace 11 kV Line Nelson Creek Road	NGH3	25	25	25	25	25	0	0	0	0	0
07-4132	RPL	Replace 11 kV line at Punakaiki with underground cable	RAP1	270	0	0	0	0	0	0	0	0	0

Distribution Projects continued ($'000)													
ID	Act	Description	Area	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
07-4131	RPL	Punakaiki Razorback, Replace H-Structure	RAP1	30	0	0	0	0	0	0	0	0	0
07-1101	I	Upper Buller Gorge, 11 kV Pole Replacement	RFN4	10	10	0	0	0	0	0	0	0	0
07-4134	RPL	Inangahua Junction T Lees, 11 kV Line Replacement	RFN4	15	23	0	0	0	0	0	0	0	0
07-4133	RPL	Reefton Gilmore Road, 11 kV Line Replacement	RFN4	8	8	8	0	0	0	0	0	0	0
07-4135	RPL	Lower Buller Gorge, 11 kV Pole Replacement	RFN4	15	15	15	0	0	0	0	0	0	0
07-5104	E	Reefton Ring, Upgrade 11 kV Line	RFN5	55	0	0	0	0	0	0	0	0	0
	RPL	Reefton to Blacks Point, Replace 11 kV Line	RFN5	0	25	25	0	0	0	0	0	0	0
	RPL	Soldiers Road, 11 kV Line Replacement	RFN5	0	10	10	0	0	0	0	0	0	0
07-4136	RPL	Maimai Valley, Replace 11 kV Poles	RFN5	13	10	0	0	0	0	0	0	0	0
07-4137	RPL	Hinau, Replace 11 kV Poles	RFN5	15	0	0	0	0	0	0	0	0	0
07-4138	RPL	Crushington-Garveys Creek, 11 kV Line Replacement	RFN5	30	30	30	0	0	0	0	0	0	0
	RPL	Garveys to Craigs Flat Line Replacement	RFN5	0	10	10	10	0	0	0	0	0	0
	RPL	Ross Township, Upgrade 11 kV Conductor	RSS3	0	20	0	0	0	0	0	0	0	0
07-5102	E	Light Conductor Replacement	SYS	30	30	30	30	30	0	0	0	0	0
07-5103	E	Ganged Fusing of 11 kV spurs	SYS	60	60	60	0	0	0	0	0	0	0
07-1104	I	Replace Condemned Distribution Poles	SYS	50	50	50	50	50	50	50	50	50	50
07-1105	I	Fit Pole Caps to Softwood Poles	SYS	2	2	0	0	0	0	0	0	0	0
07-1106	I	Replace Missing or Unreadable Danger Notices on Poles.	SYS	10	10	5	5	5	5	5	5	5	5
07-1102	I	River Protection Works for Distribution Lines	SYS	50	50	50	50	50	50	50	50	50	50
07-1103	I	Purchase of Aerial Photography	SYS	20	20	20	0	0	0	0	0	0	0
	RPL	Unspecified Distribution Line Replacement	SYS	0	0	200	400	600	600	600	600	600	600
07-4139	RPL	Wahapo - Okarito, 11 kV Line Replacement	WAH1	18	15	15	15	15	15	15	15	15	15
07-4140	RPL	Waitaha, 11 kV Line Replacement	WTH1	20	20	20	20	0	0	0	0	0	0
Total				**2473**	**1527**	**1360**	**937**	**915**	**795**	**795**	**720**	**720**	**720**

As for Reefton, it is possible that unanticipated new industrial load could trigger the need to enhance the network. Notwithstanding this, the network is relatively strong in the Greymouth and lower Grey Valley areas, with supply from major substations at Dobson and Greymouth and relatively new feeders emanating from both sites.

Project 07-5105: Kumara Area, Upgrade Conductor /Relocate Fuses

Due to high fault currents available on conductors close to the Kumara substation, it is necessary to upgrade light conductors and/or relocate fuses to protect such conductors within the area. All conductors within a 7 km radius of the substation will require attention. This involves replacing approximatley1 km of 7/.064 and 7/ .080 conductor and installing a new 3 way ganged fuse unit at pole 03101 in conjunction with conductor upgrade. Dropout fuses at S600 and S1968 will be relocated out to the main line.

6.3.2.3 Development

Project 07-6102: Grey Hospital to New World, New feeder cable

The Greymouth Hospital is on a spur feed at present, advice has been received to suggest that the hospital can not keep all its essential services operating on the emergency generator. Should another party carry out civil works for other projects on a route from Cowper St. to the Hospital RMU, then Westpower should install ducting to allow a ring feed to be made possible.

Project 07-6103: Alexander Tce - Alternative feed to Greymouth CBD

The majority of Alexander Tce alternate feed to Greymouth CBD was completed in the 05-06 year. Some works, such as cable connections, will be carried out in the upcoming year.

Project 07-6105: Logburn Road 11 kV Line Construction

To create additional security to the Ngahere 1 11 kV feeder, a tie line shall be constructed from Logburn Road substation to the existing 11 kV line at Van der geest cowshed. This line will span a distance of approximately 2.5 km.

To significantly increase the capacity of the power system in the Greymouth Area, a major upgrade of the Transpower Dobson-Inangahua transmission circuit will be required to provide the necessary upstream transmission capacity.

6.3.3 Hokitika Area

The overall condition of distribution lines in the Hokitika is very good with almost all lines constructed using either concrete or treated wood poles.

6.3.3.1 Maintenance

(i) Routine Patrols and Inspections

A condition assessment programme will be continued to identify substandard components or construction methods.

Similar to the Reefton area, it is expected that this will form the basis of a repair programme involving individual component replacements throughout the planning period.

After the initial inspection, the line is to be inspected on a rolling 5-year basis, covering 20% of the route length per year.

Fault patrols and fault repairs are carried out on an as required basis.

(ii) Faults

Faults in the Hokitika area are normally caused by wind and lightning, with trees falling through the line also being a common occurrence.

A fault base will be maintained in the Hokitika area and contracted to ElectroNet Services.

(iii) Repairs and Refurbishment

On ongoing programme to replace very old service poles will continue as required.

(iv) Replacement

Project 07-4116: Hokitika to Ruatapu, 11 kV Line Replacement

At 39 years old, the 11 kV line from Hokitika to Ruatapu has reached replacement criteria. This 10 km section of line contains approximatley 120 poles. Replacement will take place over the next 5 years with the 2006-07 financial year seeing a continuation of last years replacement with 25 poles from the Mahinapua

Hotel to S780, Becker, Mananui replaced. Poles and fittings shall allow for future 33 kV conversion. The existing Waxwing conductor shall be replaced with Iodine AAAC.

Project 07-4115: Lake Kaniere Lodge 11 kV Line Upgrade

The single phase section of 11 kV line from the Geologist Creek spur through to O'Reilly's bach at the end of the line requires attention. This line has 10 substandard hardwood poles, four along Dorothy Falls Road are tagged to be replaced in the 06-07 year while the remainder, on the spur to O'Reilly's bach, will be changed the following year.

Project 06-4123: Ross Township, Upgrade 11 kV Conductor

In an effort to rid the Westpower network of any substandard copper conductor, the 800 m of 7/.136 Cu in Moorhouse St, Ross, has been identified as in need of replacement. This will include the replacement of insulators and any substandard crossarms found.

6.3.3.2 Enhancement

Apart from the specific projects discussed below, there is no general enhancement programme planned for Hokitika.

6.3.3.3 Development

The 66/11 kV Hokitika substation provides a strong 11 kV bus near to the major loads in Hokitika, and therefore removes an effective voltage constraint that has existed for several years. This allows major new loads in the area to be supplied without significant development of distribution line infrastructure.

Of course, any major loads either some distance from Hokitika or some distance from the associated distribution lines, will require new line development.

Project 07-6104: Kowhitirangi Ring Feed

To ensure swift restore times for installations in the Whitcombe Valley area, an 11 kV ring shall be constructed to join the Station Rd 11kV with the Whitcombe Valley Road 11 kV.

6.3.4 South Westland Area

The distribution network in South Westland is contained in pockets based around Waitaha, Harihari, Whataroa Wahapo, Franz Josef Glacier and Fox Glacier south to Paringa and is generally in good condition.

6.3.4.1 Maintenance

The lines around Waitaha, Harihari and Whataroa have been substantially rebuilt over the last ten years and are generally in excellent condition, requiring little planned maintenance work.

(i) Routine Patrols and Inspections

The Okarito line (from Wahapo Substation) is a wood pole line constructed in the 1970's. Although this line is in reasonable condition for its age, it will now require a higher level of inspection and servicing as it reaches mid-life.

As for other areas, it is expected that this will form the basis of a repair programme involving individual component replacements throughout the planning period.

The line is to be inspected on a rolling 5-year basis, covering 20% of the route length per year.

Fault patrols and fault repairs are carried out on an as required basis.

(ii) Faults

Faults in the South Westland area, are normally caused by wind and lightning.

A notable feature of South Westland, particularly the Whataroa area, is the incidence of very strong gorge easterly winds. This can at times result in outages as branches and other debris gets caught up in the distribution network.

A fault base will be maintained in the Harihari area as a sub-contractor to ElectroNet.

(iii) Repairs and Refurbishment

An ongoing programme to replace very old service poles will continue as required.

Any poles identified as reaching replacement criteria as a result of the pole inspection programme will be replaced as required, but these are not expected to comprise a significant number because of the age involved.

(iv) Replacement

Project 07-4108: North of Franz Sub to Molloy's, Replace 11 kV conductor

Due to the growth in the Franz Josef area, the existing Squirrel ACSR 11 kV conductor north of the Franz substation to Molloy's subdivision will be insufficient to manage expectant loads. This project may not be initiated for 2-5 years. The 2.6 km length of underbuilt conductor is to be replaced with Mink ACSR from the substation to pole 17470 on the State Highway near S1144.

Project 07-4114: Harihari La Fontaine Rd, Upgrade 11 kV Line

The 11 kV line along La Fontaine Road in the Harihari area has reached the end of it's ecomonic life. 35 existing hardwood poles and associated fittings require replacement along the 5 km of line. This project is to be staged over a 3 year period. The existing mullet conductor shall be replaced with ferret.

Project 07-4139: Wahapo - Okarito, 11 kV Line Replacement

A recent condition assessment programme in the Okarito area has revealed that the 11 kV poles in the immediate area are in need of replacement. Many are showing rot at the ground level and are generally in a state of disrepair. This project will see 10 of these poles replaced this year. Further poles shall be replaced in later years as the condition assessment programme indentifies priorities.

6.3.4.2 Enhancement

As many of the distribution lines in the South Westland area have recently been rebuilt or upgraded, there is unlikely to be a requirement for capacity enhancement. There is a possibility that some small areas may require this work, however, as a result of in-fill development.

6.3.4.3 Development

Extension of the 11 kV underground network is likely in Franz Josef as the town expands. A major new residential subdivision project is underway, but current indications are that it could be developed in a piece-meal fashion over several years.

6.3.5 System Wide Distribution Projects

Project 06-1104: Replace Condemned Distribution Poles

The Condition Assessment programme frequently indentifies the need to replace individual poles within a section of line to ensure the security of that line. A sum has been allocated in the maintenance budget to replace such poles.

Project 07-1102: River Protection Works for Distribution Lines

In recent times it has been nessessary to install river protection works for distribution lines, particually near major rivers. Erosion around structures has been an ongoing problem therefore a contingency sum will be allocated in the AMP for such protection works.

Project 07-1103: Purchase of Aerial Photography

With the increasing use of the GIS for mapping purposes and asset identification, the purchase of aerial photographs in built up areas, particularly Greymouth, Hokitika and Reeftion, has become necessary.

Project 07-1105: Fit Pole Caps to Softwood Poles

In earlier times some softwood poles were installed without aluminium pole caps fitted. To prolong the life of any of these poles found, caps are to be fitted.

Project 07-1106: Replace Missing or Unreadable Danger Notices on Poles.

To ensure public are aware of the danger posed by power lines and equipment, regulations require all structures to have warning notices attached. Occasionally these notices may go missing or fade to the point they are no longer legible. Funds are allocated to replace these signs

Project 07-5102: Light Conductor Replacement

This is an ongoing project which will see the gradual replacement of Mullet conductor with Squirrel. This replacement program was initiated due to the non-standard nature of the flat bodied Mullet. Jointing sleeves are extremely difficult to source and the corrosion prone nature of the conductor deemed it an undesirable component on the network. In addition, Mullet conductor is no longer rated for the fault levels now experienced in some areas as a result of network reinforcement.

Project 07-5103: Ganged Fusing of 11 kV spurs

Recently a ganged fuse three phase unit has become available for the protection of spur lines off important feeders. It is proposed to start installing these on tees off important feeders to allow permanent faults to remain isolated from the feeder thus allowing power to be restored to the majority of the customers via a recloser.

Each set will cost in the order of $6k to install and it is proposed to install 10 sets a year until the majority of tees off essential feeders are equipped.

6.4.0 Reticulation Assets

Westpower owns a diverse range of reticulation assets, ranging from brand new underground subdivisions, through to fifty-year-old overhead wood pole lines.

6.4.1 Reefton Area

The Reefton area comprises a mixture of relatively new underground construction and very old overhead wood pole lines, with very little in between. One advantage of this area is that it is well away from the seacoast and suffers less from the effects of corrosion than most other areas within Westpower. For this reason, the overhead lines can still be in serviceable condition at an older age than in other areas.

6.4.1.1 Maintenance

(i) Routine Patrols and Inspections

As with distribution lines, the 2006-07 financial year will see the continuation of the condition assessment programme. Each line (feeder) is to be inspected on a rolling 5-year basis, covering 20% of the route length per year. During the inspection every aspect of the line is checked.

As for other areas, it is expected that this will form the basis of a repair programme involving individual component replacements throughout the planning period.

Fault patrols and fault repairs are carried out on an as required basis.

(ii) Faults

Faults are limited to the occasionally substation fuse blowing or the failure of a pole, either during high winds, or when hit by a vehicle.

Fault staff in the area, are able to handle these faults locally.

(iii) Repairs and Refurbishment

Any poles identified as reaching replacement criteria as a result of the pole inspection programme will be replaced as required, and if the level in particular sections of line exceeds 50% of the line value, this will be upgraded to a replacement programme for that section.

It is expected that most remedial work will be accomplished through simple component replacement.

(iv) Replacement

Due to previous reticulation line upgrades in the Reefton area, replacements are not required in this financial year. The ongoing condition assessment programme may identify replacements for later years.

6.4.1.2 Enhancement

With the development of the Oceana Gold Limited mine, the economic outlook for Reefton is expected to be bullish. Some upgrading of the LV network will be required to met expected growth demand in the area.

Project 07-5201: Reefton, Upgrade of LV Network

This project will be run in conjunction with the “Upgrade 11 kV Line - Reefton Ring”. An upgrade of the 400 V reticulation supplying Reefton will help alleviate any anticipated shortfall in capacity, along with the replacement of any poles not capable of withstanding new design loads.

6.4.1.3 Development

There are no significant development works planned for the Reefton area. Any development that does occur will be on the basis of new customer requirements.

6.4.2 Greymouth Area

The comments that applied to Reefton reticulation assets apply also to Greymouth, except that the relative amount of very old wood pole lines is greatly reduced. The reason for this is the major replacement programme completed in the 1990’s as discussed in section 5.3.1.2

6.4.2.1 Maintenance

(i) Routine Patrols and Inspections

As with Reefton, a detailed condition assessment programme will be continued.

Fault patrols and fault repairs are carried out on an as required basis.

(ii) Faults

Faults are limited to the occasionally substation fuse blowing or the failure of a pole, either during high winds, or when hit by a vehicle.

Fault staff in the area are able to handle these faults locally.

Reticulation Projects and Programmes ($'000)										
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Inspect, Service & Test	114	104	93	81	81	81	81	81	81	81
Faults	20	20	20	20	20	20	20	20	20	20
Repairs	17	17	17	17	17	17	17	17	17	17
Replacement	94	95	55	0	0	0	0	0	0	0
Enhancement	35	135	25	25	0	0	0	0	0	0
Development	279	370	209	142	117	117	117	117	117	117
Total	**279**	**370**	**209**	**142**	**117**	**117**	**117**	**117**	**117**	**117**

Reticulation Projects ($'000)													
ID	Act	Description	Area	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
-	E	Iveagh Bay Underground	ALD4	0	100	0	0	0	0	0	0	0	0
07-4201	RPL	Oxford St, Taylorville LV Pole Replacement	DOB1	10	0	0	0	0	0	0	0	0	0
07-4202	RPL	Replace overhead 400 V with underground, Condon Street	FRZ3	18	0	0	0	0	0	0	0	0	0
07-4203	RPL	Woodstock, LV Line Replacement	HKK10	15	15	15	0	0	0	0	0	0	0
07-4205	RPL	North End Ahaura, 400V Line Replacement	NGH1	21	10	0	0	0	0	0	0	0	0
07-4204	RPL	Blackball LV Replacement	NGH1	10	10	0	0	0	0	0	0	0	0
07-5201	E	Reefton, Upgrade of LV Network	RFN5	25	25	25	25	0	0	0	0	0	0
-	RPL	Upgrade 400V poles and conductor, Blacks Point township	RFN5	0	20	20	0	0	0	0	0	0	0
-	RPL	Ruatapu Township, Replace LV	RSS1	0	20	0	0	0	0	0	0	0	0
07-4206	RPL	Ross Township, Upgrade 400V Poles and Conductor	RSS3	20	20	20	0	0	0	0	0	0	0
07-5202	E	Upgrade Hokitika link boxes to 3 way switching	SYS	10	10	0	0	0	0	0	0	0	0
07-1201	I	Replace All Motor Rated Fuses	SYS	2	2	2	0	0	0	0	0	0	0
07-1205	I	South Westland Ripple Relay Replacement	SYS	11	11	0	0	0	0	0	0	0	0
07-1203	I	Inspection, GPS and labelling of LV pillar and link boxes	SYS	10	0	0	0	0	0	0	0	0	0
07-1204	I	Data collection of LV circuits	SYS	10	10	10	0	0	0	0	0	0	0
07-1202	I	Replace Condemned Reticulation Poles	SYS	30	30	30	30	30	30	30	30	30	30
Total				**192**	**283**	**122**	**55**	**30**	**30**	**30**	**30**	**30**	**30**

(iii) Repairs and Refurbishment

Any poles identified as reaching replacement criteria as a result of the pole inspection programme will be replaced as required, and if the level in particular sections of line exceeds 50% of the line value, this will be upgraded to a replacement programme for that section.

It is expected that most remedial work will be accomplished through simple component replacement.

(iv) Replacement

Project 07-4201: Oxford St, Taylorville LV Pole Replacement

The five hardwood LV poles at the northern end of Oxford St, Taylorville have been identified as requiring replacement. Poles 04206-04030 along with associated fittings shall be replaced.

Project 07-4204: Blackball LV Replacement

As with the previous financial year, any substandard poles within the Blackball township are to be replaced. This project is expected to continue for the next 2 years.

Project 07-4205: North End Ahaura, 400V Line Replacement

Although the 400 V poles in Camp and Clifton Streets, Ahaura were upgraded in the mid eighties, pre used hardwood poles were installed. A recent condition assessement of these poles revealed many were splitting and suffering rot problems. A project will be initiated to replace these poles. 7 400 V poles will need to be changed with the existing conductor remaining.

6.4.2.2 Enhancement

As most of the reticulation in the Greymouth area has recently been rebuilt, there is unlikely to be a requirement for capacity enhancement. There is a possibility that some small areas may require this work however as a result of in-fill development.

6.4.2.2 Development

New subdivisions often involve the development of reticulation networks that are handed over to Westpower on completion. In most cases the developer builds these to Westpower's standards.

6.4.3 Hokitika Area

Most of the reticulation in Hokitika has been undergrounded, as part of major replacement programmes in the 1980's and as a result these assets are in excellent condition. Only a small number of pockets of overhead reticulation remain, and those that do are concrete pole lines, also in good condition

(i) Routine Patrols and Inspections

No planned inspections are planned on the underground reticulation.

Fault patrols and fault repairs are carried out on an as required basis.

(ii) Faults

Faults are limited to the occasional substation fuse blowing or the failure of a pole, either during high winds, or hit by a vehicle.

Fault staff in the area, are able to handle these faults locally.

(iii) Repairs and Refurbishment

It is expected that most remedial work will be accomplished through simple component replacement.

(iv) Replacement

Project 07-4206: Ross Township, Upgrade 400V Poles and Conductor

This project, which is to span two years, comprises of the replacement of all substandard low voltage poles within the Ross township.

6.4.3.2 Enhancement

As most of the reticulation in the Hokitika area is already underground with significant spare capacity, there is unlikely to be a requirement for capacity enhancement.

No further undergrounding work is planned unless subsidised by the local District Council or the end user.

An exception to this is the case where a small section of overhead line is replaced in an otherwise underground area for instance.

Project 07-5202: Upgrade Hokitika link boxes to 3 way switching

As a means of reducing the installation cost, many LV link boxes in the Hokitika area consist of two sets of links, even when three separate LV feeders meet at that point. This reduces the operational flexibility of the system through reducing the number of configurations that can be utilised. These link boxes will be upgraded to provide for three sets of links to gain maximum flexibility and improve alternative supply options for consumers.

6.4.3.3 Development

New subdivisions often involve the development of reticulation networks that are handed over to Westpower on completion. In most cases the developer builds these to Westpower's standards.

6.4.4 South Westland

Most of the reticulation in the townships of Harihari, Franz Josef and Fox Glacier was undergrounded as part of major replacement programmes in the 1980's and, as a result, these assets are in excellent condition. Only a small number of pockets of overhead reticulation remain, and those that do are concrete pole lines, also in good condition

(i) Routine Patrols and Inspections

No inspections are planned on the underground reticulation.

Fault patrols and fault repairs are carried out on an as required basis.

(ii) Faults

Faults are limited to the occasional substation fuse blowing or the failure of a pole, or when a pillar-box is hit by a vehicle.

Fault staff from the area are, able to handle these faults locally.

(iii) Repairs and Refurbishment

It is expected that most remedial work will be accomplished through simple component replacement.

(iv) Replacement

Project 06-4202: Replace overhead 400 V with underground, Condon Street

Condon St. in Franz's CBD has the last section of overhead conductor in the township. As other parties do work in Condon St. it is proposed to install duct to suit later laying of 400 V, and maybe 11 kV, to allow the last street to be undergrounded.

6.4.4.2 Enhancement

No enhancement projects are planned for this area, as there is ample capacity generally available.

6.4.4.3 Development

New subdivisions often involve the development of reticulation networks that are handed over to Westpower on completion. In most cases the developer builds these to Westpower's standards.

6.3.5 System Wide Reticulation Projects

Project 07-1201: Replace All Motor Rated Fuses

Motor rated fuses were installed to allow a certain amount of overload to be applied to prevent fusing. This situation is quite legal but general purpose fuses of Q1 or Q2 charateristic may be more appropriate. As motor rated fuses are found they shall be replaced.

Project 07-1202: Replace Condemned Reticulation Poles

The Condition Assessment programme frequently indentifies the need to replace individual poles within a section line to ensure the security of that line. A sum has been allocated in the maintenance budget to replace such poles.

Project 07-1203: Inspection, GPS and labelling of LV pillar and link boxes

A recent audit of Westpower's LV pillar and link boxes has resulted in the initiation of a project which will involve the inspection of all of these netwok components.

Project 07-1204: Data collection of LV circuits

To ensure accurate records of Westpower's assets are kept, data will be collected on all LV assets.

Service Projects and Programmes ($'000)										
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Inspect, Service & Test	45	45	45	45	35	35	35	35	35	35
Faults	18	18	18	18	18	18	18	18	18	18
Repairs	25	25	25	25	25	25	25	25	25	25
Replacement	0	0	0	0	0	0	0	0	0	0
Enhancement	0	0	0	0	0	0	0	0	0	0
Development	70	70	70	70	70	70	70	70	70	70
Total	**158**	**158**	**158**	**158**	**148**	**148**	**148**	**148**	**148**	**148**

Service Projects ($'000)												
		Area	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
I	Upgrade Underveranda Lighting	SYS	10	10	10	10	10	0	0	0	0	0
D	New Service Connections	SYS	70	70	70	70	70	70	70	70	70	70
I	Service Pole Replacement	SYS	35	35	35	35	35	35	35	35	35	35
		Total	115	115	115	115	115	105	105	105	105	105

6.5.0 Services

In general, Westpower does not carry out maintenance on customer owned service lines. These are the responsibility of the customer to maintain and they can use any competent contractor to do so.
There are several exceptions to this general rule however including

- replacement of blown service fuses due to faults
- repair of substandard service lines where these were never brought up to standard prior to transferring to the customer
- replacement of service poles on the street where these were previously shared with Telecom and are now substandard
- repairs to network connection equipment
- repairs to service spans across road reserve

Financial control procedures mean that only approved work is carried out , and that the customer will be required to pay for most work on customer-owned service lines.

The ongoing replacement of re-wireable fuses with HRC types as part of LV replacement projects has significantly reduced the number of premature service fuse failures, which should be reflected in a reduced cost of fault work.

Service lines are generally owned by the end customer and as such are not maintained by Westpower, however, as discussed above, there are some notable exceptions to this and these create a maintenance liability for Westpower

6.5.1 Service Poles

The condition assessment programme includes the assessment of service poles not on private property. Any poles found to be in need of replacement will be done so as a high priority. These poles pose a Health and Safety risk which must be mitigated as soon as possible.

Service Pole Replacement

This project has been initiated to ensure funds are available to replace any substandard service pole found on the network. These poles pose a health and safety risk so therefore the risk must be mitigated on a high priority basis.

6.6 Zone Substations

6.6.1 Inspections, Servicing and Testing

Westpower's station equipment is to be routinely inspected, tested and serviced in accordance with the requirements of Westpower's Maintenance Standards relevant to the actual equipment. These standard requirements which define the scope and frequency of work, are reflected in maintenance schedules for

Zone Substation Projects and Programmes ($'000)										
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Inspect, Service & Test	756	632	372	263	388	488	253	373	218	218
Faults	12	12	12	12	12	12	12	12	12	12
Repairs	19	19	19	19	19	19	19	19	19	19
Replacement	230	390	160	120	0	0	0	0	0	0
Enhancement	790	1060	125	200	0	0	0	0	0	0
Development	5248	0	500	0	2700	500	0	0	0	0
Total	**7054**	**2112**	**1187**	**613**	**3118**	**1018**	**283**	**403**	**248**	**248**

individual stations.

Equipment servicing is categorised as either “minor” (non-invasive), or “major” (invasive). Testing and inspections are categorised as minor. Typical frequencies are:

- minor service - every 2 years
- major service - every 4 years

The intervals vary according to the equipment and its location. Special inspections and tests are also included in maintenance schedules or may be arranged as required.

Work identified as a result of the routine inspections and tests is budgeted for as repairs and refurbishment.

6.6.1.1 Station Inspections and Testing

Westpower’s station maintenance involves a general monthly station inspection in accordance with specified procedures from which reports are derived.

Other station inspections incorporate annual thermovision inspections, fire protection and security.

6.6.1.2 Switchgear

Oil insulated switchgear is regularly inspected and the oil is changed as necessary depending on the results of breakdown tests, or when there are obvious visual signs of high carbon content. Extra servicing is carried out where the switchgear has sustained a higher than normal level of “heavy” faults.

Male and female contacts are checked for wear and dressed or replaced as necessary.

Vacuum or SF6 gas insulated switchgear undergoes regular visual inspection including checks of SF6 gas pressure.

A baseline ultrasonic discharge investigation was carried out early in 1999 for substations with indoor 11 kV switchgear, and this has formed the basis for future studies which will be carried out at regular intervals.

Thermovision inspections are carried out on all switchgear on an annual basis.

6.6.1.3 Power Transformer Servicing and Testing

As part of Westpower’s maintenance programme, all major power transformers have an annual minor maintenance service which encompasses a visual inspection, routine diagnostic tests and minor repair work in

accordance with Westpower standards which incorporate manufacturers' recommendations and Westpower's experience.

In general, maintenance on the transformers consists of maintaining oil within acceptable dielectric and acidity standards, patching up corrosion, fixing oil leaks and annual diagnostic tests on the insulating oil. In addition the units fitted with on-load tapchangers require periodic inspection of the tapchangers and the contacts are dressed or replaced as necessary. Additional remedial work required outside the scope of the maintenance contract is referred to Westpower for further action and budgeted as repairs and refurbishment.

(i) Oil Testing- Oil Conductivity and Dissolved Gas Analysis

Over the last seven years, all Zone Substations have had dissolved gas analysis tests carried out and this identified potential problems that need monitoring. This will be followed up by further annual Oil Conductivity and DGA tests until trends are reliably established. Once this is done, the period will be reviewed, possibly on an individual unit basis.

Costing for minor maintenance is very dependent on location and based on the present maintenance expenditure.

Costing for major maintenance, i.e. on-load tapchangers, is not only dependent on the location of the site but also the usage and types of unit and is such that some units have to be serviced every two years and others every six years.

6.6.1.4 Structures and Buswork

The routine maintenance of structures, buswork and disconnectors is usually performed simultaneously when a particular circuit or section of bus is released from service.

Disconnectors are scheduled for servicing every 2 years but this is extended up to 4 years when there are operational difficulties in getting a maintenance outage. The servicing is non-invasive and is generally limited to checks, adjustments, lubrication, cleaning and corrosion control.

Buswork and associated hardware is inspected and maintained with disconnectors, and includes checking and cleaning of insulators. At sites, which are subject to atmospheric pollution, insulator cleaning must be done more frequently than usual.
Structures are maintained up to a maximum interval of 4 years and work is limited to corrosion control, general check of fixings, and removal of any debris. Wood poles are subject to a check for signs of rotting. It has been decided that for most stations earth testing can be carried out every 5 years, and this will become the practice in future.

6.6.1.5 Instrument Transformers

As part of Westpower's maintenance programme all instrument transformers have an annual minor maintenance service which encompasses a visual inspection, routine diagnostic tests and minor repair work. Additional remedial work required is outside the scope of the maintenance contract and is referred to Westpower for action.

Typically, the minor maintenance costs based on present maintenance for instrument transformers is in the range $40-$220 depending on type and voltage.

(i) Other Station Equipment

The new battery banks are virtually maintenance free and only a basic inspection and charger check is necessary.

Fire protection and security alarm systems are to be inspected every 3 months and serviced annually. Other switchyard equipment such as local service transformers, surge diverters, line traps, cables, etc are main-

Zone Substation Projects ($'000)													
ID	**Act**	**Description**	**Area**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
07-5402	E	Install a Double Underhung Disconnector at Arnold Sub	ALD	5	0	0	0	0	0	0	0	0	0
07-1401	I	Arnold Zone Sub transformer refurbishment and maintenance	ALD	10	0	0	0	0	0	0	0	0	0
07-1411	I	Arnold Zone Sub OLTC Maintenance	ALD	15	0	0	0	0	15	0	0	0	0
07-1402	I	Cronadun - Regulator Refurbishment and Maintenance	CRN	20	0	0	0	0	0	0	0	0	0
07-5401	E	Dillmans Protection Upgrade	DIL	5	5	25	0	0	0	0	0	0	0
07-6401	D	Ripple Plant Optimisation	DOB	18	0	0	0	0	0	0	0	0	0
07-1403	I	Dobson Zone Sub transformer refurbishment and maintenance	DOB	75	0	0	0	0	0	0	0	0	0
-	E	Fox - Zone Sub regulator refurbishment and maintenance	FOX	0	120	0	0	0	0	0	0	0	0
07-1413	I	Fox Glacier Zone Sub transformer refurbishment and maintenance	FOX	10	0	0	0	0	0	0	75	0	0
07-5403	E	Franz Zone Sub, Install Tower and Comms Gear	FRZ	50	0	0	0	0	0	0	0	0	0
-	I	Franz Zone Sub OLTC Maintenance	FRZ	0	0	0	0	0	0	15	0	0	0
07-1406	I	Franz Josef & Fox Glacier Subs, Install Cellphones	FRZ	20	0	0	0	0	0	0	0	0	0
07-1404	I	Franz Zone Sub Transformer Refurbishment and Maintenance	FRZ	60	0	0	0	0	0	0	0	0	0
07-1405	I	Franz Zone Sub 11 kV Bus Reconfiguration	FRZ	80	15	0	0	0	0	0	0	0	0
07-6402	D	RGSP Globe Hill - Build New Zone Substation	GLB	400	0	0	0	0	0	0	0	0	0
-	I	Paint radiators and refurbish GLB T1	GLB	0	0	0	0	0	5	0	0	0	0
-	I	Globe Hill Zone Sub OLTC Maintenance	GLB	0	0	0	0	0	0	15	0	0	0
07-5404	E	Greymouth Zone Sub, Replace Protection	GYM	40	275	0	0	0	0	0	0	0	0
-	I	Paint Gantry Steelwork at Grey Substation	GYM	0	20	30	0	0	0	0	0	0	0
07-1416	I	Greymouth Zone Sub OLTC Maintenance	GYM	30	0	0	0	0	30	0	0	0	0
-	I	Construct New Boundary Fence at Greymouth Substation.	GYM	0	50	0	0	0	0	0	0	0	0
-	I	Greymouth Zone Sub transformer refurbishment and maintenance	GYM	0	30	0	0	150	150	0	0	0	0
-	I	Paint exterior and replace roof at GYM Substation	GYM	0	0	0	20	0	0	0	0	0	0
-	RPL	Greymouth Zone Substation T1 Arrestor Replacement	GYM	0	30	0	0	0	0	0	0	0	0
-	RPL	Greymouth Zone Sub - 66 kV Minimum Oil CB Replacement	GYM	0	180	0	0	0	0	0	0	0	0
-	RPL	Greymouth Zone Sub, Replace ODJB's	GYM	0	20	0	0	0	0	0	0	0	0
-	D	SWGR Zone Sub Upgrade - Harihari Sub	HHI	0	0	0	0	2000	0	0	0	0	0
-	I	Harihari - Zone Sub regulator refurbishment and maintenance	HHI	0	0	10	0	0	0	0	0	0	0
-	I	Harihari Zone Sub transformer refurbishment and maintenance	HHI	0	0	10	0	0	0	0	0	0	0
07-5405	E	Install new 110 V DC System and Rerrange Protection at HKK sub	HKK	30	0	0	0	0	0	0	0	0	0
-	I	Hokitika Zone Sub OLTC Maintenance	HKK	0	30	30	0	0	0	30	30	0	0
07-1425	I	Hokitika Zone Sub transformer refurbishment and maintenance	HKK	10	0	0	0	0	30	0	0	0	0
07-1407	I	Zone Sub Instrumentation and Auxillay Equipment Upgrade	HKK	20	20	10	10	10	10	10	10	10	10
07-1408	I	Longford Corner Regulator Refurbishment and Maintenance	HKK10	10	10	0	0	0	0	0	0	0	0
-	I	Haupiri regulator refurbishment and maintenance	HPR	0	0	5	0	0	0	5	0	0	5
-	D	Build New Zone Sub - Kokatahi	KOK	0	0	0	0	0	500	0	0	0	0
-	E	Kumara Substation Protection Upgrade	KUM	0	10	100	0	0	0	0	0	0	0
-	E	Extend Kumura 66 kV Bus	KUM	0	0	0	200	0	0	0	0	0	0
-	I	Kumara Zone Substation 66 kV CB Maintenance	KUM	0	60	0	0	0	0	0	0	0	0
-	I	Kumara Zone Sub OLTC Maintenance	KUM	0	0	0	15	0	0	0	0	15	0
07-4402	RPL	Kumara Substation, Replace 11 kV Potheads	KUM	10	0	0	0	0	0	0	0	0	0
-	E	Kumara Zone Sub, Construct a new 11 kV switchroom	KUM	0	500	0	0	0	0	0	0	0	0

Zone Substation Projects ($'000)													
ID	Act	Description	Area	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
-	I	Kumara Zone Sub transformer refurbishment and maintenance	KUM	0	0	0	0	0	0	0	60	0	0
07-6406	D	Logburn Road, Construct New 110/33/11 kV Substation	LGN	2730	0	0	0	0	0	0	0	0	0
-	I	Logburn Road Zone Sub OLTC Maintenance	LGN	0	0	0	0	0	15	0	0	0	0
-	I	Paint radiators and refurbish LGN T1	LGN	0	0	0	0	0	0	5	0	0	0
07-5406	E	Ngahere Zone Sub, 11 kV Bus Re-arrangement	NGH	30	0	0	0	0	0	0	0	0	0
07-1409	I	Ngahere Zone Sub Transformer Refurbishment and Maintenance	NGH	15	0	0	0	0	0	0	0	0	0
-	I	Ngahere Zone Sub OLTC Maintenance	NGH	0	0	0	0	15	0	0	0	0	0
-	I	Pike River Zone Sub OLTC Maintenance	PIK	0	0	0	0	0	15	0	0	0	0
-	I	Paint radiators and refurbish PIK T1	PIK	0	0	0	0	0	5	0	0	0	0
07-6403	D	Pike River Coal – Build New 33/11 kV Zone Sub	PIK	1800	0	0	0	0	0	0	0	0	0
07-5407	E	Rapahoe Zone Sub Protection Upgrade	RAP	85	0	0	0	0	0	0	0	0	0
07-5408	E	Rapahoe Zone Sub, Provide 11 kV Cable Isolation	RAP	20	0	0	0	0	0	0	0	0	0
-	I	Paint Gantry Steelwork and reinsulate - Rapahoe Substation	Rap	0	20	30	0	0	0	0	0	0	0
-	I	Rapahoe Zone Sub transformer refurbishment and maintenance	RAP	0	15	0	0	0	0	0	0	0	0
-	I	Rapahoe Zone Sub OLTC Maintenance	RAP	0	0	0	15	0	0	0	0	15	0
-	I	Paint radiators and refurbish RFN T2 and T3	RFN	0	0	0	0	10	0	0	0	0	0
-	I	Reefton Zone Sub OLTC Maintenance	RFN	0	0	0	0	30	30	0	0	0	30
07-6404	D	RGSP 110/33 kV Reefton Substation	RFT	50	0	0	0	0	0	0	0	0	0
07-1410	I	Reefton Zone Sub Transformer Refurbishment and Maintenance	RFT	10	0	10	0	0	0	0	0	0	0
-	D	SWGR Zone Sub Upgrade - Ross Sub	RSS	0	0	0	0	600	0	0	0	0	0
07-1412	I	Ross Zone Sub Transformer Refurbishment and Maintenance	RSS	10	0	0	0	0	0	0	0	0	0
-	I	Ross Zone Sub Regulator Refurbishment and Maintenance	RSS	0	0	0	0	0	0	0	0	5	0
07-6407	D	WMS (mobile sub) Storage Facility	SYS	130	0	0	0	0	0	0	0	0	0
07-6408	D	WMS - Purchase of Mobile Substation	SYS	20	0	0	0	0	0	0	0	0	0
-	D	RGSP - Development of Ikamatua/Blackwater Zone Substation	SYS	0	0	500	0	0	0	0	0	0	0
07-6405	D	Pike River Coal - Development of Atarua Tee	SYS	100	0	0	0	0	0	0	0	0	0
07-5409	E	Purchase of Portable Earths and Authorisation Equipment	SYS	10	0	0	0	0	0	0	0	0	0
07-5413	E	Purchase of SF6 Test Equipment	SYS	60	80	0	0	0	0	0	0	0	0
07-5414	E	Provide Mobile Sub Access to Zone Substations	SYS	60	60	0	0	0	0	0	0	0	0
07-5411	E	Install GPS Time Reference to Zone Subs	SYS	10	10	0	0	0	0	0	0	0	0
07-5412	E	Install New Ripple Control Static Convertors	SYS	360	0	0	0	0	0	0	0	0	0
07-5410	E	Ngahere Substation - Install 33 kV Bypass Switches	SYS	25	0	0	0	0	0	0	0	0	0
07-1427	I	Carry out thermovision inspections of Zone Substation equipment	SYS	5	5	5	5	5	5	5	5	5	5
07-1414	I	Zone Sub Seismic Repairs	SYS	50	50	0	0	0	0	0	0	0	0
07-1417	I	Develop a Protection Database	SYS	15	0	0	0	0	0	0	0	0	0
07-1428	I	Oil filter and dry out system for transformers	SYS	25	15	15	15	15	15	15	15	15	15
07-1426	I	Corona Discharge Testing at Various Zone Subs	SYS	7	7	7	7	7	7	7	7	7	7
07-1419	I	Zone Substation Security Systems	SYS	10	10	0	0	0	0	0	0	0	0
07-1418	I	Investigate and Replace Mercury Switched Temperature Gauges	SYS	50	0	0	0	0	0	0	0	0	0
07-1423	I	Zone Sub Building Climate Control	SYS	20	20	20	0.5	0.5	0.5	0.5	0.5	0.5	0.5
07-1422	I	Zone Substation Building Maintenance	SYS	30	30	30	30	30	30	30	30	30	30
07-1421	I	Earthing Review of Zone Subs and Associated Redemial Works	SYS	30	30	30	30	0	0	0	0	0	0

Zone Substation Projects ($'000)														
ID	Act	Description	Area	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
07-1420	I	Purchase and Installation of Earthing Spigots	SYS	4	0	0	0	0	0	0	0	0	[illegible]
07-1415	I	Perform Oil tests at Zone Subs (DGA)	SYS	20	20	20	20	20	20	20	20	20	[illegible]
07-1424	I	Zone Sub Landscaping and Beautification	SYS	8	8	8	8	8	8	8	8	8	[illegible]
-	RPL	PLC Replacement	SYS	0	50	50	0	0	0	0	0	0	[illegible]
07-4401	RPL	Replace Ripple Injection RTU's at HKK and RFN	SYS	20	0	0	0	0	0	0	0	0	[illegible]
07-4403	RPL	KFE Recloser Replacement at Zone Substations	SYS	100	110	110	120	0	0	0	0	0	[illegible]
-	I	Wahapo Zone Sub OLTC Maintenance	WAH	0	0	15	0	0	0	0	15	0	[illegible]
-	I	Wahapo Zone Sub transformer refurbishment and maintenance	WAH	0	60	0	0	0	0	0	0	0	[illegible]
07-4404	RPL	Wahapo Zone Sub, Install Ripple Plant	WAH	100	0	0	0	0	0	0	0	0	[illegible]
-	D	SWGR Zone Sub Upgrade - Waitaha Sub	WAH	0	0	0	0	100	0	0	0	0	[illegible]
-	I	Waitaha - Zone Sub regulator refurbishment and maintenance	WTH	0	0	0	0	0	10	0	0	0	[illegible]
-	I	Whataroa Zone Sub transformer refurbishment and maintenance	WAT	0	10	0	0	0	0	0	0	0	[illegible]
-	I	Whataroa - Zone Sub regulator refurbishment and maintenance	WAT	0	0	0	0	0	0	0	10	0	[illegible]
-	I	Waitaha Zone Sub transformer refurbishment and maintenance	WTH	0	10	0	0	0	0	0	0	0	[illegible]
			Total	6937	1995	1070	496	3001	901	166	286	131	13

tained as necessary when the associated circuit is taken out of service.

6.6.2 Fault Repairs

Equipment failures occur randomly and without warning and range from a simple circuit breaker mechanism failure due to a broken circlip to a costly transformer winding failure. The cost budgeted is the cost to restore supply or the service following the failure, not the cost of any repair work after supply or service has been restored.

It is estimated that there are approximately two such faults per month. It is expected this frequency will be reduced as aged/defective equipment is refurbished or replaced.

The projected expenditure is based on actual expenditure incurred in recent years. It is not practicable to allocate projected expenditure against each sub station asset category given the range of faults, which can occur.

6.6.3 Planned Repairs and Refurbishment

This area of expenditure includes corrective work identified following inspections and tests and while undertaking routine maintenance or following equipment failures. The magnitude and costs of the work can vary greatly.

The planned expenditure also includes the cost of materials and spares.

6.3.3.1 Power Transformers

The major causes of power transformer failures are winding and internal connection faults. These are caused in general by electrical through faults or lightning strikes.

The other major internal maintenance on a power transformer is oil refurbishment and desludging which is carried out as required based on oil acidity test results. It is not expected that this will be required on any of Westpower's units within the planning period

At mid-life, a full dry out and core retighten is recommended.

(i) Radiator Replacement

Radiator replacement is only carried out on coolers where the design of the radiators or extent of corrosion means repairs cannot be carried out satisfactorily

The corrosion occurs after 20 or more years of age in transformers in corrosive environments (such as coastal). The radiators are replaced only once in the life of a transformer. Only two of Westpower's current power transformers meet this criteria.

(ii) Repainting

Painting is carried out on a regular basis at a period of generally between 10 to 15 years depending on site conditions. It is planned to paint approximately 1 unit per year over the period 2002-2011

(iii) Other Equipment

Ongoing repairs are required to a variety of other station equipment including portable earthing equipment and battery banks.

6.6.4 Replacement Programmes

Westpower has formulated its replacement programme based on the following criteria:

6.6.4.1 Circuit Breakers - Outdoor

In line with the practice of overseas utilities as reported by CIGRE, Westpower has a policy, subject to project-specific economic analysis, of replacement rather than life extension of aged deficient bulk oil and minimum oil circuit breakers by major refurbishment.

Circuit breakers are also replaced for the following reasons:

- where they have high maintenance costs
- where they are unreliable due to an increased defect rate
- where a system node requires a maintenance free circuit breaker i.e. maintenance outages cannot be tolerated

There are generic problems associated with minimum oil circuit breakers resulting from moisture ingress, which presents a safety hazard to personnel working in switchyards. This results in random explosive failures where porcelain fragments can travel up to 50 metres and cause considerable damage to adjacent equipment. Such an incident has occurred on one of Westpower's minimum oil circuit breakers due to inappropriate levels of maintenance.

It is internationally recognised that forty years is generally the "time expired" life of circuit breakers. Some types have an economic life greater or less than this figure. Bulk oil breakers generally have a longer life, while minimum oil breakers typically last only 30-35 years.

While age is not itself criteria for replacement, analysis based on likely total economic lives for each type, make and model of circuit breaker provides a means of assessing likely future replacement requirements. The replacements themselves would be determined by safety, economics and reliability assessments at the time.

Westpower currently has three 66 kV minimum oil circuit breakers, and a replacement strategy is being

formulated that will ensure ongoing performance at these sites.

6.6.4.2 Circuit Breakers - Indoor

Metalclad switchgear deteriorates with age resulting in ageing of insulation materials, such as formation of voids and penetration of moisture. Visible compound leaks and audible corona discharge often accompany this.

Replacement is justified primarily on reliability/risk of failure grounds and customer service operating limitations. There is potential for explosive failure, which occurs infrequently (approximately one such failure every ten years). Recent failures of SO-HI metalclad switchgear has led to the Greymouth 11 kV switchboard, being the only SO-HI type in Westpower's area, being replaced in 2003.
As contractors work in close proximity to the equipment and the equipment is oil filled there is an increased risk of personal injury. Overseas utilities have adopted designs such that new oil filled equipment is not installed indoors and blast walls have been installed between old equipment and places where contractors are required to work for extended periods.

Modern SF6/vacuum replacement installations with air insulated bus chambers rather than the old compound insulated types are virtually maintenance free. There is a high cost associated with maintenance of old oil filled and compound insulated equipment, which requires annual major service and frequent fault maintenance.

The typical economic life of Westpower's indoor metalclad switchgear installations (typically 11 kV) has been assessed to be 50 years based on past experience. At present only a small percentage are over 20 years old.

6.6.4.3 Structures, Disconnectors and Buswork

The Westpower policy of using either galvanised steel or concrete support columns in switchyards means that there is only minimal maintenance required for buswork.

Disconnectors are scheduled for replacement when they develop a history of unreliability or failures, when their maintenance costs become unacceptably high, or when they are identified as being electrically underrated.

A programme is currently under way to review the condition and suitability of each disconnector in Westpower's network. It has been found that the older type of disconnector without flicker arcing horns is not suitable for use in main lines when paralleling of feeders is involved, although they are still quite suitable for use on spur lines. A replacement programme is in place and for the purposes of this plan a contingency sum has been allowed.

6.6.4.4 Instrument Transformers

Aged instrument transformers are only replaced when they fail, or when they are about to fail as diagnosed by testing. They are then replaced with a similar unit, usually a spare. Other replacements occur during site development works and depending on whether the condition and ratings etc of the transformer are suitable for use at another site they may be scrapped.

At Greymouth Substation, the 66 kV instrument transformers will be replaced over time with vandal resistant units using composite insulators because of the risk of failure due to ongoing vandal damage.

6.6.4.5 Power Transformers

There are no plans to replace any of the existing power transformers during the planning period, based on the age and condition of the units.

There is a concern that an increased replacement requirement due to deteriorating condition will be required within the next 20 to 30 years, since the transformers purchased in the 1970's are likely to begin to fail at around 50 years of age.

Regardless of whether a pre-emptive replacement programme is undertaken, it seems likely that units will fail at an increasing rate in future, and this will force replacement. Provided sufficient diagnostic tests are undertaken to identify imminent failure and provided some suitable spare units are available, this should not lead to a noticeable decrease in customer supply reliability and could be a cost-effective replacement strategy option.

6.6.5 Maintenance Summary

In summary, the Zone Substations maintenance expenditure is shown in the above tables.

There are consistent expenditure requirements for power transformer repair work, involving radiator repairs, repainting, and repairs to internal connections and oil refurbishment.

Overall, other station expenditure projections are similar to present expenditure levels, with some changes and trends for specific assets and activities resulting from the Asset Management Plan analysis.

6.6.6 Enhancement

The age profile of Westpower's Zone Substations is such that only minimal enhancement expenditure is required throughout the planning horizon. The capacity of all of the assets is sufficient to handle normal expected load growth over the next ten years.

6.6.6.1 Oil Interception Facilities

Oil interception facilities are installed to meet environmental requirements under the Resource Management Act. Previous policy did not set a cut off criteria for the amount of oil at a site before oil containment facilities were installed. But this has now been set at 1,500 litres in line with Transpower standards, which will likely be the measure for what could be considered "reasonably necessary" in terms of the Act.

6.6.7 Development

All development projects are dependent either on new investment agreements being reached with large customers or a clear economic justification. None of the projects discussed below are committed at this stage.

Project 07-6401 Ripple Plant Optimistation

Some finishing works may be required to complete this project last year. A contingency sum has been allowed for this.

Project 07-6402: RGSP Globe Hill - Build New Zone Substation

As a part of the Globe Mine reopening, the mine will require a 33/11 V Zone Sub to connect between the new 33 kV sub transmission circuit and the site 11 kV reticulation.

Project 07-6403: Pike River Coal – Build New 33/11 kV Zone Sub

The Pike River Coal Mine will be established in the this year and the mine will require a 33/11 V Zone Sub to connect between the new 33 kV Sub transmission circuit and their site 11 kV reticulation.

Project 07-6404: RGSP 110/33 kV Reefton Substation

To complete works at the new Reefton substation, funds have been made available to carry out fecing, landscaping etc.

Project 07-6406: Logburn Road, Construct New 110/33/11 kV Substation

To provide an adequate 33 kV power supply to the proposed Pike River Coal Mine, a new 110/33/11 kV will be constructed at Logburn Road.

Project 07-6407: WMS (mobile sub) Storage Facility

With the completion of the Mobile substation imminent, storage of the unit will need to be addressed. A barn type shed is to be contstructed at Crofts yard which will provide an ideal central location.

Project 07-6408: WMS - Mobile Substation

Much of the work on the Mobile substation has been carried out. Due to the late delivery of the transformer and trailer, the finishing touches will be applied in the early part of the year.

Zone Substation Projects 2005-06

Various Substations

Project 07-1414: Zone Sub Seismic Repairs

A recent seismic assessment carried out on Westpower's zone subs has listed remedial action required. A contingency will be provided to complete such works.

Project 07-1415: Perform Oil tests at Zone Subs (DGA)

An enhanced baseline analysis of transformer oil conductivity and dissolved gases will be continued in the 2006 year to gain a better understanding of the condition of the asset.

Project 07-1417: Develop a Protection Database

Funds are to be allowed for the development of a protection database based on the commercially available SEL5010 software.

Project 07-1418: Investigate and Replace Mercury Switched Temperature Gauges

Some Zone Sub transformers have been fitted with temperature gauges with Mercury Switches. During Seismic activity there is a chance the Mercury could move causing trippings or nuisance alarms. Rather than install blocking devices it is cleaner to replace any gauges that are found with Mercury switches.

Project 07-1419: Zone Substation Security Systems

To reduce vandalism and ensure zone substation compounds are free of unwanted visitors security cameras are to be installed. Resulting video will allow controllers to monitor these areas over an IP link.

Project 07-1420: Purchase and Installation of Earthing Spigots

It had been common practice to directly place portable earths onto conductor leading to equipment. This is no longer acceptable as it causes damage to equipment and at some locations earths are difficult to apply. It is more appropriate to have spigots installed for earths to be applied to. This project proposes to have spigots installed as equipment is released for maintenance

Project 07-1421: Earthing Review of Zone Subs

Westpower is required to carry out regular earth testing of its Zone Substations as a regulatory and health and safety issue. The company must also ensure that damage to other plant such as Telecom equipment is minimised in the event of an earth fault, and a survey is currently being carried out of all Zone Substation earth mats to ensure compliance.

Project 07-1422: Zone Substation Building Maintenance

This is an ongoing project which can include building maintenance such as cladding repairs, spouting repairs etc on all of Westpower's zone substation buildings.

Project 07-1423: Zone Sub Building Climate Control

This project was initiated to ensure that equipment, especially that of the electronic kind, enclosed in Westpower's zone substation buildings are kept at the correct temperature and humidity levels. This project will see an initial cost, with ongoing maintenace costs.

Project 07-1424: Zone Sub Landscaping and Beautification

This is an ongoing project which incorporates, as the title suggests, landscaping and gardening work aimed at improving the amenity values at Westpower's zone substation sites.

Project 07-1426: Corona Discharge Testing at Various Zone Subs

To identify any failing insulation in zone substations, a corona discharge inspection programme is to be carried out. Strategic lines shall be inspected on a rotational basis, with each line being reviewed every three years.

Project 07-1427: Carry out thermovision inspections of Zone Substation equipment

To identify high resistant joints present in zone substations, a thermovision inspection programme is to be carried out. Strategic lines shall be inspected on a rotational basis, with each line being reviewed every three years.

Project 07-1428 Oil filter and dry out system for transformers

A number of the zone sub transformers have moisture ingress which severely shortens their life. A portable filter system is proposed to be moved around the transformers to remove much of this moisture via online filtering. Extra finance ($10k) will be required in the 06-07 financial year to allow for the update to include acid treatment.

Project 06-1416: Upgrade Transformer Breathers in Zone Substations

Moisture ingress into transformers severely shortens their life. Regular maintenance of moisture trapping breathers is required to limit the moisture ingress. Some breathers will be upgraded to higher volume types in an attempt to limit further moisture ingress.

Project 07-4403: KFE Recloser Replacement at Zone Substations

KFEs are starting to give variable performance in zone substations. Their settings selection is limited. It is proposed that as their setting limitations are identified as to cause nuisance they are to be replaced progressively with KFME/FXB or 351 combinations. The removed reclosers are then held for replacements of failed units or put in less onerous positions in rural parts. It is proposed to change out the two NGH and one WAT reclosers in the next year as their set-ability is not ideal and the protection replacement will lend with the general communications upgrade to the site. One of the Ngahere reclosers also has an earlier version of automation that has not worked ideally.Two removed KFE's will be reused at less important sites, one will be held as spare, there are no spare KFE's at present.

Project 07-5409: Purchase of Portable Earths and Authorisation Equipment

Much of the existing operator equipment is becoming worn or in need of upgrade to meet the increasing fault levels of the system. This project proposes to fit out the substations with the appropriate operator equipment to the latest standards.

Project 07-5410: Install 33 kV Bypass Switches

Minor maintenance cannot be carried out on Ngahere's 33 kV transformer recloser without a complete shut-down. The installation of a bypass switch will allow testing and other minor work to be carried out while maintaining supply

Project 07-5411: Install GPS Time Reference to Zone Subs

The installation of time reference devices in each of the zone substations is required to help in the studies of faults on the Westpower network. These devices syncronise all zone substation digital relays with satallite time via IRIG-B time code.

Project 07-5412: Install New Ripple Control Static Convertors

Westpower's current population of ripple injection plants are nearing the end of their economic life with spare parts becoming difficult to obtain. The replacement programme planned involves replacing one critical plant per year over 3 years with a modern, high capacity unit and using the plant that has been released from service as spare parts to maintain the other plants.

Project 06-5414: Provide Mobile Sub Access to Zone Substations

Consideration must be made to provide permanent access and substantial earth grid to some zone substations for the mobile substation. Funds shall be allocated to allow this work to continue.

Reefton Substation

Project 07-1410: Reefton Zone Sub Transformer Refurbishment and Maintenance

The transformer which was located at RFN sub has been sent for servicing. This transformer will eventually be shifted to Ngahere.

Cronadun Regulator

Project 07-1402: Cronadun Regulator Refurbishment and Maintenance

1970's 2 MVA unit, should provide at least another 20 years service. Needs painting. Estimated cost $3k – carry out in 2006/2007.

Ngahere Substation

Project 07-1409: Ngahere Zone Sub Transformer Refurbishment and Maintenance

New in mid 80's, paint radiators and unit in 2006, OLTC overhaul

Project 07-5406: Ngahere Zone Sub, 11 kV Bus Re-arrangement

TTo accommodate a refurbished transformer at Ngahere sub will involve some manouvering of transformers. The transformer originally from Reefton T1 but currently being refurbished, will be transported and fitted into Ngahere substation. The transformer currently at Ngahere T1 (TX:1728) will be overhauled and then placed at RFT as a spare.

Arnold Substation

Project 07-1401: Arnold Zone Sub Transformer Refurbishment and Maintenance

T1 new in 1995, paint radiators and unit in 2007, no major work foreseen for 15 years.

Project 07-5402: Install a Double Underhung Disconnector at Arnold Sub

To allow isolation of the HV circuit breaker at Arnold Substation, a double underhung disconnector is to be installed. The Ngahere substation upgrade has provided a redundant underhung disconnector which shall be utilised for this project.

Dobson Substation

Project 07-1403: Dobson Zone Sub Transformer Refurbishment and Maintenance

Sister unit to FOX, needs painting and site tidy up in 2007 , major overhaul requirement being monitored – oil dry out and acidity reduction required.

Rapahoe Substation

Project 07-5407: Rapahoe Zone Sub Protection Upgrade

The protection installed at Rapahoe is either original to the station or recycled from the Kaniere switching station. The later has been found to have lost accuracy. All the station protection, except the transformer differential protection, is proposed to be replaced as well the aged SCADA interface and autoreclose system.

Project 06-5408: Rapahoe Zone Sub, Provide 11 kV Cable Isolation

To allow the 11 kV feeder cables emanating from Rapahoe substation to be isolated, without an outage on the entire substation, a reconfiguration of the 11 kV network outside the sub yard will need to take place. This will include the installation of a new pole, 2 new 11 kV disconnectors and some LV relocation work.

Greymouth Substation

Project 07-5404: Greymouth Zone Sub, Replace Protection

Although the existing protection equipment on the banks at Greymouth is still quite serviceable, it does not provide the communication and additional protection functions used in modern schemes. In particular, adaptive settings, which are required to maintain protective discrimination under differing system configurations, such as bank outages, are not available with the current scheme. It is proposed to replace the existing CombiFlex relays with SEL units as installed in Hokitika recently

KumaraSubstation

Project 07-4402: Kumara Substation, Replace 11 kV Potheads

The 11 kV potheads are of the cast iron type and are an undesirable network component. This type of pothead should not be retained in the system due to previous failures, therefore the potheads outside Kumara Substation shall be replaced.

Dillmans Substation

Project 07-5401: Dillmans Protection Upgrade

The protection relays at Dillmans are original. Testing of some similar types of protection elements has shown they are starting to drift a little, probably due to their capacitors drying out. It is proposed to change out the protection with design done one year then the works the next.

Hokitika Substation

Project 07-1407: Hokitika Zone Sub T4 and T5 Temperature Gauge Upgrade

The temperature gauges on HKK T4 and T5 require replacement.The new units have different bulb size therefore require the oil to be lowered in the main tank, removal of old unit and the welding in of new bulb pocket.

Project 07-5405: Install new 110 V DC System and Rerrange Protection at HKK sub

To allow a more effective back-up of the d.c. system at Hokitika sub, a second 110 V d.c. unit shall be installed. The two protection systems will then each have an independent d.c. supply.

Longford Corner Regulator

Project 07-1408: Longford Corner Regulator Refurbishment and Maintenance

Manufactured in the1970's this 2 MVA unit, should provide at least another 20 years service, however will require painting. It will also need a new bypass arrangement as the present ones are brown insulators.

Ross Substation

Project 07-1412: Ross Zone Sub Transformer Refurbishment and Maintenance

The transformer will require a paint job, There is no OLTC so the tapping switch needs checking for carbon build up. The unit should be withdrawn from service for maintenance in 2007 and replaced with a spare.

Wahapo Substation

Project 07-4404: Wahapo Zone Sub, Install Ripple Plant

With the commissioning of the new ripple plant at Reefton Sub an opportunity has arisen to relocate the existing plant to Wahapo. This would increase the South Westland ripple signal and allow ripple control while the HKK1012 33 kV cct is split.

Franz Substation

Project 07-1404: Franz Zone Sub Transformer Refurbishment and Maintenance

The transformer at Franz Sub needs major tap changer work and a repaint. In 2006 it should be removed for maintenance.

Project 07-1405: Franz Zone Sub 11 kV Bus Reconfiguration

The FRZ 11 kV metering unit has 100/50/5 CT ratios. This will become under rated in time as the load grows. The unit could be removed from service now that metering can be carried out in the new relay on 1612. In the position of the metering unit, an isolating spar type ABS can be installed to allow the 11 kV bus to be livened from local temporary generation or a mobile substation. Single phase VTs will need to be installed as well as Riser class surge arrestors on the outgoing cables.

Project 07-1406: Franz Josef & Fox Glacier Subs, Install Cellphones

To allow remote connection to the SEL relays at both the Franz and Fox substations cellphones will need to be installed on site. Setting changes will be able to be carried out remotely along with the collection of event data and statistical metering.

Project 07-5403: Franz Zone Sub, Install Tower and Comms Gear

The Franz CBD has had an 11 kV ring installed along with RMUs that could be automated. Before the automation can occur, a local UHF radio system is required to be established as the VHF signal is not strong enough to tranverse the bush. A tower and comms equipment is required to set up a local radio network.

6.7.0 Distribution Substations

6.7.1 Inspection, Servicing and Testing

All of Westpower's distribution substations require to be regularly tested every five years for safety reasons in accordance with the Electricity Regulations. At the same time the general condition of the transformer is checked and an oil sample taken to monitor the internal state of the unit.

6.7.2 Fault Repairs

Lightning damage or ingress of water causes most transformer faults.

Westpower has had a programme over the last seven years of retro fitting lightning arrestors on all substations that do not yet have these fitted, and this is now nearing completion. Past experience has shown that lightning arrestors greatly reduce the risk of transformer damage.

Regular inspection of transformers will also reduce the number of failures due to water ingress caused by deterioration such as rusty tanks.

Minor repairs such as bushing replacements can be carried out on site if necessary, but most fault repairs involve the swapping out of a transformer unit with a spare from the store.

6.7.3 Planned Repairs and Refurbishment

Corrosion and resulting water contamination of the insulating oil in distribution transformers is a major concern. A programme of identifying badly corroded transformer tanks has been instigated.

Once identified, these transformers will be removed for repair, re-tanking or replacement as dictated by the state and age of the unit.

Major rewinds of transformers are not undertaken unless the transformer size is over 50 kVA and the transformer is less than ten years old. This is based on economics.

(i) Oil Refurbishment/Desludging

Oil refurbishment is planned for 10 distribution transformers per year.

Project 07-1501: Sub (site) Upgrades

To ensure Westpower's distribution substations comply with the Electricity Regulations and Codes of Practice such as ECP35, a programme has been established to test earthing systems on all distribution substation sites and upgrade if necessary. This is an ongoing project, with all earth test results and upgrade notes recorded in the Electrical Network System.

Project 07-1502: Chance Dropout Fuse Replacement

The Chance drop out fuses have been observed locally and away to not always pivot open under fault clearing conditions. This is due to dissimilar metals in the bearing area corroding and sticking and poses a health and safety issue. All the Chance units in the salt zone need changing out in the near future

Project 07-1503: Replacement of Tinned Live Line Taps

Tinned bronze live line taps have been applied to Aluminum conductors and Aluminum live line taps to Copper conductors. In a salty environment these are causing the conductor to be eroded. Some of the screw threads are also being found to bind. Live line taps are now considered a temporary device in the "salty zone" and are to be replaced by Amp joints in the near future.

6.7.4 Replacement Programmes

There is a major programme in place for replacing older transformers that have failed as a result of old age or lightning damage. The transformer technician individually assesses each transformer when returned to the store and an appropriate recommendation on replacement or repair made by the engineer.

This is a means of prudently managing the asset and ensuring that an appropriate age profile is maintained. A distribution transformer condition monitoring programme is about to be introduced which will identify the condition of the current population and provide a substantial basis for assessing likely costs in future asset management plans.

Current levels of transformer replacements are planned to continue. Typical prices for new units range from

Distribution Substation Projects and Programmes ($'000)										
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Inspect, Service & Test	221	221	221	221	221	221	221	221	221	221
Faults	23	23	23	23	23	23	23	23	23	23
Repairs	18	18	18	18	18	18	18	18	18	18
Replacement	30	40	30	30	30	30	30	30	30	30
Enhancement	110	110	170	30	30	30	30	30	30	30
Development	60	60	60	160	210	210	260	260	260	260
Total	**462**	**472**	**522**	**482**	**532**	**532**	**582**	**582**	**582**	**582**

Distribution Substation Projects ($'000)													
ID	Act	Description	Area	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
07-5501	E	Greymouth CBD Subs Upgrade	GYM6	30	30	40	0	0	0	0	0	0	0
06-4502	RPL	Wilson Lane Sub Rebuild	GYM7	0	10	0	0	0	0	0	0	0	0
-	E	Upgrade Sub, Hartmount Place, Punakaiki	RAP1	0	0	100	0	0	0	0	0	0	0
07-6501	D	New Transformer Sites	SYS	60	60	60	60	60	60	60	60	60	60
-	D	Unspecified Distribution Substation works	SYS	0	0	0	100	150	150	200	200	200	200
07-5502	E	Fitting Lightning Arrestors	SYS	80	80	30	30	30	30	30	30	30	30
07-1503	I	Replacement of Tinned Live Line Taps	SYS	20	20	20	20	20	20	20	20	20	20
07-1501	I	Sub (site) Upgrades	SYS	80	80	80	80	80	80	80	80	80	80
07-1502	I	Chance drop out fuse replacement	SYS	30	30	30	30	30	30	30	30	30	30
07-4501	RPL	Distribution Sub Replacements	SYS	30	30	30	30	30	30	30	30	30	30
				330	**340**	**390**	**350**	**400**	**400**	**450**	**450**	**450**	**450**

$3,000 for small single-phase units to $20,000 for urban pad-mount transformers.

Project 07-4501: Distribution Sub Replacements

Westpower has assessed it's stock of spare transformers and it's ability to cover potential failures. At present a contingency allowance is made to cover this work

Project 07-4502: Wilson LaneSub Rebuild

Wilson Lane Sub has an 11 kV CB that is nearing the end of its economic life. A fuse unit has been identified as possibly coming surplus at the Fox Hotel should their development proceed. This could be moved to Wilson Lane to replace the 11 kV CB.

6.7.5 Enhancement

Project 07-5501: Greymouth CBD Subs Upgrade

Each year one of the "bunker subs" in the Greymouth area is updated to remove aged 400 V switchgear. It is proposed to continue the project at Badger Lane in the 06-07 financial year.

Project 07-5502: Fitting Lightning Arrestors

With the development of the Hokitika substation, it was discovered equipment using an impedance earthing device, under earth fault conditions, would cause the potential to rise on the healthy phases. This potential can rise above the rating of existing 9 kV lightning arrestors, therefore causing the arrestor to fail. In light of this, a lightning arrestor replacement programme has commenced, which will have all 9 kV lightning arrestors replaced with those with a rating of 12 kV where required.

6.7.6 Development

Project 07-6501: New transformer sites

Installation of new distribution substations is generally dependent on customer requests. As the distribution substation is by definition, the site on which a transformer is placed, the majority of funds required are met by the consumer. There are times however, when Westpower will fund new and replacement sites for reasons such as regulation compliance.

6.8 MV Switchgear

6.8.1 Inspection, Servicing and Testing

Circuit breakers are subjected to minor and/or major maintenance routines in accordance with the requirements of Westpower maintenance standards. Fault maintenance is also carried out when a circuit breaker has completed a specified number of fault trippings.

Modern vacuum circuit breakers are subjected to minor services and condition monitoring tests only at 4 yearly intervals. Invasive major services are not scheduled and would be carried out only if required as indicated by condition monitoring tests.

As with power transformers, there are two levels of servicing:

- minor servicing, involving external servicing (non-invasive)
- major servicing, which involves invasive servicing

The frequency and scope of servicing is defined uniquely for each type, make and model of circuit breaker, and costs per breaker vary significantly. Typically, minor servicing is carried out annually, depending on type at a cost ranging from a few hundred dollars to $1,000 per service. While major servicing, is typically undertaken every 2 to 10 years at a cost of $1,500 to $5,000 per service. There are breaker types that lie outside of these ranges both for frequency of service and service cost.

The annualised servicing cost averages around $950 per year per breaker for outdoor circuit breakers and around $305 per year per breaker for indoor metalclad switch gear.

Project 07-1601: Replace Reclosers at L13 (Longford Corner) & L57 (St Kilda) with KFEs

With the ‘Replace KFE Reclosers DOB1 and DOB3’ releasing 2 KFE reclosers, the opportunity has arisen to replace the existing KF reclosers at L13 (Longford Corner) & L57 (St Kilda). This project shall proceed after the forementioned project.

6.8.2 Fault Repairs

6.8.2.1 Circuit Breakers

Fault repairs to switchgear take place as required, but as the population of older bulk-oil reclosers diminishes in line with the circuit breaker replacement programme, the occurrence of these faults has been greatly

MV Switchgear Projects and Programmes ($'000)										
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Inspect, Service & Test	85	55	55	55	55	55	55	55	55	55
Faults	11	11	11	11	11	11	11	11	11	11
Repairs	21	21	21	21	21	21	21	21	21	21
Replace	165	170	190	90	90	50	50	50	50	50
Enhancement	155	100	130	90	65	25	65	25	25	25
Development	227	140	110	110	50	50	50	50	50	50
Total	**664**	**497**	**517**	**377**	**292**	**212**	**252**	**212**	**212**	**212**

MV Switchgear Projects ($'000)													
			Area	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
07-6601	D	Inchbonnie, Install Load Equalising Recloser	ALD4	10	0	0	0	0	0	0	0	0	
07-6602	D	Franz Josef 11 kV Ring - RMU Automation	FRZ1	100	0	0	0	0	0	0	0	0	
06-5602	E	Relocate RW17T, Trickies Road	GYM11	0	10	0	0	0	0	0	0	0	
07-6603	D	South Westland Potential Support (SWPS) Harihari Regulator	HKK1012	7	0	0	0	0	0	0	0	0	
07-6604	D	Install Capacitors at Various locations	SYS	60	90	60	60	0	0	0	0	0	
07-6606	D	New Disconnectors	SYS	15	15	15	15	15	15	15	15	15	1
07-6605	D	Install Ring Main Units - Unspecified Locations	SYS	35	35	35	35	35	35	35	35	35	3
07-5603	E	Fit Earth Fault Indicators	SYS	15	15	15	15	0	0	0	0	0	
07-5602	E	Sectionalising Load Switch Installation	SYS	40	0	40	0	40	0	40	0	0	
07-5601	E	Install Automation to Various Disconnectors	SYS	100	75	75	75	25	25	25	25	25	2
07-1601	I	Replace Reclosers at L13 (Longford Corner) & L57 (St Kilda) with KFEs	SYS	30	0	0	0	0	0	0	0	0	
07-4601	RPL	Disconnector Replacements	SYS	50	50	50	50	50	50	50	50	50	5
07-4603	RPL	Ring Main Unit Replacement - RMU5 (Milton Rd) and RMU6 (Hospital)	SYS	75	80	100	0	0	0	0	0	0	
07-4602	RPL	Replace Faulty Actuators	SYS	40	40	40	40	40	0	0	0	0	
			Total	**577**	**410**	**430**	**290**	**205**	**125**	**165**	**125**	**125**	**125**

diminished.

Failures in indoor switchgear are also relatively rare, but with the increasing age profile of this equipment, it is expected that the fault rate will begin to increase within the next five years. A case in point is the Yorkshire SO-HI switchgear at Greymouth Substation that was replaced in 2002 because of the risk of failure.

6.8.2.2 Disconnectors

Disconnectors normally fail due to deterioration of the operating arms with corrosion or from an arc developing across two or more phases. By identifying under-rated disconnectors and replacing these, the incidence of arcing faults should be reduced.

6.8.3 Planned Repairs and Refurbishment

6.8.3.1 Circuit Breakers

Planned repair work in respect to circuit breakers would be additional corrective work and refurbishment identified during routine services, inspections and tests or following failures. Refurbishment work planned

includes overhaul of decommissioned circuit breakers prior to placing in stores

This work amounts to an average of $5,000-$8,000 pa.

In addition, general corrective work arising out of defects identified from routine service inspections and tests will lead to an expected total cost of $11,000 pa.

6.8.4 Replacement Programmes

Westpower has determined its replacement programme for high voltage switchgear based on the following criteria:

(i) Safety

Where equipment presents a higher than normal risk to personnel during operating or maintaining the equipment e.g

- generic types of aged bulk oil circuit breakers with history of failures
- circuit breakers requiring hand closing

(ii) Technical Suitability

This applies to equipment that is no longer suitable for its service application e.g.

- disconnectors and circuit breakers unreliable or inconsistent in performing their functions due to excessively worn mechanisms
- equipment which fails to meet Westpower's seismic requirements
- under-rated equipment

(iii) Economics

This is where replacement is justified purely for economic reasons, e.g.

- equipment is excessively expensive to maintain or repair
- high cost of spares or where spares can no longer be purchased
- maintenance intensive equipment installed at a sensitive supply location

6.8.4.4 Circuit Breakers - Outdoor

In line with the practice of overseas utilities as reported by CIGRE, Westpower has a policy, subject to project-specific economic analysis, of replacement rather than life extension of aged deficient bulk oil and minimum oil circuit breakers by major refurbishment.
Circuit breakers are also replaced for the following reasons

- where they have high maintenance costs
- where they are unreliable due to an increased defect rate

Where a system node requires a maintenance free circuit breaker i.e. maintenance outages cannot be tolerated.
It is internationally recognised that forty years is generally the "time expired" life of circuit breakers. Some types have an economic life greater or less than this figure. Bulk oil breakers generally have a longer life, while minimum oil breakers typically last only 30-35 years.

While age is not itself criteria for replacement, analysis based on likely total economic lives for each type, make and model of circuit breaker provides a means of assessing likely future replacement requirements. The replacements themselves would be determined by safety, economics and reliability assessments at the

time.

Many of the existing older bulk-oil reclosers have been replaced with modern, low-maintenance vacuum breakers.

The continuing replacement programme for outdoor circuit breakers, has resulted in there being no breakers over 25 years of age.

6.8.4.5 Andelect Units

Westpower has experienced two serious failures of Series I versions of these oil switch units during routine operation and they are considered to constitute a serious health and safety risk. A replacement programme has been instituted to gradually replace all these units over the next four years. In the meantime, strict operational procedures are being brought into force to mitigate the risk to operators of the equipment under the particular circumstances.

Project 07-4603: Ring Main Unit Replacement - RMU5 (Milton Rd) and RMU6 (Hospital)

The Andelect Series 1 ring main units have come to the end of their economic life, as well some authorities consider these to be a health and safety risk. They will be progressively removed from Westpower's network with two a year being targeted. In 2006-2007 RMU 1 Palmerston St and RMU 5 at the base of Arnott's Heights will be replaced. In 2007-08 RMU 2 at the Courthouse and RMU 4 - Gables Motel shall be replaced with RMU7 and RMU8 to be replaced in 2008-2009.

Project 07-4601: Disconnector Replacements

Disconnectors normally fail due to deterioration of the operating arms with corrosion or from an arc developing across two or more phases. By identifying under-rated disconnectors and replacing these, the incidents of arcing faults should be reduced.

Project 07-4602: Replace Faulty Actuators

Some of the early air break switch actuators are starting to fail. It is essential to maintain these to keep the remote switching capability that has been established and a replacement programme is planned.

6.8.5 Enhancements

Several reclosers and sectionalisers (circuit breakers used to isolate faults on rural lines) are reaching the end of their economic life and are becoming unreliable. This results in prolonged and more widespread power outages than necessary during fault conditions.

It is no longer possible to source replacement parts for many of these units and because of the bulk oil design of the earlier models, the maintenance costs will increase significantly.

It is proposed that the older models of reclosers and sectionalisers be replaced over the next two years.

Project 07-5601: Install Automation to Various Disconnectors

To assist in the automation of disconnectors, rotary puffer switches are to be installed at AA3 (Arahura), AA4 (Arahura Bridge), DR25 (Barrytown, 2008). Puffer switches are to be retrofitted to FF35 (Franz Josef) and FF27 (Franz Josef) in 2007-08.

Project 07-5602: Relocate RW17T, Trickies Road

As IPL expand further, the automation of the tie switch between GYM and KUM will need to be moved to XD12 to allow IPL to take 1 MVA of load from each zone sub station. If 2 MVA was applied to KUM, the receiving end potential will be reduced affecting motor starting and other consumers.

Project 07-5603: Fit Earth Fault Indicators

A new type of fault passage indicator is being evaluated by ENS. If it proves suitable they should be fitted to all unprotected cables to detect current passage due to a fault down them. These will allow fault people to quickly identify a faulty cable to speed its isolation and allow more prompt restoration of the feeder.

Project 07-5607: Sectionalising Load Switch Installation

To aid faster restoration of load in remote areas the use of automated disconnectors has proved invaluable. Various remote areas are targeted to have their disconnectors automated. On occasion the disconnectors are found to be of the old brown type and not suitable for automating.

6.8.6 Development

Reclosers are pole-mounted circuit breakers, which automatically isolate a faulted section of the line from the rest of the network. Where a large radial network exists, reclosers are often fitted on spur lines to prevent the main line from tripping out due to a spur fault. The addition of extra reclosers to the network improves system reliability and fault selectivity. Justification of each project is carried out on a case by case basis.

Supply to the West Coast in general is voltage constrained and this is partly due to the long inductive transmission lines. When a line outage occurs due to fault or planned maintenance events, voltage collapse can occur unless significant support is available from local generation; this in turn may depend on water availability.

Investigations are continuing with Transpower on the need for further reactive voltage support on the West Coast and the most efficient way of providing this.

Project 07-6601: Inchbonnie, Install Load Equalising Recloser

The Inchbonnie area is becoming increasingly hard to supply due to growing load in the dairy sector. A project is proposed to install a load equalising recloser at Inchbonnie and use it to close the ring between Arnold and Kumara so the load can be supplied from which ever side has spare capacity at the time.

Project 07-6602: Franz Josef 11 kV Ring - RMU Automation

When the FRZ 11 kV ring was installed it was not possible to automate the new RMU's. Once a local radio license is gained, this project can be completed to give remote control of the RMU's to speed the restoration of the Franz CBD for a cable fault.

Project 07-6603: South Westland Potential Support (SWPS) Harihari Regulator

A 33 kV regulator was installed at Harihari last year. Some tidy up work will need to be carried out to complete this project.

Project 07-6604: Install Capacitors at Various locations

Installing Capacitors at strategic locations in the Network overcomes power quality issues and delays the need to upgrade conductor to those areas. Three or so remote parts of the Network are proposed to have capacitors installed this year.

Project 07-6605: Install Ring Main Units - Unspecified Locations

Often a developer requires a new supply which includes the need for a RMU. An allowance is being made for one site to meet this unplanned demand.

Project 07-6606: New Disconnectors

Several new disconnectors are to be installed to further sectionalise the network and reduce the number of customers affected by 11 kV switching operations. These disconnector installations will also assist in the locating of faults.

6.9 SCADA, Comms and Protection

6.9.1 Periodic Inspections, Servicing and Testing

6.9.1.1 SCADA System

The integrity of the main hardware and software system at the control room is of the highest importance to the ongoing management and safety of the grid network. Westpower's Asset Management staff manage the computer system and maintain the operational state of the software and hardware systems. This is a 24-hour per day task with staff on call if required to ensure high availability of equipment. The main computer hardware and software are protected by a maintenance contract with the supplier.

An approved contractor will manage all communication and SCADA equipment external to the computer system. This provides for continuous maintenance and fast response for fault repairs.

6.9.1.2 Communications

Every asset is to be inspected six-monthly, and serviced on an annual basis. The six-monthly inspection is, as far as possible, non-intrusive. No adjustments are made until items are out of tolerance, or performance is affected.

Antenna support structures, e.g. wood poles, towers, and monopoles are inspected two or three yearly.

Antennae are to be checked annually with a "Bird" RF wattmeter and Spectrum Analyzer.

6.9.1.3 Protection

The policy in this area is to maintain protection schemes with alternate major and minor services every 2 years, on each circuit.

It should be noted that "maintenance" on protection equipment is essentially "recalibration/testing" rather than the conventional view of maintenance, which would imply replacement of consumable parts. Protection maintenance is mainly required to reaffirm that the protection is calibrated within tolerance and will operate when called upon to do so.

There are international trends towards reduced maintenance. Typically intervals are being increased to between 3 and 4 years in other utilities comparable to Westpower, in particular where microprocessor (numerical) protection systems are used. These protections have in-built self testing and monitoring routines which reduce the necessity for manually driven maintenance testing.

A new fully-automated protection relay test set is being introduced to facilitate maintenance testing. This will be used for commissioning of new protection (developments and enhancements) as well as maintenance.

6.9.2 Planned Repairs and Refurbishment

6.9.2.1 Communications

Westpower maintains communications assets at approximately 28 base sites and on 5 repeater sites. The planned repair and refurbishment estimates are based on past expenditure.

Contract maintenance technicians are expected to respond to approximately 12 faults per annum.

6.9.2.2 Protection

The protection expenditure planned over the review period is mainly in the following areas

- replacement of outdoor junction boxes
- replacement of aged feeder protection and controls
- replacement of lead acid batteries with sealed cells
- seismic strengthening of protection panels
- seismic restraints for batteries
- installation of DC monitoring and distribution panels

Project 07-1701: Software Licenses

Rockwell and Modicon license support is required to be allowed for the programmable devices in the zone substations. A contingency has also been allowed for other software licenses as needed.

Project 07-1702: General Battery Replacement

Most control devices in the Network are supplied from batteries, under a failure of the system other power is lost. These are regularly discharge tested and when found to be nearing the end of their life, are replaced. This budget allows for new batteries to be purchased.

Project 07-1703: Replace UHF/VHF aerial assembly Tainui Street

The existing UHF/VHF aerial assembly at the Tainui Street depot is difficult to maintain because of restricted access. It is not possible to climb the existing antenna mast, and long reach epv's need to be used. As a critical part of Westpower's important emergency response communications system, this mast will be upgraded to the same standard as other antenna masts at the Tainui Street depot.

Project 07-1704: Mt Bonar, Upgrade Repeater Site

The current repeater site at Mt Bonar is a DoC site and DoC want to relieve themselves of this responsibility. Westpower need to firm up their position on Mt Bonar or a hill nearby. It is proposed to carry out an investigation of options.

6.9.3 Replacement Programmes

6.9.3.1 Communications

Communications equipment has in general a shorter life expectancy than heavy electrical equipment. Typically electronic equipment reaches technical obsolescence in 5-10 years although generally the equipment can be supported in service for 10-15 years.

6.9.3.2 SCADA

As with all computer-based systems, it is expected that several upgrades of the operating system, software-applications and hardware will be required throughout the planning period.

Project 07-4701: SCADA Master Station Replacement

The existing SCADA Master Station has been in service, albeit with several upgrades, since 1994 and is now beginning to lag behind the functionality of modern systems. It is recommended that the current system be upgrade to the latest windows based version, giving more modern functionality and extending the life of the current system.

SCADA, Comms and Protection Projects and Programmes ($'000)										
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Inpect, Service & Test	142	152	82	82	82	82	82	82	82	82
Faults	19	19	19	19	19	19	19	19	19	19
Repairs	13	13	13	13	13	13	13	13	13	13
Replace	110	30	20	50	430	50	50	80	50	50
Enhancement	50	20	0	0	0	0	0	0	0	0
Development	270	0	0	200	0	0	0	0	0	0
Total	**604**	**234**	**134**	**364**	**544**	**164**	**164**	**194**	**164**	**164**

SCADA, Comms Protection Projects ($'000)													
			Area	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
07-6703	D	UHF at Whataroa and Wahapo	SYS	40	0	0	0	0	0	0	0	0	0
07-6706	D	Purchase Spares for Aprisa digital radio	SYS	55	0	0	0	0	0	0	0	0	0
07-6705	D	South Westland, VHF Digital Radio	SYS	10	0	0	200	0	0	0	0	0	0
07-6701	D	Grey Valley, UHF Digital Radio	SYS	40	0	0	0	0	0	0	0	0	0
07-6702	D	Mt Kakawau, New Repeater	SYS	15	0	0	0	0	0	0	0	0	0
07-6704	D	Paparoa (POA) - WCC Digital Radio Link	SYS	80	0	0	0	0	0	0	0	0	0
07-6707	D	Purchase Backup UPS for Tainui Street depot	SYS	30	0	0	0	0	0	0	0	0	0
07-5702	E	Purchase of an Additional Work Station for Control Room	SYS	20	0	0	0	0	0	0	0	0	0
07-5703	E	Purchase and Installation of EtherNet Switches	SYS	20	20	0	0	0	0	0	0	0	0
07-5701	E	Front end comms processor	SYS	10	0	0	0	0	0	0	0	0	0
07-1701	I	Software Licenses	SYS	25	25	25	25	25	25	25	25	25	25
07-1704	I	Mt Bonar, Upgrade Repeater Site	SYS	10	70	0	0	0	0	0	0	0	0
07-1703	I	Replace UHF/VHF aerial assembly Tainui Street	SYS	50	0	0	0	0	0	0	0	0	0
07-1702	I	General Battery Replacement	SYS	20	20	20	20	20	20	20	20	20	20
07-4702	RPL	Replace RTU Units	SYS	40	10	0	30	30	30	30	30	30	30
07-4701	RPL	SCADA Master Station Replacement	SYS	40	20	20	20	400	20	20	20	20	20
07-4703	RPL	Replacement of Load Control Sytem.	SYS	30	0	0	0	0	0	0	30	0	0
				535	165	65	295	475	95	95	125	95	95

Project 07-4702: Replace RTU units

With the extensive use of Abbey RTU's the licence range needs to be extended. Also, as new protection relays are fitted to Westpower substations the current Dataterm RTU's are not capable of communicating the new information, and so new RTU's will be purchased and commissioned.

6.9.4 Maintenance Summary

The table at the beginning of this section summarises expected system maintenance expenditure.

6.9.5 Enhancement

There are several small upgrade jobs planned for the SCADA, Communication and Protection systems throughout the planning period

6.9.5.1 Remote Controlled Disconnectors

With the advent of industry-wide performance monitoring, Westpower is now being benchmarked against other Electricity Companies in terms of system reliability and continuity of supply. Furthermore, customers are becoming more aware of fault outages, this being partly due to the increase in the number of electronic

home appliances and the resulting reliance on a continual supply of electricity. For these reasons, it is becoming increasingly important to cut down on fault restoration times.

One way to do this is by automating remote air break switches. This greatly reduces the travelling time required for a faultman during sectionalising of faulted line sections. This also means that fewer staff are required to isolate the fault, reducing the overall cost of fault restoration.

Project 07-5701: Front end comms processor

With the introduction of IP over the UHF digital radio to Westpower's major substations, a communications IO server to interface between the field equipment and SCADA HMI was required. Currently this comms server is located in the control room. This device has now become mission critical and now requires a fail over device. Also required for this project is a smart IP switch to monitor IP traffic on the radio network.

Project 07-5703: Purchase and Installation of EtherNet Switches

With Westpower employing an increasing number of EtherNet devices, a more structured approach is required to give the devices time to communicate with the SCADA hub. It is proposed that a managed switch is required at both Paparoa and at the Control Centre to facilitate the required access.

6.9.6 Development

Project 07-6701 - Grey Valley, UHF Digital Radio

This project will see the completion of stage 2 of the digital radio rollout. Once completed IP will be available in Hokitika, Kumara, Rapahoe, Ngahere, Arnold and Reefton.

Project 07-6702: Mt Kakawau, New Repeater

For several years, Westpower has been using it's existing VHF speech radio channels to provide SCADA communications facilities to outlying areas. While this has worked well, and made efficient use of existing channel capacity, the number of Remote Terminal Units (RTU's) connected to the system has increased rapidly over recent times as a result of Westpower's Distribution Automation Programme and the situation has now reached the stage where a separate VHF SCADA channel is warranted.

Project 07-6703: UHF at Whataroa and Wahapo

To extend the life of the current UHF radio link into South Westland it is recommended Westpower install new RTU's in Whataroa and Wahapo substations and move all the UHF Radio equipment form the Railtech site into the BCL site.

Project 07-6704: Paparoa (POA) - WCC Digital Radio Link

It is proposed to install a duplicate link from Paparoa to the Control Room to allow some redundancy in the most important link. As more of the SCADA system moves over to the Digital radio scheme, this link becomes more vital.

Project 07-6705: South Westland, VHF Digital Radio

An investigation is required to determine the best options for high speed radio South of Hokitika. The old UHF is thought to have 5 years life utilising the spares from the northern area.

Project 07-6707: Purchase Backup UPS for Tainui Street depot

To provide further redundancy to the Tainui St backup power supply, an additional UPS is to be purchased. This will provide a 24 hour supply in the case of failure of the number one UPS.

6.10 Distribution Transformers

The population of distribution transformers covers a diverse range of sizes, types and ages. As such, it is

Distribution Transformer Projects and Programmes ($'000)										
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Inpect, Service & Test	100	100	100	100	100	150	150	150	150	150
Faults	10	10	10	10	10	10	10	10	10	10
Repairs	0	0	0	0	0	0	0	0	0	0
Replace	50	50	50	50	50	50	50	50	50	50
Enhancement	0	0	0	0	0	0	0	0	0	0
Development	460	460	460	460	460	460	460	460	460	460
Total	**620**	**620**	**620**	**620**	**620**	**670**	**670**	**670**	**670**	**670**

Distribution Transformers Projects ($'000)													
ID	Act	Description	Area	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
07-6801	D	Purchase of new transformers	SYS	460	460	460	460	460	460	460	460	460	460
07-4801	RPL	Transformer Replacements	SYS	50	50	50	50	50	50	50	50	50	50
		Total		510	510	510	510	510	510	510	510	510	510

important that a comprehensive management plan is put in place, as the condition of the asset is not always easily discernible on an overall basis.

Westpower's policy is to extend the life of distribution transformers where this is economically feasible. In support of this policy, many distribution transformers run well below their rated values for much of the time resulting in long lives for the cores and windings. Provided that the tanks and oil is well maintained the overall unit may be kept in service for up to 55 years. In this way, the maximum return can be leveraged from these high value assets.

6.10.1 Maintenance

6.10.1.1 Routine Patrols and Inspections

Smaller pole-mounted distribution transformers are regularly inspected on a rolling five-year basis in conjunction with Westpower's substation earth testing programme.

The inspection includes checks for

- tank corrosion
- paint chips
- breakdown
- oil leaks
- insulator damage
- breather condition
- termination faults

Where possible, the oil level is checked and recorded, and if an oil sample valve is available (standard issue on all new transformers), a sample of the oil is taken and checked for dielectric breakdown.

Larger pole-mount and all pad-mount units have Maximum Demand Indicators (MDI's) which are read every

quarter. These indicate loading trends to be monitored and allow for early intervention should a unit become overloaded.

Very large transformers in areas such as the CBD of Greymouth and Hokitika have annual thermograph surveys carried out to check the tank and termination temperatures as well as to identify any other potential hotspots. Any indications suggesting that the transformer requires attention results in prompt on-site repairs, or if this is not possible, the transformer is swapped with a spare unit from the store and sent back to the contractor's workshop for refurbishment.

6.10.1.2 Faults

The majority of faults are caused by lightning damage; it is very rare for a unit to fail because of old age or deterioration because of the regular inspection and servicing carried out. (It is likely that the level of faults would be much higher but for Westpower's policy of fitting lightning arrestors to all substations)

Most faults are handled by swapping the transformer with a spare and sending the damaged unit back to the transformer workshop for inspection and repair - or scrapping if the damage is too severe.

An exception to this is bushing faults on large units where the bushing can be easily repaired or replaced on site.

6.10.1.3 Repairs and Refurbishment

Repairs can range from a minor paint touch-up on earlier painted units through to insulator repairs and bolt replacements. Refurbishment may include oil changes, rewinds and even tank replacements.

Rewinds are only attempted on relatively modern units where modular replacement windings are readily available.

Tanks are often subject to corrosion, especially in the case of older painted units. At the same time however, the internal core and windings may be in excellent condition. For this reason, tanks are often repaired or replaced if the unit is otherwise in good condition.

Each unit is assessed on its age, condition and service history in determining whether to repair or replace the unit.

Transformer Gasket Issues

Further difficulties with gasket erosion, followed by a lack of satisfactory progress from our small transformer suppliers, led to a full investigation being carried out into this problem in conjunction with Industrial Research to try and determine the exact failure mechanism. What was initially thought to be a partial discharge problem turned out to be related to leakage current along the outside of the bushing, This leakage current increases markedly when exposed to salt fog conditions, as commonly experienced on the West Coast of the South Island.

A number of measurements were taken in a test environment and a viable mechanism that explains the gasket erosion problem was developed. Interestingly, the zinc-rich paint that had been applied as an interim measure was found to be of little practical value as the paint was not particularly conductive and a new, conductive paint is now being used in the interim. Notwithstanding this, paint is likely to wear off over time, only stalling any deterioration rather than overcoming the problem.

The best long term solution identified has been to source an 11 kV bushing with a conductive coating from the flange, where it interfaces with the tank gasket, down to the internal thread where the securing nut is fitted. This provides a parallel low-impedance path for any leakage current away from the exposed gasket edge and should permanently overcome the problem.

A suitable bushing has been found, this is now specified for all new transformer supplies. Furthermore, a long term replacement programme has been instituted to upgrade the existing population of transformers; particularly those at-risk units in the vicinity of the sea coast.

6.10.1.4 Replacement

Project 07-4801: Transformer Replacements

Very old transformers that require extensive refurbishment or transformers that have been extensively damaged due to say lightning damage are often replaced rather than repaired. This is a purely economic decision.

All replacement units are purchased to Westpower's purchasing specifications, which prescribe galvanised tanks, stainless steel fixings and oil sampling valves to minimise the cost of future maintenance.

6.10.2 Enhancement

Little enhancement work is carried out on distribution transformers, as these are essentially a standard module with no capacity for upgrading. Occasionally duplex arcing horns may be fitted to existing units where lightning arrestors can not be used.

6.10.3 Development

New units are purchased to Westpower's purchasing specifications as required. These are normally required for new loads remote from Westpower's existing reticulation network and are paid for by the customer or developer.

Independent contractors installing new substations for customers may provide new units and hand them over to Westpower on commissioning provided that test results are satisfactory.

6.11 Other

Westpower's three original ripple injection plants are all of the same make and model (Plessey TR series) making lifecycle management easier to implement. New plants such as that recently installed at Dobson are sourced from Enermet.

Other Projects and Programmes ($'000)										
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Inspect, Service & Test	15	15	15	15	15	15	15	15	15	15
Faults	5	5	5	5	5	5	5	5	5	5
Repairs	5	5	5	5	5	5	5	5	5	5
Replacement	0	0	0	0	0	0	0	0	0	0
Enhancement	0	0	0	0	0	0	0	0	0	0
Development	0	0	0	0	0	0	0	0	0	0
Total	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**

6.11.1 Maintenance

6.11.1.1 Routine Patrols and Inspections

Monthly checks are carried out as part of regular Zone Substation visits which include the visual inspections of the

- converters
- coupling transformers
- coupling cells
- GPS time base receivers

Every three years independent experts determine injection levels, current balance, optimum tuning and load sharing with other units during a full inspection.

6.11.1.2 Faults

The solid state construction of the injection plants, and the fact that they operate well below their maximum power levels, means that faults are very uncommon.

On rare occasions the high-power output transistors may require replacement or the logic board may require repair.
At other times, vermin may get into the high voltage coupling cells causing flashover.

The redundancy built into the injection network means that the failure of any single plant will not severely impact on overall ripple signal propagation and faults are able to be handled without undue time pressure on restoration.

6.11.1.3 Repairs and Refurbishment

Minor repairs are required on the coupling equipment and converters from time to time as a result of fault events.

There is no planned repair and refurbishment program planned for this equipment which is relatively young and in good condition. It is expected that the plants will give at least ten years of trouble-free service.

6.11.1.4 Replacement

Replacement of all of the original TR series units is planned over the next three years.

6.11.2 Enhancement

The capacity of the existing equipment is fixed and provides ample room for network expansion. No enhancement work is planned.

6.11.3 Development

No new plants are expected to be required for the foreseeable future however allowance has been made for unspecified development projects that ultimately turn up and require inclusion into the Asset Management Plan.

7.0 FINANCIAL SUMMARY

7.1 Financial Forecasts

Table 7.1a below shows the projected ten-year asset management plan expenditure, by asset type and by activity.

These tables have been built up from the individual project and programme expenditures developed in Section 6 – Lifecycle Management Plan, and demonstrate a generally falling expenditure over the duration of the planning period.

Summary by Activity										
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Inspection, Service & Testing	3286	3062	2740	2570	2655	2690	2455	2575	2420	2410
Faults	412	412	412	412	412	412	412	412	412	412
Repairs	191	175	175	175	175	175	175	175	175	175
Replace	2169	1823	1380	1102	1400	890	930	845	815	815
Enhancement	1325	1605	610	375	225	155	145	105	105	105
Development	11960	5472	2445	2060	4190	1640	840	840	840	840
Total	19344	12550	7763	6695	9058	5963	4958	4953	4768	4758

Summary by Asset Type										
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Subtransmission	5699	5229	1725	1672	1442	977	617	577	577	567
Distribution	3778	2832	2665	2242	2220	2100	2100	2025	2025	2025
Reticulation	279	370	209	142	117	117	117	117	117	117
Services	158	158	158	158	148	148	148	148	148	148
Zone Substations	7054	2112	1187	613	3118	1018	283	403	248	248
Distribution Substations	462	472	522	482	532	532	582	582	582	582
MV Switchgear	664	497	517	377	292	212	252	212	212	212
SCADA, Comms, Protection	604	234	134	364	544	164	164	194	164	164
Distribution Transformers	620	620	620	620	620	670	670	670	670	670
Other	25	25	25	25	25	25	25	25	25	25
Total	19344	12550	7763	6695	9058	5963	4958	4953	4768	4758

Table 7.1a – Asset Management Plan Expenditure

It should be noted that the estimates for the first half of the planning period are based on known drivers and hence are more accurate than those for the second half which are more in the nature of forecasts due to a large number of unpredictable factors. Nevertheless, in developing these figures, Westpower has had several years of experience in budgeting and controlling this expenditure and there is a high degree of confidence in the values.

The management fee, included in I,S&T, is a fixed annual fee paid to the maintenance contractor to cover costs such as spare transformer management and the provision of otherwise uneconomic fault bases at Reefton and Harihari.

A contingency sum has also been provided to allow for unexpected events. This is especially necessary in the fault activity area where expenditure is highly dependent on weather conditions. In fact just a few severe lightning storms can make a major impact on the annual result.

Figure 7.1b show the distribution of expenditure in terms of work activity. The levels of expenditure are similar for Development, Enhancement, Replacement and Inspection, Servicing and Testing while Faults and Fault Repairs are down at 2%.

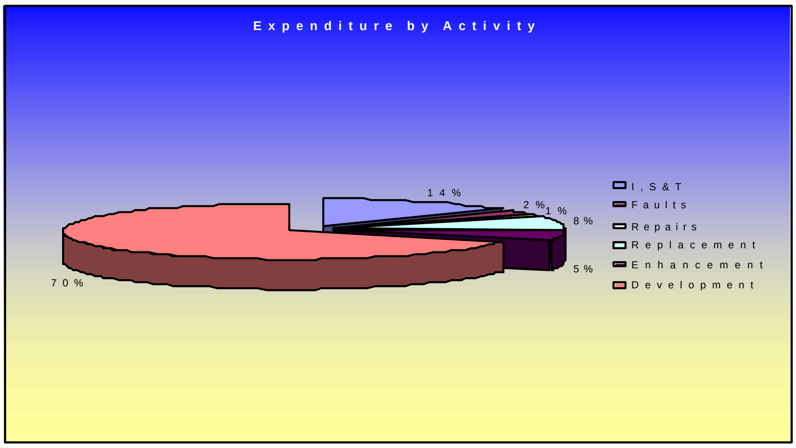


Figure 7.1b

The higher levels for Development and Enhancement are due to the major projects such as the West Coast Grid Reinforcement project and Reefton Gold Supply Projects. Previously Westpower has had a large proportion of older lines that were rapidly approaching failure, and a replacement programme over the last ten years has substantially overcome this issue.

The I,S&T expenditure has increased due to a more rigorous vegetation control programme along with an upward movement in contractor rates.

The enhancement expenditure reflects a continued emphasis on distribution automation as reclosers and disconnectors are progressively automated. By doing this, Westpower is able to greatly reduce outage durations and switching times, resulting in an improved SAIDI reliability statistic.

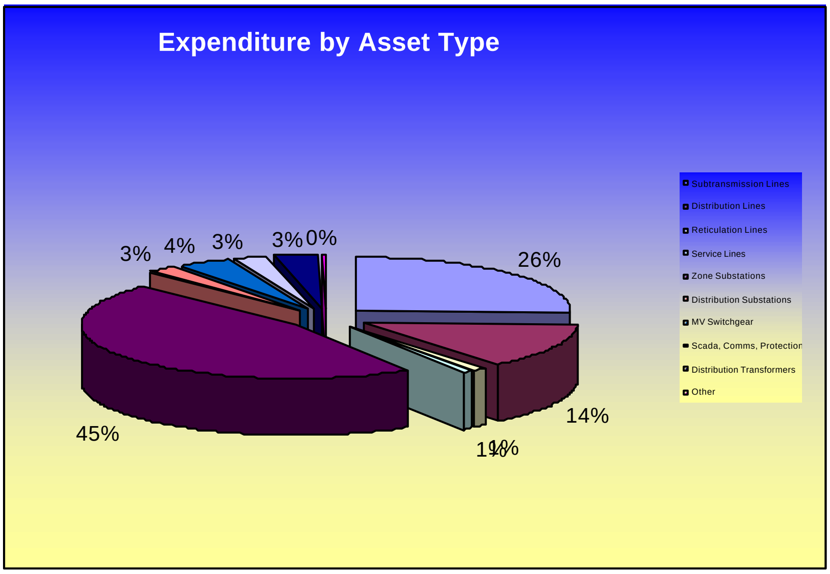


Figure 7.1c

Figure 7.1c shows the expenditure by asset type.
Asset types such as Zone Substations and SCADA Comms and Protection have a relatively young age profile and little ongoing maintenance is required. Not surprisingly, these assets also have

the lowest susceptibility to fault failure.

7.2 Assumptions and Sensitivity Analysis

Some basic assumptions have been made. These include:

- As a Lines Business, Westpower will continue to be a going concern under the new regulatory regime.
- Asset Management, System Control and Corporate Services functions will be provided by ElectroNet Services and be based in Greymouth.
- The Lines Business will continue to own ElectroNet Services and to operate it on an arms length basis.
- The Lines Business must satisfy the twin constraints of providing a risk-adjusted normal profit for its beneficiaries sufficient to retain investment performing within the regulatory limits set by government regulations

Other factors that will impact on network expenditure include

- Weather (which affects fault expenditure)
- Load Growth / Decline
- Price Control (through regulation)

Figure 7.2a gives a graphical representation of the likely sensitivities to these factors.

Weather affects the fault expenditure through the level of storm damage experienced. As it is very difficult to predict weather patterns over a 12 month period, the budget for fault expenditure can only be an estimate based on historical averages and general knowledge of the asset condition.

The sensitivity of the network to storm damage has greatly reduced over the last 20 years as major sub-transmission and distribution feeders have been progressively replaced with better quality materials. Lightning arrestors have been placed on all substations and reclosers to protect that equipment during lightning storms. In addition, a continuing distribution automation programme has reduced the amount of time and effort required for fault location and repair.

Regulation under the "CPI-X" regime controls the prices that can be charged. As a result, costs need to be closely controlled to ensure continued company profitability.

If prices are forced downward, costs will have to be reduced accordingly through reduced maintenance expenditure. The most likely area for attention would be that of Inspection, Servicing and Testing, as this has little immediate effect on system performance and can be deferred for short periods to smooth out expenditure.

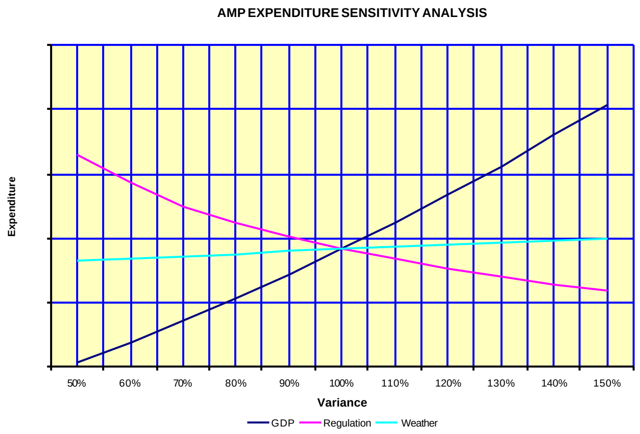


Figure 7.2a – AMP Expenditure Sensitivity Analysis

GDP on the West Coast has a direct effect on Westpower's revenue stream through reduced distribution to large customers. It also has an indirect effect as secondary and tertiary level consumers in the commercial and domestic area contract. As for price control, any reduction in revenue must be reflected in cost savings if profitability is to be maintained.

Several major projects have been mooted for the West Coast over recent years involving primary extractive industries such as coal mining. Any large new loads will require major system reinforcement with associated increased expenditure on development and enhancement projects, however this will have to be funded by the end user, either as a capital contribution or through a longer term contractual arrangement. Maintenance expenditure will not be directly affected except insofar as competition for resources may slightly reduce the level of non-critical work carried out.

7.3 Actual Deviations from Previous Asset Management Plans

7.3.1 Unallocated Works

The following explains additional works (over $20,000) not included in the 2006-07 Asset Management Plan but for various reasons were undertaken.

Repair leak on Polytech Transformer

The Polytech transformer has developed a slight weep on the radiator flange at the tank. The manufacturer has requested that the transformer be returned for maintenance. Repair costs amounted to $26,943

05-4602 Replace RMU15 at Moana

RMU 14 & RMU15 at Moana are Andelect Series 1 RMU. This type of equipment is being replaced in Westpower's network following H&S concerns raised by other authorities. These two are in the plan for this years progressive change out of all units. Replacement costs amount to $20,016

05-6607 Install Ring Main Unit at Cowper street

Foodstuffs NZ are developing a new supermarket in Cowper St. and request a 300 kVA supply. This can not be met from the existing reticulation so a dedicated transformer will be installed. A new RMU is required to allow it to be connected to the distribution network. Most of this work will be funded by Foodstuffs via an optimised cost, but Westpower would like to allow for a further cable connexion in this RMU to allow a ring feed to be made past the Hospital. Westpower are funding the additional costs to provide for this and will amount to approx $186,551

Upgrade protection at Dobson Substation

This project includes design, installation and commissioning of new SEL 311C and 351A relays. The controllers for 1322, 1362 and 1382 will be replaced by SEL311C (Distance Protection Relay) and the controller for 1342 will be replaced by SEL 351A. This job will amount to $29,912

7.3.2 Uncompleted Works

The following details projects with an allocated expenditure in the 2005-06 budget, but were not actually carried out.

Distribution Lines

The budgeted amount of distribution line projects not carried out in the 2005-06 year totalled $466,000. $250,000 of this, however, was targeted for the construction of distribution lines around the yet to be developed Globe Hill mine site. Other distribution line projects did not proceed due to a number of reasons, namely resource, enviromental or third party issues.

Summary of Distribution Line Projects Budgeted - Not Commenced		
Activity	Project Description	$('000)
I, S & T	Protection Works for Distribution Lines	30
Development	Aharua - Raupo, Construct 11 kV River Crossing (Atarau alternate feed)	10
Replacement	Welshmans Road, Reconductor 11 kV Line	5
Replacement	Punakaiki Razorback, Replace H-Structure	15
Replacement	Murray St to Herbert Street, 11 kV Line Replacement	10
Replacement	Slatey Creek, 11 kV Line Replacement	30
Replacement	Paringa River to Lake Paringa, Retension Conductor	16
Replacement	Hokitika to Ruatapu, 11 kV Line Replacement	50
Development	RGSP Globe Hill - Build Distribution Lines for Mine Site	250
Replacement	Blair Block 11 kV Line Replacement	20
Enhancement	Iveagh Bay Underground	30
Total		**466**

The table below summarises those projects that did not proceed.

Distribution Substations

A large portion of budgeted Distribution Substation works was dependant on developers plans and significant load changes in given areas. With this in mind, projects totaling $40,000 were not requuired to be carried out in the 2005-06 financial year.

Summary of Distribution Substation Projects Budgeted - Not Commenced		
Activity	Project Description	$('000)
Development	Punakaiki River, Install Pad Mount Sub	30
Replacement	Wilson Lane Sub Rebuild	10
Total		**40**

The table below summarises those Distribution Substation projects that did not proceed.

MV Switchgear

Resource constraints coupled with difficulties obtaining outage windows restricted the commencement of some MV Switchgear projects. $125,000 in allocated funds, primarily providing MV Switchgear with automation, was not required.

Summary of MV Switchgear Projects Budgeted - Not Commenced		
Activity	**Project Description**	**$('000)**
Development	Inchbonnie, Install Load Equalising Recloser	10
Development	Franz Josef 11 kV Ring - RMU Automation	65
Enhancement	Relocate RW17T, Trickies Road	10
Enhancement	Sectionalising Load Switch Installation	40
Total		**125**

The table below summarises those MV Switchgear projects that did not proceed.

Reticulation Lines

In general, most reticulation line projects were completed. The project that did not proceed were not deemed urgent and will be carried in future years.

Summary of Reticulation Line Projects Budgeted - Not Commenced		
Activity	**Project Description**	**$('000)**
I, S & T	Replace All Motor Rated Fuses	6
Total		**6**

The table below summarises those Reticulation Line projects that did not proceed.

SCADA. Comms and Protection

Delays in the commencement of parent projects, along with resource contraints led to the deferment of a group of SCADA, Comms and Protection projects.

Summary of SCADA, Comms and Protection Projects Budgeted - Not Commenced		
Activity	Project Description	$('000)
I, S & T	Mt Bonar, Upgrade Repeater Site	10
Development	Paparoa (POA) - WCC Digital Radio Link	10
I, S & T	Software Licenses	25
Development	UHF at Whataroa and Wahapo	20
Replacement	Replace RTU Units	20
I, S & T	South Westland, Purchase UHF Spares	10
Replacement	SCADA Master Station Replacement	120
Development	Grey Valley, UHF Digital Radio	100
Development	South Westland, VHF Digital Radio	5
I, S & T	Replace UHF/VHF aerial assembly Tainui Street	15
Total		**335**

The table below summarises those SCADA, Comms and Protection projects that did not proceed.

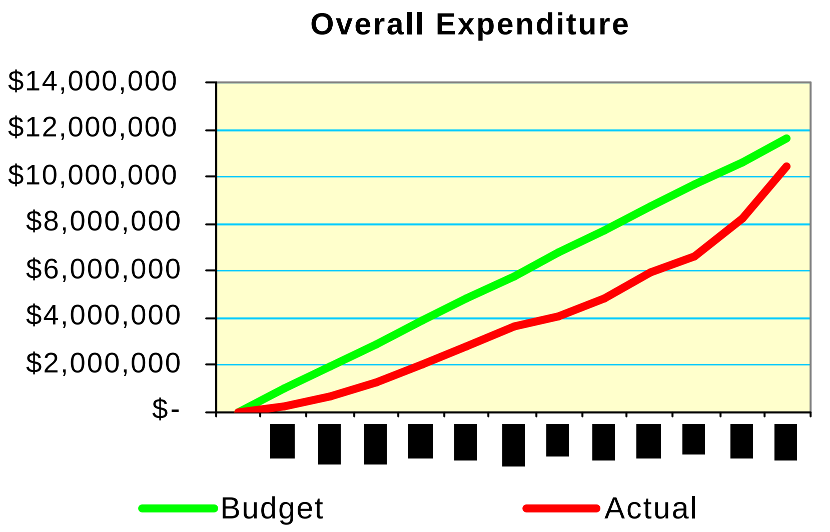
Zone Substation

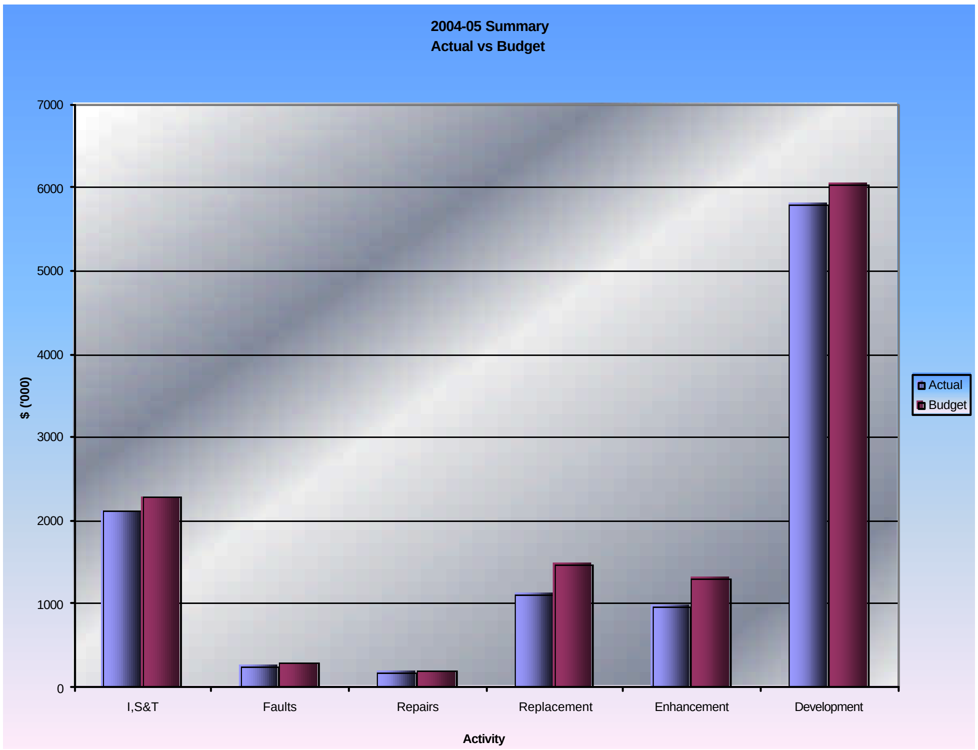
Although the funds allocated for zone substation projects that were not carried out totals $1.189 m, $1 m was budgeted for the construction of the proposed Blackwater Substation. This project did not proceed due to the uncertainty of the future of OGL's Waiuta project. The majority of the other projects not to go ahead were maintenance projects included in the AMP under the assumption that the mobile substation would be available.

Summary of Zone Substation Projects Budgeted - Not Commenced		
Activity	Project Description	$('000)
Enhancement	Install GPS Time Reference to Zone Subs	10
Enhancement	Dillmans Protection Upgrade	5
I, S & T	Upgrade Transformer Breathers in Zone Substations	20
Enhancement	Rapahoe Zone Sub Protection Upgrade	115
I, S & T	Franz Josef & Fox Glacier Subs, Install Cellphones	5
I, S & T	Develop a Protection Database	15
I, S & T	Hokitika Zone Sub T4 and T5 Temperature Gauge Upgrade	10
I, S & T	Investigate and Replace Mercury Switched Temperature Gauges	10
Enhancement	Franz Zone Sub, Install Tower and Comms Gear	50
Development	RGSP - Development of Ikamatua/Blackwater Zone Substation	500
Development	Pike River Coal - Development of Ahaura Tee	500
I, S & T	Franz Zone Sub Transformer Refurbishment and Maintenance	60
I, S & T	Ross Zone Sub Transformer Refurbishment and Maintenance	10
I, S & T	Dobson Zone Sub transformer refurbishment and maintenance	15
I, S & T	Arnold Zone Sub transformer refurbishment and maintenance	10
I, S & T	Ngahere Zone Sub Transformer Refurbishment and Maintenance	10
I, S & T	Reefton Zone Sub Transformer Refurbishment and Maintenance	3
I, S & T	Longford Corner Regulator Refurbishment and Maintenance	10
I, S & T	Cronadun - Regulator Refurbishment and Maintenance	13
Development	Pike River Coal – Build New 33/11 kV Zone Sub	1200
Development	RGSP Globe Hill - Build New Zone Substation	800
I, S & T	Zone Sub Building Climate Control	20
Enhancement	Ngahere Substation - Install 33 kV Bypass Switches	25
Enhancement	Greymouth Zone Sub, Replace Protection	20
Enhancement	Ngahere Zone Sub, 11 kV Bus Re-arrangement	30
Total		**3466**

Summary of Expenditure 2005-2006

The table on the following page summarises those Zone Substation projects that did not proceed.





8.0 ASSET MANAGEMENT PRACTICES

8.1 Introduction

The electricity distribution system is comprised of assets with long lives. The management of these assets (including maintenance of existing assets and development of new assets) is Westpower's primary focus in providing an effective and efficient distribution service to its customers. Further, because distribution is only one part of an integrated electricity system, consultation and coordination of plans is an essential ingredient for the effective functioning of that system.

This plan is an annually produced plan covering the next 10 years and documents likely or intended asset management requirements. The plan provides a focus for ongoing analysis within Westpower aimed at continuously improving the management of the distribution system and it provides a vehicle for communicating asset management plans with customers.

In many cases, particularly where asset development is involved, the work will be driven directly by customer requirements and associated financial commitments. This plan is based on Westpower's present understanding of its customers' requirements. It is part of the process of communication with customers and Westpower will be responsive to customer input, with regard both to actual expenditure commitment and to long term future planning.

The plan is also intended to demonstrate responsible stewardship of assets by Westpower to its customers and shareholders. The plan shows the maintenance and replacement requirements which are intended to maintain the operating capability of the system over the long term. Each year a process is carried out which reviews Westpower's achievement with respect to this plan and the results of this are summarised in the previous section.

This section broadly outlines Westpower's Network Services current and desired Asset Management practices and specific improvement initiatives prior to discussing proposed Asset Management improvements in Section 11.

To identify and prioritise the Asset management practices and needs of Network Services, Asset Management improvement tasks are discussed under broad headings of **Processes, Information Systems** and **Data**.

Processes are the business processes, analysis and evaluation techniques needed for life cycle asset management.

Information Systems are the information support systems used to store and manipulate the data.

Data is that required for effective decision making (ie for manipulation using information systems).

The previous tables broadly describe the current Westpower Asset Management practices and possible future (desired) business practices it is intended to ultimately develop. The Asset Management Improvement plan discusses improvement priorities, timetables and resources for the next 3 years.

The following are specific issues and Asset Management procedures that are currently being addressed.

8.2 Rationalisation of Responsibilities and Procedures

The structure of ElectroNet's asset management group continues to develop to meet business needs and legislative change. Responsibilities, reporting lines, work flows and procedures have been implemented for the different activities carried out in the office. These activities included action, planning, monitoring and reporting.

Process	Current Business Practice	Desired Business Practice
Level of service *(See Section 11.1.1.18)*	Draft level of service document. Limited performance measures in use. Consultation undertaken in association with Resource consent applications, department of conservation concession applications and specific developments and enhancements requested by customers via ElectroNet Services.	Wider range of performance measures. Service level review process established and implemented. Regular customer feedback surveys. Greater understanding of customer preferences.
Knowledge of Assets *(See Sections 11.1.1.2:11.1.1.10:11.1.1.18)*	Process for new as-builts to be entered into ODV database. Data capture for validation of ODV database in place. Attribute and condition information collection process from maintenance activities not comprehensive.	Asset Management system in place to maintain asset maintenance history. Process for collection of data from maintenance by contractor.
Condition Assessment *(See Section 11.1.1.10)*	No condition feedback requirement in service delivery contracts. Routine maintenance inspection. Testing of specific sites undertaken where performance is suspected to be outside targeted level of service.	Establish programme for condition assessment of critical assets.
Risk Management (See Section *11.1.1.18)*	Risk management practised informally, based on the knowledge of experienced staff.	Critical assets monitored, failure modes and effects understood and used for contingency planning and Asset Management prioritisation.
Accounting/ Economics *(See Sections 11.1.1.3: 11.1.1.18)*	Financial systems record costs against maintenance activities. Maintenance expenditure allocated against individual feeders. Valuation based on Infrastructure accounting. Deferred maintenance identified in plan.	Forecast renewals used to measure the drop in service potential.
Operations *(See Sections 11.1.1.6: 11.1.1.18)*	Substantial documentation of operational processes. Ongoing training of operators.	Ongoing training/updating programme.
Maintenance *(See Sections 11.1.1.7: 11.1.1.18)*	Fault Service Contract with ElectroNet Services.	Develop unit prices for all maintenance work with ElectroNet Services. Process for ongoing review of maintenance needs and delivery.
Performance Monitoring	Feeder metering via telemetry for all zone substation feeders. System quality monitoring via Call Cares reports of faults. Power quality monitoring at individual installations at customer request or complaint. Load loss monitoring at Grid entry points.	Establish fault codes for easy identification of faults. Greater range of performance standards for service delivery contracts. Process for monitoring compliance of contractors with performance standards established.
Optimised Life Cycle Strategy *(See Sections 11.1.1.4: 11.1.1.5)*	Replacement of Assets based on assessment by experienced staff. No formal risk management strategies.	Develop 10-year renewal programme with budgets based on predicting failure for critical assets, replacement on failure of non-critical assets. Life cycle and risk costs considered in optimisation process.
Project Management	Contract management process in place. Project management procedures reasonably well documented.	Document project management procedures to optimise lifecycle costs established.
Asset Utilisation	Capacity of network assessed by load flow monitoring and computer modelling.	Fully develop graphs and charts of feeder loadings and power factor.
QA / Continuous Improvement *(See Sections 11.1.1.9)*	Some inspection of work undertaken but no formal process for quality assurance of decision making; management procedure and data.	System of quality checks on all key Asset management activities in place.

System	Current Business Practice	Desired Business Practice
Asset Registers *(See Section 11.1.1.12)*	Current database can be integrated into GIS when required.	Asset Management System database for network assets. Integration of Asset Management System database and future GIS database.
Financial System *(See Section 11.1.1.12)*	Service Maintenance Management system allocates costs to various activities in financial system. Depreciation based on age of asset.	Maintenance costs allocated against individual substation feeder assets in Asset Management System.
Maintenance Management *(See Sections 11.1.1.12: 11.1.1.14)*	Maintenance history of network equipment assets being recorded. Service Maintenance Management system in place.	Critical and non-critical assets identified. Service Maintenance Management system used for cycle maintenance programmes.
Condition Monitoring *(See Section 11.1.1.13)*	No basic condition monitoring system for asset types.	Condition monitoring systems established for key assets. Condition data loaded into Asset Management System linked to valuation. Predictive modelling capability available for critical assets.
Customer Enquiries	Limited records of customer enquires. No computerised customer service system.	Electronic record of customer enquiries. Asset links to customer enquires.
Risk Management *(See Section 11.1.1.13)*	No Asset Management system capability.	Failure modes, and probabilities and risk cost available from Asset Management System.
Optimised renewal Strategy	Renewal on adhoc basis.	Life cycle costs taken into account in assessing renewal options. Renewal strategy in place.
Forward Works Programme	10-year forward maintenance and renewal forward programmes based on historical data. Development needs based on CAPEX criteria.	Optimised future costs based on various scenarios.
Integration of Systems *(See Section 11.1.1.15)*	No integration of customer database, Service Maintenance Management system or Asset Management system.	Geographical Information system to interface with all of existing systems using geo coding on New Zealand Map Grid.
Plans and records *(See Section 11.1.1.12)*	Records being entered into data base systems for future use with GIS.	Plans and records linked via GIS.
Operations and Maintenance Manuals *(See Section 11.1.1.12)*	Some dependence on worker knowledge. Operations well documented for access to network by others. Maintenance manuals for limited number of zone substations.	Basic manuals available for all significant assets.
Levels of Service	Reported monthly to management.	Reports generated automatically by Asset management System
Failure Management Plans *(See Section 11.1.1.14)*	Procedures for operational activities documented.	Complete procedures for systems failure documented.
Asset Management Plans	Initial network Asset Management Plan commenced.	Mature Asset Management Plan used for forward planning and customer consultation.
Geographical Information System	Spatial co-ordinates being obtained for network assets.	GIS system fully integrated with IMS.

Data	Current Business Practice	Desired Business Practice
Asset Classification	Network asset hierarchy established. Asset categories identified for asset cost records.	
Asset Identification	Unique ID numbers allocated in ENS for all network assets.	Comprehensive asset register.
Asset Textual/ Spatial Data	Quality and completeness variable.	Appropriate spatial/textual data available on GIS/plans/AMS.
Maintenance Tasks	Check sheets for Zone Substations.	Documented maintenance tasks for network. Documented maintenance programmes for Zone Substations.
Historical Condition & Maintenance Data	Limited information available.	Maintenance data history in Asset Management System used for maintenance scheduling.
Future Prediction Data	Predicted future growth data limited. Simulated future load flows from computer model based on theoretical growth.	Simulated future load flows from computer model based on growth predictions. Comprehensive future load growth data.
Life Cycle Costs	Life cycle costs not collected.	Life cycle cost data used for renewal decision making.

The charts below, depict the overall actual vs budget comparison.

8.3 Network Services Operational Support

Westpower uses ElectroNet Services as its preferred maintenance contractor for all network associated inspection service and testing, faults, fault repair, maintenance replacement and network enhancement. Some development work is put out to tender or, where a third party is involved, outside contractors may carry out this work.

Service level agreements are currently in place with ElectroNet Services for Asset Management and Asset Maintenance. Any larger Enhancement and Development projects will have contracts prepared on a specific project basis.

8.4 Information Systems Development

The Asset Management Group has implemented the Service Maintenance Management (SMM) system, that is used for issuing works orders and reconcile monthly invoices with the purchasing system. Expenditure can be tracked by activity and by asset type.

Also improvements have been made to the Electrical Network System which keeps information on types of equipment installed at a site. This information tracks maintenance history of transformers and other associated equipment.

8.5 Specifications, Procedures and Manuals

Westpower has spent considerable effort in preparing a set of manuals for use by contractors, which provides information to contractors on Westpower Specifications, levels of competency, Network Releases and access to sites. A set of network design standards are also available to contractors who wish to undertake network extensions and network reconstruction.

Procedures have also been completed which are deemed to be mandatory for contractors who wish to carry out work for Westpower or on Westpower's network.

8.6 Deregulation/Compliance with MED & Commerce Commision Requirements

The specific external environment in which Westpower operates is the power supply industry in general.

8.7 Electricity Industry Reform Act

The passing of the Electricity Industry Reform Act (through Parliament on 3 July 1998) signalled a major change in the industry.

This has had a far reaching impact on the electricity industry in New Zealand and completely changed the way in which electricity was delivered to the end customer

The Act provided for:-

- Break-up of ECNZ into three competing SOE's
- Ownership separation of all Line and Energy companies
- Introduction of low-cost retail competition
- Greater performance disclosure by line businesses
- Empowerment of Commerce Commission to impose price control on line charges.

8.7.1 Economies of Scale

A time of relative stability appears to have been reached within the industry with a commensurate reduction in merger and acquisition activity. While there is no direct imperative for mergers and acquisitions intrinsic in the current legislation, market forces are likely to continue to act on inefficient operators with high fixed costs relative to their asset base. This is particularly pertinent following the introduction of the targeted threshold regime.

If Westpower is to remain profitable it needs to compare favourably with other lines businesses. Thus the challenge for Westpower is to remain viable through appropriate cost control and superior standards of asset management. Cost reduction alone is insufficient as it ignores the impact on asset performance, which is a vital factor in the continued operation of the company.

A spin-off benefit from an intensified maintenance programme is a major reduction in fault outages, the benefits of which will be ongoing. When combined with a reduction in planned outages through lower planned maintenance activity, a significant improvement in reliability can be expected.

8.8 Commerce Commission Requirements

The Commerce Commission will control information disclosure through the Electricity (Information Disclosure) Regulations.

These regulations have a direct impact on Westpower by forcing the line companies to disclose their financial and asset performance data to allow comparison with other line companies. The Commerce Commission will be taking a more active roll in these comparisons which could lead to further external interference in Westpower's asset management practices.

Key performance statistics will need to be disclosed regularly under the proposed legislation, with the first major review for price control purposes being undertaken after two years based on average weighted performance.

Westpower's asset management performance will be visible for all interested parties to see and provide a strong incentive to Westpower to maintain and improve current standards. Regular reviews of Westpower's procedures will take place based on this disclosed information

8.9 Regulatory Risk

8.9.1 Pricing Regulation

The Commerce Commission has introduced a new regulatory environment for electricity lines businesses. This consists of a targeted control regime whereby individual lines businesses will be investigated with a view to imposing individual price control in the event that they exceed particular thresholds with respect to

1. Price Path
2. Reliability

At present, the price path involves an annual adjustment of Consumer Price Index (CPI) –X% per annum,(where X=1 for Westpower) effectively resulting in a 1% revenue drop in real terms over each year of a five year period beginning in 2003.

The resulting reduction in real revenue requires that Westpower continue to focus clearly on cost reduction, while at the same time ensuring that reliability continues to improve. The professional asset management planning processes applied by Westpower over the last ten years have placed the company in an excellent position to respond to the challenges of the new environment with a well-maintained asset base. New disciplines required by the regulatory environment will be incorporated into future asset management plans.

Westpower's asset management will be targeted at providing the maximum service quality possible at the lowest price and cost while, at the same time, staying within regulatory limits.

Countervailing Power

Further pressure will be brought to bear by the monopsony power of vertically integrated generation/energy companies (gentailers).

To use an illustration put forward by some commentators, the lines businesses have effectively become "trucking companies" used to shift electricity from generators and Transpower grid connection points to customers. The only difference is that Westpower owns all of the "trucks" in the area.

Lines businesses now operate in a highly regulated market including both price and quality control with little opportunity for growth apart from that caused by a general upturn in the economy. Increasingly dominant and demanding suppliers and customers will exacerbate this situation.

The direct effect of this will be the need for Westpower to operate in an efficient manner to reduce costs

8.10 Asset Renewal Policy

The General renewal strategy is to rehabilitate or replace assets when justified by:

- Asset performance

Renewal of an asset is where it fails to meet the required level of service. The monitoring of asset reliability, capacity and efficiency during planned maintenance inspections and operational activity identifies non-performing assets. Indicators of non-performing assets include:

- Structural life
- Repeated failure
- Ineffective and/or uneconomic operation
- Economics

Renewals are programmed with the objective of achieving:

- The lowest life cycle cost for the asset (uneconomic to continue repairing), or
- An affordable medium term cash flow, or
- Savings by co-ordinating renewal works with other planned works
- Risk

The Risk of failure and associated environmental, public health, financial or social impact justifies proactive action (e.g. impact and extent of supply discontinuation, probable extent of property damage, health risk etc).

Planned and reactive replacement works can be prioritised in accordance with the priority ranking shown in the following table.

Priority	Renewal Criteria
1 (High)	Asset failure has occurred. Asset failure of critical system component is imminent. Regular maintenance required. Complaints
2	Failure of non-critical asset is imminent and renewal is the most efficient life cycle cost alternative. Maintenance requiring more than six visits per year.
3	Reticulation maintenance involving two to three visits annually. Difficult to repair, due to fragile nature of material, obsolescence.
4	Existing assets have low level of flexibility and efficiency compared with replacement alternative.
5 (Low)	Existing asset materials or types are such that known problems will develop in time

8.11 CAPEX Analysis

Capital expenditure needs to be carefully targeted to ensure that the greatest benefit is reaped from each capital dollar expended.

Westpower has always had a policy of producing well-researched business cases for major capital projects. A Discounted Cash Flow (DCF) is used to derive the Internal Rate of Return (IRR) of a project and then to compare this with the hurdle rate. In general this hurdle rate is equivalent to the Weighted Average Cost of Capital (WACC) for the business.

Any project that demonstrates a higher rate of return than the hurdle rate will add value to Westpower's business. If several projects are competing for capital funding, these may be ranked in terms of their rate of return; however caution is needed if the projects are of markedly different size.

8.12 Distributed Generation

Distributed Generation is electricity generation equipment connected to the Customer's installation, and capable of generating electricity back to the electricity Network, as well as supplying electricity for the Customer's own use at the location it is installed.

Usually it will be a fixed installation but it may be disconnectable and moveable if required. The installation will include all necessary protection equipment required for the safe operation of the Distributed Generation system.

In the context of Westpower's guides for connection, Distributed Generation comprises:

- Small systems of less than 5 kW capacity
- Medium systems of between 5 kW and 30 kW capacity
- Large systems between 30 kW and 1000 kW capacity.

Large systems would normally be associated with industrial sites or as dedicated generation facilities. Westpower's policy is to actively encourage Distributed Generation as a means of reducing system losses and improving both the reliability and quality of supply to the area.

Customers interested in developing such facilities are invited to contact Westpower's agent ElectroNet Services to request a copy of the Distributed Generation Information Pack. This pack will provide valuable assistance in planning and engineering an acceptable solution.

Formal application forms will be available to ensure that the appropriate information is provided to allow Westpower to approve connection to its network and ensure compatibility with the existing reticulation network.

Any new Distributed Generation installation also requires contractual arrangements to be put in place with a retailer to purchase any excess electricity generated. Westpower may then credit the retailer for the energy that is exported at the same price that the retailer is charged for the delivery of energy, providing a net benefit to the Distributed Generator

9.0 NETWORK RELIABILITY

This section reviews the current security levels of the Westpower Distribution Network.

In general, Westpower security levels meet accepted guidelines for loads of this size and type.

For loads of 10 MW and above, an *n-1* security level is maintained, whereby supply can be maintained for any single component failure. For small loads of less than 1 MW, no backup is specifically provided except where these are conveniently available e.g. tying 11 kV feeders together.
Supply to the Central Business Districts of Reefton and Greymouth is secure with adequate redundancy built in. Some work is being done on options to enhance the security of supply to the Greymouth CBD where system redundancy is limited.

Westpower does not use Extra High Voltage cables of the type made famous by the Mercury CBD disaster and is therefore not exposed to a similar risk.

The major risk to the security of supply to the West Coast lies with the Transpower network. There are two long, exposed transmission feeds into the West Coast, from Inangahua and Coleridge, and at peak times both of these feeds are required along with support from Trustpower generation.

Another area of concern is the exposure of South Westland to the availability of a section of Aerial Bundled Cable (ABC). Wahapo Power Station provides an effective backup for the section of ABC around Lake Wahapo. As the Trustpower Wahapo Power Station is not always available however, this needs to be taken account of in assessing overall security to the area.

A recent realignment of the section of ABC around Lake Wahapo has improved the reliability of this link, and a replacement of a similar section around Lake Mapourika with Hendrix Spacer Cable has further reduced Westpower's exposure.

Local generation has also greatly reduced the risk of major system outages when a Transpower fault occurs.

The security of Westpower's network is thus considered to be satisfactory given the nature of the terrain and size of loads involved.

9.1 Westpower Sub-transmission and Distribution Networks

System security and reliability depend on two factors

- Failure Rates
- Repair Times

These two areas will be looked at in terms of the two most common line construction types, cables and overhead lines, which make up Westpower's Subtransmission and Distribution Networks

9.1.1 Cables

In general, cables are very reliable as they are not exposed to the external environment and if carefully laid,

should give at least 50 years of good service. The most likely mode of failure is damage by contractors using hydraulic excavators.

Whilst the failure rate of cables is relatively low however, the Mercury CBD experience demonstrated that repair times are critical. Underground cables are the major constraint in this area. In fact, in the Mercury case, when the 110 kV cables failed, it took several weeks to repair and repressurise each cable.

In Westpower's case, the highest voltage underground cables it operates are at a voltage of 33 kV, and these are of standard Paper-Lead construction over a very short distance of less than 100m with backup.

The majority of Westpower's underground HV cable network consists of 11 kV cable of both Paper-Lead and XLPE construction. Both of these are dry-type constructions that allow for joints to be readily made within four hours after the fault has been located and the trench dug.

In the Greymouth area, the reticulation in the Central Business District (CBD) consists of a double-redundant ring of 11 kV cables. At least two separate HV cables would have to fail to cause an outage of a distribution transformer. Even if this was to happen, the LV networks are highly interconnected and would continue to supply most of the load.

All of Westpower's cables are operating well within their thermal ratings, even taking account of the possibility of poor thermal resistivity backfill.

9.1.2 Aerial Bundled Cable

There is a section of 33 kV Aerial Bundled Cable (ABC) in South Westland forming part of the 33 kV Sub-Transmission Network.

Until recently, this section of ABC through the bush near Lake Wahapo, exhibited both high failure rates and long repair times. This section of line has recently been rerouted alongside the State Highway which has resulted in greatly improved reliability.

The failure rate has reduced because there are no longer large trees falling through the line. Furthermore, because there is good roadside access along the full length of the route, repairs can be effected very quickly. At the same time, a new type of heatshrink repair joint has been introduced for faster repair times.

As an example, the only fault on this line since the shift, occurred on an evening in December 1997. This resulted in South Westland being fed from Wahapo Power Station for the night. At first light the next morning, a repair crew was mobilised and a full repair completed within about four hours. Previously, it could take up to two days to effect a repair when all repair equipment had to be carted into the bush.

Wahapo Power Station is the backup supply to the area when the Wahapo ABC fails, and providing water is available, all of the load in the area will be supplied. If Wahapo is unavailable, there is no alternative feed.

For the section of line around Lake Mapourika there is no alternative feed as this is located South of Wahapo. Part of this cable is also situated away from the road, increasing repair times. An alternative Spacer Cable system was constructed in 2000 around the State Highway, which has increased the reliability of this section of line.

Alternative risk management scenarios involving standby diesel generators merit further consideration for this type of fault.

9.1.3 Overhead Lines

Most of Westpower's reticulation consists of overhead lines.

Over the past fifteen years, all of the major 33 kV and 11 kV feeders have been replaced or refurbished and

are in very good condition overall.

While overhead lines are subject to more faults than underground cables, due to such things as lightning and bird strikes, it is relatively easy and quick to get them back into service.

The maximum repair time of about four hours is required when a complex pole structure is damaged due to say a vehicle running into it.

Distribution automation equipment installed over recent years has allowed Westpower to quickly diagnose and locate rural faults, and then restore supply remotely to adjacent areas without having to get staff on site.

Spares of all types of conductor and poles are kept in stock to cover most eventualities. Access to other network company's stocks is likely in the event of a major disaster.

9.2 ZONE SUBSTATIONS

Westpower operates 15 Zone Substations at Reefton, Ngahere, Rapahoe, Dobson, Arnold, Greymouth, Kumara, Hokitika, Ross, Waitaha, Harihari, Whataroa, Wahapo, Franz Josef and Fox Glacier. These substations are used to feed the 11 kV distribution networks and are therefore key components as far as network security is concerned

Dual transformers are installed at Greymouth and Hokitika substations, in comparison to the other substations, which rely on single transformers. The large power transformers installed at these sites are very reliable, however, and rarely give problems.

Westpower's network has been designed so that in the event of a power transformer failing, the network could be reconfigured, and a spare unit sourced from either elsewhere in the network or the emergency spare stock. In addition, Westpower is currently developing a mobile 33/11 kV substation which can be rapidly deployed in the event of a 33 kV transformer failure.

The switchgear and protection equipment is relatively modern and well maintained with many years of effective life still remaining.

The following tables give a breakdown of network reliability by Zone Substation and feeder. This shows that many feeders have some form of backup and that appropriate spare transformers are held for all major substations.

Substation	Load (MW)	# HV Feeds	Feeders	Backup	Comments
Reefton	2.5	1	CB4 CB5	CB4 at Sub CB5 at Sub NGA CB1 to Maimai	This substation is dependent on the integrity of the radial feeder from Dobson. Repair times are short. A backup transformer is available ex Dobson.
Ngahere	2.6	1	CB1 CB3	DOB CB1 ALD CB4 RFT CB1 to Ahaura	There is no backup for a 33 kV feeder fault. Backup is available for the Blackball feed from Dobson or Arnold. Partial back feed from Reefton to Ahaura is possible. Repair times are short. A backup transformer is available ex Dobson. In a substation fault, alternate feeds are not large enough to supply the major connected load, the Ngahere Gold Dredge.
Rapahoe	4.0	1	CB1 CB3	CB3 at Sub DOB CB1	There is no backup for a 33 kV feeder fault. Backup is available via a bypass switch for 33kV and 11 kV circuit breaker faults. Dobson is able to supply the domestic11 kV load and minimal industrial load e.g. mine pumps. A backup transformer is available ex Dobson. Repair times are short.
Dobson 11kV	2.7	1	CB1 CB3	RAP CB3 ALD CB3 NGA CB1 GYM CB8	This substation is fed directly from the Transpower Dobson 33 kV bus, and so is not subject to Westpower Subtransmission Line Faults. The 33/11 kV transformer also acts as a spare, which can be transported to Ngahere, Rapahoe, Hokitika, Wahapo or Franz Josef if required. Several 11 kV ties exist for the feeders out of this substation and repair times are short.
Dobson 33kV	6.6	2	CB1322 CB1342 CB1362 CB1382	CB1362 at Sub No Backup CB1322 at Sub 11kV Tie to Arnold	This is the major 33 kV supply point for the Grey Valley and is supplied direct from the Trans Power network. The radial 33 kV feeders can be bypassed at the substation for circuit breaker faults but there are no alternate feed for the feeders themselves. Repair times are short. CB1382 is not provided with a bypass, as Arnold Power Station provides an alternate source on the 11 kV network
Arnold	1.8	1	CB3 CB4	DOB CB1 KUM CB4	The backup for a 33 kV feeder fault is the local generating station tied in through the 11 kV network. Backup is available for the Stillwater feed from Dobson, and for the Moana feed from Kumara. Partial back feed to Dobson or Turiwhate is possible. Repair times are short. A backup transformer is available ex Dobson.
Greymouth	11.0	2	CB7 CB7 CB13 CB6 CB12 Cb11	CB12 No backup CB6 DOB CB3 CB13 CB11 KUM CB1 CB7 CB11 CB6 CB12	This is Westpower's largest Point of Supply that feeds the Greymouth Central Business District (CBD). There are several radial 11 kV feeders that are intermeshed at several points providing a significant amount of diversity. The Cobden Feeder has no backup once it crosses the Grey River, however the reticulation is all overhead with low repair times. The 11kV cable network in the CBD is highly intermeshed with a "double-ring" construction. All substations have two, and many three, 11 kV cable feeds.
Kumara	1.1	3	CB1 CB4	GYM CB6 ALD CB4 HKK CB10	This supply is fed directly from the Kumara 11 kV bus, which is in turn supplied by a very reliable Transpower 66 kV bus. Both 11kV feeders can be back fed from Greymouth, Arnold or Arahura Substations. A spare transformer is available from Greymouth Substation.
Hokitika	12.0	2	CB10 CB4 CB12 CB5 CB9 CB11 CB13	CB4 CB10 CB12 CB4 CB9 CB11 CB5 CB11 CB5 CB9 WAH1512	This substation feeds Hokitika and all of South Westland down to Paringa. In addition, it supplies 3 feeders to the Westland Dairy.

Ross	0.8	2	CB1 CB3	No Backup HKK 10 Partial	CB1 is a dedicated feeder for the Birchfield Minerals mine site. Domestic load on CB3 can be fed from AHA C310 but this is severely voltage constrained. Both feeders have a short repair time.
Waitaha	0.1	2	CB1	No Backup	The 33 kV substation feed can be from Arahura or Wahapo if the Wahapo Power Station is available. This is a very small and isolated substation and no backup is possible for the 11 kV feeders. A spare transformer is available.
Harihari	0.3	2	CB1 CB3	CB3 at Sub CB1 at Sub	The 33 kV substation feed can be from Arahura or Wahapo if the Wahapo Power Station is available. This is a small and isolated substation and no backup is possible for the 11 kV feeders apart from a bypass for the 11 kV circuit breakers. A spare transformer is available.
Whataroa	0.3	2	CB1	No Backup	The 33 kV substation feed can be from Arahura or Wahapo if the Wahapo Power Station is available. This is a small and isolated substation and no backup is possible for the 11 kV. A spare transformer is available.
Wahapo	0.05	1	CB1	No Backup	The 11 kV substation bus can be fed from Arahura or Wahapo if the Wahapo Power Station is available. This is an isolated substation and no backup is possible for the 11 kV. A spare transformer is available from Dobson. This substation also connects Wahapo Power Station into Westpower's sub-transmission network.
Franz Josef	2.2	1	CB1 CB3	CB3 at Sub CB1 at Sub	This substation, ffed from Hokitika feeds the Franz Josef area. There are two sections of Aerial Bundled Cable in this feeder, which have significant repair times. The aerial routes and terrain can be very difficult. There is no feasible backup.
Fox Glacier	.4	1	CB1		This substation was constructed in 2003 to supply the Fox Glacier area, south to Paringa.

9.3 TRANSPOWER NETWORK

The major risk to the security of supply to the West Coast lies with the Transpower network.

There are two long, exposed feeds into the West Coast, from Inangahua and Coleridge, as shown on the adjacent map, and at peak times both of these feeds are required along with support from the Trustpower generation. The significant costs involved in providing extra security above the existing levels make this prohibitive

(NB. This plan was prepared in June 2002 and since that time the Arahura Substation has been replaced by Hokitika.)

The construction of the twin-circuit Kumara-Kawhaka line in May 1997 by Westpower has greatly improved security of supply to the Kumara and Greymouth supply points.

9.4 Overall Reliability

It is considered that the levels of security are appropriate for Westpower's network in line with industry best practice for loads of this size and type

10 RISK MANAGEMENT PLAN

Westpower has a separate Risk Management Plan completed as part of its overall business planning strategy. This included Business Impact Analysis and Business Continuity Planning.

In addition, Westpower is actively involved in a regional Lifelines project looking at ways of managing the risks involved with major disasters and ensuring that plans are in place to deal with most of the likely scenarios.

A copy of the full Risk Management Plan is available from Westpower on request, however a general overview of the process is included below to demonstrate the robust and professional approach taken to this important aspect of planning.

A full review of the risk management plan is due for completetion in the 2006/07 year and updated details will be provided in next years AMP.

10.1 Risk Management Planning Framework

A detailed risk assessment was conducted which:

- Defined specific risks.
- Assessed the potential impact of each risk on a six-point scale from 100 [Minor] to 600 [Critical].
- Assigned management responsibility to each risk.
- Identified current control measures for all risks with a potential impact of 400 [Major] or above and rated the effectiveness of the controls.
- Explored the likelihood of occurrence.
- Documented the results.

The methodology adopted was consistent with the joint Australian and New Zealand Standard AS/NZ 4360:1999. It is a simple and effective method but remains subjective. The validity of the risk control assessments may require further investigation and analysis by Westpower, particularly where the risk is critical to

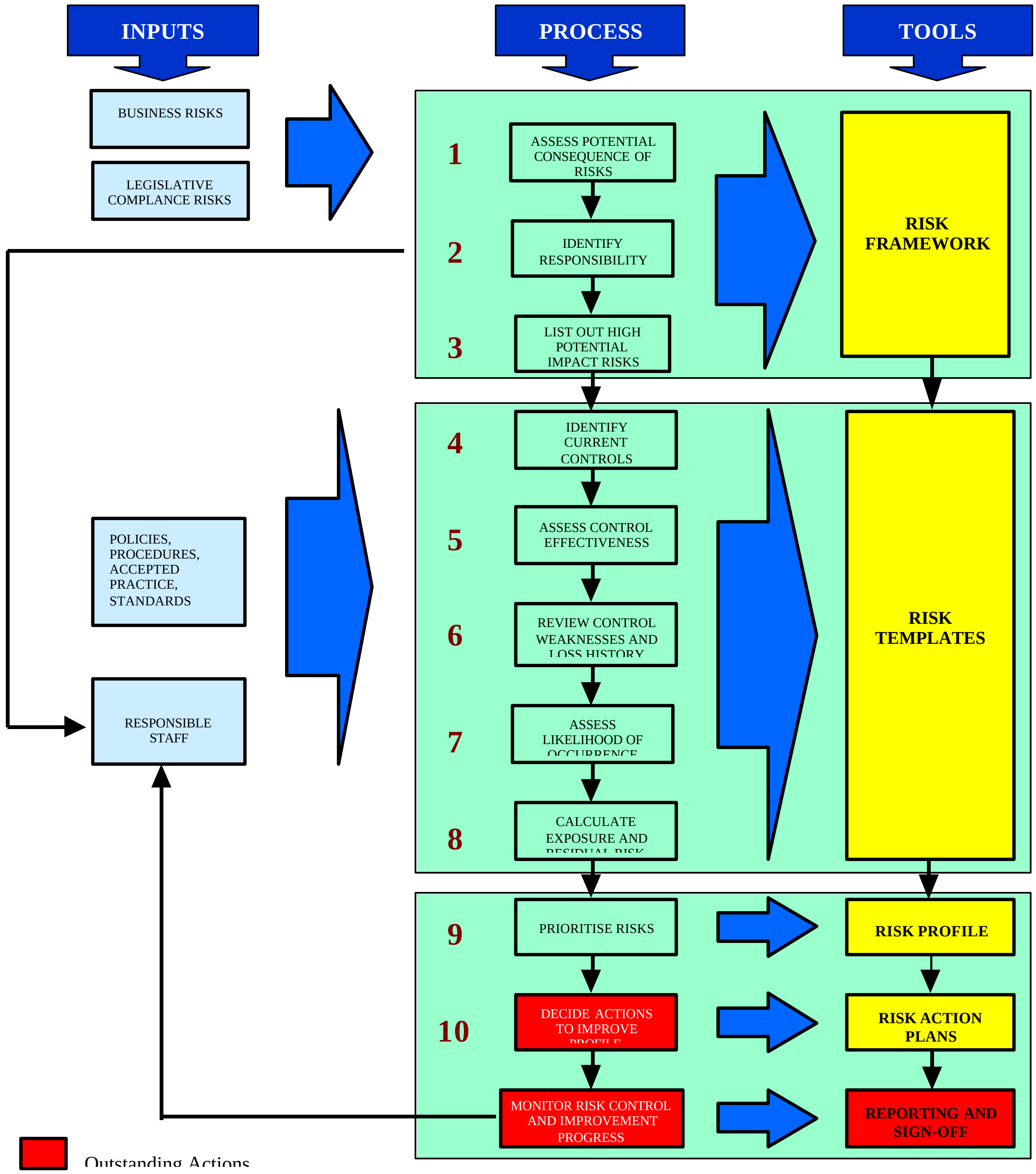
Risk Factor	Rating	Recommendations
Physical Security	30	Review security requirements for each of the sub-stations. In particular investigate benefits of installing an alarm system in Franz Josef sub-station monitored through SCADA and personal pagers Key Register needs to be updated and unreturned keys retrieved where possible. If this can not be done then an assessment should be made of critical security points and locks replaced in these places.
Plant Maintenance	24	Continue the process of improvement of the existing plant maintenance and life cycle planning and reporting strategy. Ensure that the Service Maintenance Module (SMM) enhancements are matched with any revisions to the plant maintenance strategy. Review the process of issuing scheduled work orders to ensure a match to the Asset Management Plan. Need to ensure there is a high degree of consistency.

the business. An example of the one of the outputs is shown below.

10.2 Risk Planning Methodology

The risk management team facilitated a workshop with Westpower management to work through and assess the impact of 60 risks presented in a framework under 13 categories.

The diagram shown below charts the methodology used for Westpower. In the diagram below the process boxes, numbered 1-10, correspond with the process methodology stage descriptions that follow.



Stage 1. Assess Potential Risk Consequence

Risk is measured in terms of consequence and likelihood. At the workshop, Westpower management assessed the potential impact of each risk on the organisation. Their assessment of the potential risk consequence was based on the following table developed in consultation with senior Westpower Management.

RISK CONSEQUENCE TABLE - Westpower Limited

Rating	Level	Possible Impact on Company	Annualised Financial Impact
600	Critical	• Board approval for actions and on-going support from the Company's bankers required. • High Priority actions needed to recover situation • Loss of stakeholder support • Major stakeholder concern • Viability of Company threatened	Greater than $5 million
500	Severe	• Direct Intervention of the Board. • Urgent and sustained Management action required to prevent crisis. • Stakeholder unease and reduced support • High profile, adverse national media coverage (TV, radio and print) • High number of people affected by an incident or over year by incidents	Between $1 million and $5 million
400	Major	• Immediate Management action needed to control the situation. • Multiple incidents affect a significant number of people a year in total (Non-random) • Major stakeholder concern • Adverse national media coverage (TV, radio and print)	Between $500,000 and $1 million
300	Significant	• Management action needed to prevent escalation. • Multiple incidents affect a significant number of people a year in total (Random) • Widespread complaints (public and community organisations) • Adverse national media coverage (print)	Between $100,000 and $500,000
200	Moderate	• Action needed to confirm controls • Localised complaints (small groups or communities) • Adverse local media coverage (not picked up nationally) • Single incident affects a small number of people	Between $50,000 and $100,000
100	Insignificant	• Covered under normal Management actions • Negative local media coverage • Personal grievance claim	Less than $50,000

Stage 2. Identify Responsibility

One of the tasks completed at the workshop was to identify the responsible person for each of the risks given a consequence rating. It is the person identified that is best able to rate the current control methods and weaknesses.

Stage 3. Identify High Consequence Risks

A key aim of the risk workshop was to separate out the significant, high-impact risks for further attention from those with lesser impacts. Using a cut-off risk impact level of 400 we prepared the following list of risks to pursue further. Each of these risks were assessed in detail in interviews conducted with the staff responsible identified at the workshop.

Risk	Consequence
Financial Management	400
Illegal or Unacceptable Behaviour	300
Government Regulation	550
Inventory Management and Purchasing	300
Project Management	500
Staff Planning	400
Succession Planning	400
Revenue Protection	400
Business Continuity Planning	500

Stage 4. Identify Current Controls

As part of the interview process, each high impact risk was discussed in detail and a description of the current control methods obtained. These results were captured in Risk Templates .

Stage 5. Assess Control Effectiveness

Next, the control effectiveness of the current control methods was assessed using the following rating scale.

CONTROL EFFECTIVENESS TABLE - Westpower Limited

Control Effectiveness	Descriptor	Definition
95%	Excellent	The controls in place mitigate the risk to the maximum extent and are being performed in the manner for which they were designed
80%	Very good	The controls and procedures are very good. There is small room for improvement.
70%	Good	The majority of the risk is managed, however there is potential for the controls to fail. An improvement is recommended.
55%	Adequate	The controls and procedures manage the risk at face value. There is a great reliance on them operating correctly without any checks or assurances.
45% +	Unacceptable	The controls manage only some of the risk.
30% +	Non-existent	The controls are largely passive.

Stage 6. Review Control Weakness and Loss History

Also, as a part of the interview process, an assessment was made of the weaknesses associated with the current control measures. At the same time, suggestions for improvements were put forward by managers and a brief review of the recent loss history for this risk was noted.

This information was also captured in the Risk Templates contained in Appendix C.

Stage 7. Assess Likelihood of Occurrence

Westpower staff were asked to rate the likelihood of a loss against the risk exposure. The risk exposure is determined by subtracting the controls effectiveness from the risk consequence.

The likelihood was assessed by using the following scale:

Likelihood	Descriptor	Definition
0.95	Almost Certain	There is an extremely high exposure to the risk (frequency). Controls are unlikely to prevent realisation of potential impact **OR** An external influence will almost certainly occur and render the internal controls inoperative.
0.75	Highly Likely	There is a very high exposure to the risk (frequency). No provision to identify the higher potential impact events. No confidence in controls to prevent realisation of potential impact **OR** Known external influences have the potential to render the internal control environment inoperative.
0.50	Likely	There is a high exposure to the risk (frequency). Little provision to identify the higher potential impact events. Low confidence in controls to prevent realisation of potential impact **OR** Good reason to expect that external influences may degrade the internal control environment inoperative.
0.20	Possible	There is an exposure to the risk (frequency).Some provision to identify higher impact events. Reasonable confidence in controls to prevent realisation of potential impact. **OR** Some unease that external influences may degrade the internal control environment.
0.10	Unlikely	There is low exposure to the risk (frequency). Provisions in place to identify and treat higher impact events. Good confidence in controls to prevent realisation of potential impact. **OR** Little reason to believe that external influences may degrade the internal control environment.
0.05	Highly Unlikely	There is little or no exposure to the risk (frequency). Good provisions in place to identify and deal with the higher impact potential events. High confidence in controls to prevent realisation of potential impact. **OR** External influences are non-existant or rare with long return periods.

Stage 8. Calculate Exposure and Residual Risk

Appendix C shows the results of the interviews as a series of templates that captures the key information about each risk. These templates include descriptions of the control methods and weaknesses as well as the calculation the residual risk value using the following formula:

ANNUALISED POTENTIAL RISK CONSEQUENCE – CONTROL EFFECTIVENESS = RISK EXPOSURE X RISK LIKELIHOOD = **RESIDUAL RISK LEVEL**

Stage 9. Prioritise Risks

By using the risk assessment formula shown on the previous page, we were able to prioritise the top risks for Westpower based upon the residual risk level. The risks are shown in order in the following table:

Risk	Residual	Rank
Government Regulation	114	**1**
Legislative Compliance	90	**2**
Business Continuity Planning	55	**3**
Capacity	50	**4**
Strategic Planning	45	**5**
Fire Protection	45	**6**

Stage 10. Action Plan Development

The Risk Management Team believes that any risk with a residual rating of 40 or above should be matched by a corresponding Action Plan. There were 6 risks above this figure.

The suggested action plans developed by Aon have been included in Section 4 of this Report. These were formulated from discussions held with key staff during the interview phase. These will be further developed by Westpower leader in consultation with the Risk Co-ordinator and Aon.

10.3 Failure Mode and Effects Critically Analysis

Asset failure will be managed using the failure mode and effects critically analysis (FMECA) process. This forms part of the "desired practice" for optimised renewal strategy as outlined in Table 6.1.

Having identified the failure modes, risk costs and treatment options for key assets, the appropriate option will be included in the Asset Management Plan. This process and typical failure modes, effects and treatments are summarised in figures 10.3a and 10.3b.

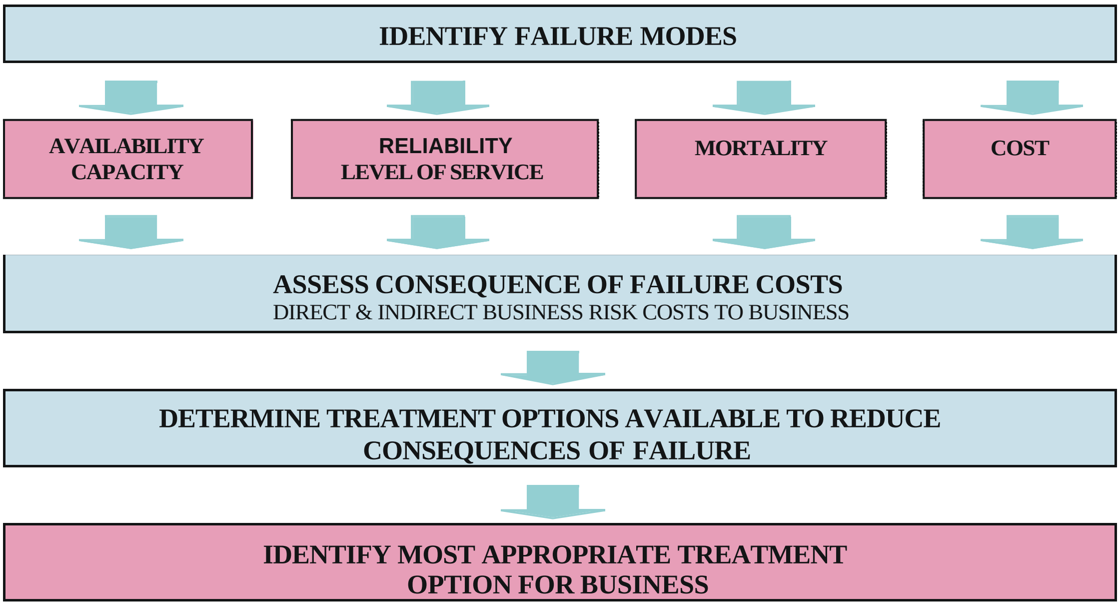


Figure 10.3a - Failure Modes Analysis Process

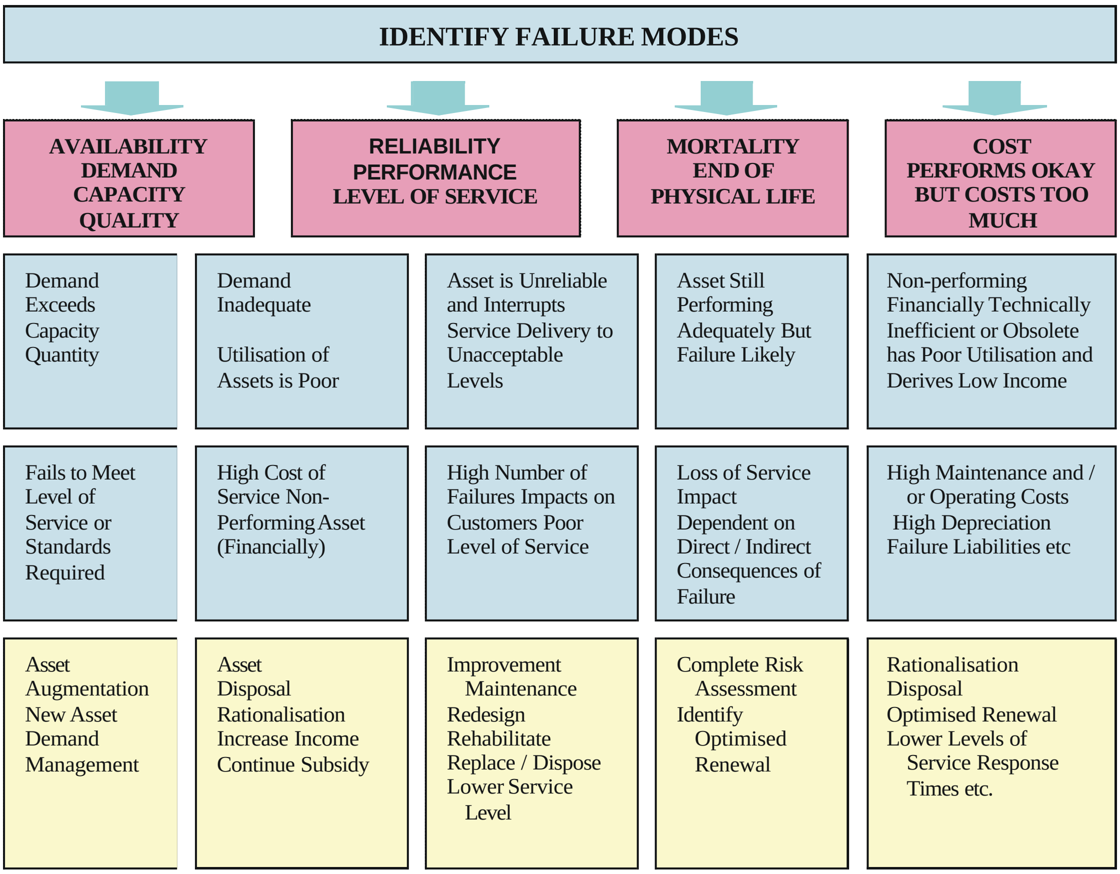


Figure 10.3b - Typical Failure Modes, Effects and Treatments

10.4 Safety

Safety is always a prime driver in and risk management strategy and Westpower takes this seriously. To ensure that these matters are properly addressed, a formal Health and Safety Committee structure has been created and this committee comprises a wide range of staff from all areas of the business.

In addition, Westpower's contractor, ElectroNet Services Limited, has been audited by the Accident Compensation Commission (ACC) and received a tertiary level grading for its safety processes and systems, the highest grading available.

Safety is kept to the fore through regular refresher courses and staff training programs designed to enhance the awareness of safety issues throughout all aspects of the workplace.

In addition to the above, Westpower ensures that an active Hazard Identification Program is in place including the development of registers for specific types of hazard. At Zone Substations, hazard identification notice boards are used to inform all personnel coming on to site of what the currently identified hazards are and they are encouraged to add to the list any new hazards that present themselves.

New equipment is always checked for safety and specific operational procedures developed where necessary. All manufacturers are required to supply Material Safety Data Sheets for substances used in the workplace and this is kept in a readily available register.

10.5 Environmental

Oil spills are the most likely form of environmental damage that is likely to occur as a result of Westpower's activities. This risk has been specifically identified for further attention and has been reported at Board level.

To mitigate this risk, Westpower has had in place an active program to upgrade bunding at all major substations where there are oil containment vessels with a capacity of more than 1500 litres. The one remaining Zone Substation site that fits this criterion is now compliant.

Spill response kits are supplied to all major sites and staff are trained in their use to mitigate the impact of any potential spill.

10.6 Key Risks Identified

Key risks for Westpower are similar for most lines businesses and are mainly due to climatic and seismic factors.

Westpower has identified the following major risks to its ability to supply electricity

- Earthquake
- Storms (including high winds)
- Lightning
- Flooding
- Ripple injection system failure

Earthquake

The likelihood of a major earthquake on the West Coast due to slippage on the Alpine Fault is considered to be relatively high within the next 50 years. There is very little that can be done to minimise the risk to overhead lines and cables in the event of an earthquake, but it is also relatively straightforward to straighten poles and restring conductors as long as access and materials are available.

A seismic withstand report was prepared for most Zone Substations in the 2003/04 year to identify any seismic strengthening measures that can be taken to mitigate the impact of a major earthquake.

In addition, Westpower closely co-operates with other lines businesses and uses similar industry standard equipment to ensure that a ready supply of spares will be available if required.

Storm Damage

Westpower faces this risk regularly with several major storm events experienced in any one year.

Damage is caused by poles being blown over or trees or other large objects being blown into the overhead lines.

Westpower mitigates this risk by maintaining a regular pole inspection program to check that poles are adequately rated for the service they are likely to face. Any poles that are found to be substandard are replaced quickly.

A wide range of spares are kept by Westpower's contractor, including poles, conductor, fittings and transformers to ensure that storm damage can be readily dealt with. The level of spares holding for various types of equipment have been developed through experience over a number of years and a regular reporting and reordering program is maintained to ensure that minimum quantities are maintained.

In addition, regional depots are maintained at Reefton, Hokitika and Harihari so that a rapid response can be provided throughout Westpower's area.

Lightning

The West Coast is quite correctly known as the major lightning incidence region of New Zealand, both in terms of strike density and intensity.

As Westpower has had to live with this phenomenon over many years, it has developed design practices to minimise the damage caused by lightning strikes. These include the fitting of modern surge diverters on all distribution substations, something not common in most parts of the country.

For Zone Substations, Station Class (Line Discharge Level 3) Arrestors are fitted on the terminals of all major power transformers and overhead shield wires are fitted on incoming overhead circuits.

A substantial spares holding is maintained for transformers as this is a common cause of damage for this plant and severe lightning events can sometimes last for several days.

Flooding

This risk mainly affects ground mounted assets such as pad mount distribution transformers and ring main units.

Where possible, the location of this equipment is chosen so that it is at least 300 mm above maximum recorded flood levels, although this is not always feasible in areas such as the CBD of Greymouth.

In the event of a major flood, operational plans are in place to make sure that power is isolated from plant prior to flooding reaching levels where it could cause causing an electrical fault and possible hazards to workers and the public. Of course, this is in addition to the normal protection systems used to isolate equipment in the event of a fault.

Ripple Injection System Failure

The ripple injection system is an integral part of Westpower's control system for managing demand on the network and providing tariff switching signals for retailers. A failure of the ripple system could result in

unmanageable peaks being applied to the system eventually resulting on brown-outs or, under extreme circumstances, blackouts.

Over recent years, Westpower has diversified its base of ripple injection plants and now has units installed at Hokitika, Greymouth, Dobson and Reefton. These are synchronized together so that if one unit should fail, coverage is provided from the remaining units.

In addition, each unit can be operated locally in an emergency.

10.7 Mitigation Measures

A number of strategies and plans are in place to mitigate the risks identified to Westpower's network and operational capability

1. Regular inspection, service and testing is carried out to check the operational capability of all equipment. This includes checking of vegetation in close proximity to overhead lines and active vegetation management.

2. Distribution automation has been progressively expanded throughout the network over recent years and this has allowed additional plant to be regularly monitored to give indications of an early failure.

3. Westpower has Network Design and Construction standards as well as a materials approval system to ensure that only quality materials are used and that a high standard of workmanship is maintained. This ensures that the integrity of the network protected.

4. Regular staff training is implemented in system operation and the issue of permits so that access to the network is always carried out in a safe manner.

5. Contingency Plans and emergency procedures are in place. Included amongst these plans are the following: -

    - Emergency Response Plan
    - Regional Emergency Load Shedding Plan
    - Electrical Industry Emergency Contact List
    - Zone Substations - Emergency Operating Order Templates

As discussed above, a number of engineering measures have been taken to mitigate risk including:-

- A healthy complement of spares is maintained so that most eventualities can be covered without resorting to external support.
- A seismic strengthening programme will begin at Zone Substations during the current financial year.
- Development of a fully portable 33/11 kV substation is in the construction stage to provide coverage for single transformer Zone Substations. Sufficient spare power transformers are available to cover faults.
- Spare circuit breakers and controllers have been purchased to cover expected failure rates.
- A replacement 11 kV ripple plant will be installed in the 2005/06 year

10.8 West Coast Engineering Lifelines Plan

Survey 2004 / 2005

Executive Summary

As a part of Westpower's ongoing commitment to the risk management of their West Coast electricity distribution network, a selection of critical facilities within their operating area were surveyed to assess vulnerability to damage from a number of pre-determined natural hazards, for example wind storms and severe earthquakes.

This survey is part of Westpower's means of compliance with the requirements of the *Civil Defence and Emergency Management Act 2002*. The new act seeks to improve New Zealand's resilience to emergencies through promoting a comprehensive, all-hazards approach to managing risk

Compliance with the above Act is based upon four "R's", *Reduction, Readiness, Response and Recovery.* This report broadly covers all four aspects of Westpower's network for the West Coast Area.

The full report contains a detailed summary of findings together with completed vulnerability charts that quantifies risk and importance in a systematic way. These charts are based upon the system originally employed for the Wellington and Christchurch engineering lifeline studies. The quantification level is sufficient to enable relative risk to be assessed to assist a process of mitigating areas of risk in a progressive manner from highest risk/vulnerability/importance to lowest.

The Westpower network is operated from a Control Centre in the Offices at their Depot on Tainui Street, Greymouth. These facilities were inspected. Since then a major upgrading project has been commenced at the depot. Wherever possible, the new work has been brought up to the requirements of the latest loadings and materials standards which will significantly reduce future vulnerability in this area.

The following main substations and switchyards were surveyed as part of the exercise:

- Greymouth Substation
- Dobson Substation
- Arnold Power Station Switchyard
- Rapahoe Substation
- Kumara Power Station Switchyard
- Hokitika Substation
- Franz Josef Substation
- Fox Substation

In addition to the above, a selection of less important substations were surveyed to gain an assessment of the overall network. These included substations / switchyards at Badger Lane, Harihari, Mawhera Quay, Ross, Wahapo Power Station, Waitaha, and Wilson Lane.

The major transmission lines feeding into the Westpower portion of the West Coast CDEM area are:

Inangahua – Blackwater A	110 kV single circuit on poles
Dobson – Blackwater A	66 kV single circuit on poles
Arahura (Hokitika) – Otira A	66 kV double circuit on poles
Arahura (Hokitika) – Dobson A	66 kV single circuit on poles (between Dobson and Greymouth)

The major Transmission Lines that Westpower own themselves are:

Greymouth - Kumara	66 kV single circuit on poles
Kumara – Kawaka	66 kV double circuit on poles

Hokitika – Harihari 66 kV single circuit on poles

Westpower's transmission / distribution lines cover several routes over widely varying terrain from coastal plains to relatively unstable and rugged hill country. Some redundancy is built into portions of the system whereby an outage on any one particular line depending upon time of day / time of year, may not affect supply to other areas of the network.

The Transpower Network supplying the Westpower Distribution Network.

Most poles supporting transmission and distribution lines are well founded to prevent collapse under high wind / ice conditions, and therefore are only moderately vulnerable to earthquake induced slope instability.

Westpower are able to use a number of independent means of communication to control their network, namely:

- Two-way radio
- Telecom landline telephone network
- Cellular phone network (In some areas)

Each system is essentially independent of each other and therefore there is significant redundancy in the event of disruption.

The following is a summary of common findings throughout the Westpower's network with suggested mitigation measures opposite.

Vulnerability	**Suggested Mitigation**
Transmission lines passing over unstable terrain	*Add diversification were ever possible (long term planning)*
Some transformers and regulators not robustly held down	*Modify hold down systems to current EQ standards*
Some buswork vulnerable to insulator damage from supporting posts moving differentially	*Provide slip joints in buswork at appropriate points*
Some prefabricated control buildings not robustly restrained	*Upgrade hold down systems to cope with full EQ and wind loadings*

Vulnerability/suggested mitigation summary cont...

Vulnerability	Suggested Mitigation
Restrain batteries from sliding with support frames and possibly damaging cables and terminals	Provide corrosion proof packing and tie down small communication batteries
Some two way radios and access manuals unrestrained	Provide lips to storage shelves and attach radios to walls etc
Some equipment support stands ungrouted with long hold down bolts vulnerable in bending	Provide suitable non shrink grout under base plates
New control room to be as robust as possible	New control room will be up to latest standards. Ensure all VDU's, computers and communication equipment well restrained
Some critical spares unrestrained and vulnerable	Appropriately restrain all critical spares

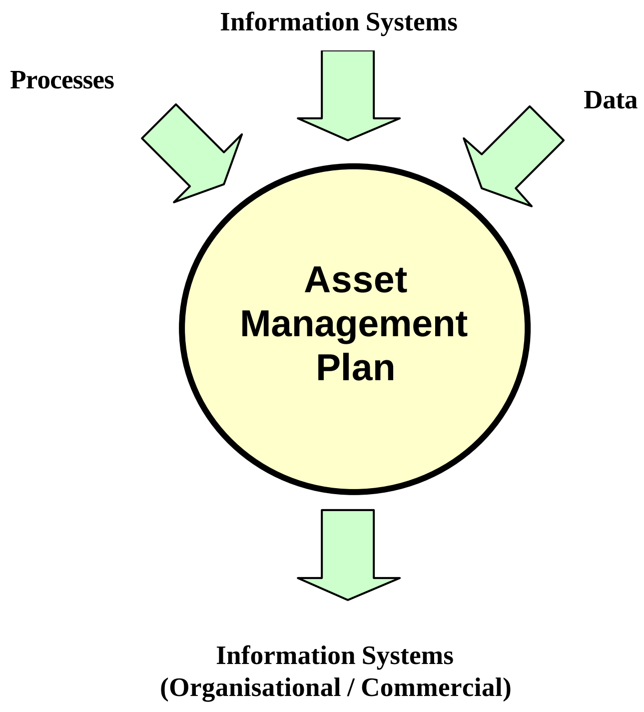
11 IMPROVEMENT PLAN

11.1 Asset Management Planning Framework

Westpower's Asset Management status approach is based on evaluating the following key areas of life cycle asset management:

1. Processes and Practices;
2. Data and Knowledge;
3. Information support Systems;
4. Commercial Tactics;
5. Organisational / People issues;
6. Asset Management Plans.

The relationship between the Asset Management plan and its supporting practices (processes, data and information systems) and implementation tactics (commercial tactics and organisational / people issues is illustrated in figure 10.1.



Studies were undertaken using the following inputs:

- Interviews with key Asset Management staff.
- Nominal assessments of existing Asset Management practices.
- The assessment of key reports.
- Audits of selected projects by the Lines Inspector.
- Workshops with Asset management staff.

The following is a detailed description of the key areas evaluated, and the latest performance scores at at June 2005. Westpower is also planning a major upgrade of it's Information Support Systems and that is discussed in Section 12.

11.1 Demand Analysis

The provision of infrastructure services really represents the provision of appropriate infrastructure to meet customer demands. If an organisation does not understand the demand for asset services from its key customers and stakeholders then the assets constructed and maintained may either over provide for the demand or under provide. It is therefore important that an organisation clearly understands the demand for its services.

In this element Westpower takes into account the following;

- History Records *Previous Score 65 - Current Score 65*

This assesses the past historical trends in demand and the depth of knowledge the organisation holds.

- Element Break-up *Previous Score 80 - Current Score 80*

In this instance the knowledge the organisation holds on elements that make up the demand are assessed eg. temperature, unit demand variations, key customer groups, population changes etc.

- Customer and stakeholders Surveys *Previous Score 55 - Current Score 55*

This sub-element assesses the method by which the organisation has assessed the levels of service and other details required by their customers.

- Trend Predictions *Previous Score 65 - Current Score 65*

This sub-element assesses the organisation's ability to predict trends in terms of demand and service standards.

11.2 Knowledge of Asset

This element assesses the organisation's processes and practices or policies relating to the methods used to acquire and maintain knowledge of their assets.

The key sub-elements assessed are:

- Hierarchical Level *Previous Score 70 - Current Score 70*

The depth to which an organisation can access information on assets is vital to the overall AM performance. From a best practice perspective this hierarchical level should be taken down to a maintenance managed item (MMI) and the information should be capable of been aggregated up to reflect assets, facilities, sub-systems or entire service programs.

- Physical Attributes and Data (Primary)

This assesses the three priority levels of data namely:

1. Basic (primary) physical attributes; *Previous Score 75 - Current Score 75*
2. Detailed information on the construction of the assets, their manufacture and condition - *Previous Score75 - Current Score 75*
3. Tertiary level information including risk, maintenance plans, detailed condition assessment and performance etc. *Previous Score 70 - Current Score 70*

These quality elements vary for individual asset types and Westpower assesses these elements in terms of the type of asset being considered.

- Condition *Previous Score 705 - Current Score 75*

The way in which the organisation assesses the condition of individual assets and their components and the process used for recording this data.

- Performance *Previous Score 70 - Current Score 70*

The way in which the organisation assesses the performance of individual assets and their components and records the same.

- Utilisation *Previous Score 80 - Current Score 80*

This sub-element relates to the knowledge the organisation has on the current demand for the asset service and the way in which it is tied to the capacity of the asset.

11.3 Asset Accounting and Costing

This element assesses the quality of the processes used to determine the true cost of service. The audit takes into account the following sub-elements:

- Valuations *Previous Score 70 - Current Score 70*

The method of valuation used by the organisation, its appropriateness and the accuracy with which the valuations have been developed. It also assesses the methods used to update this information.

- Depreciation and Effective Lives *Previous Score 70 - Current Score 70*

The methodology used to establish the effective lives of the individual assets and if necessary their components and the accuracy of the depreciation calculations.

- Operational Costs *Previous Score 65 - Current Score 65*

The quality with which the organisation can assess the operations of individual facilities and assets and the break-up of these operational costs in terms of labour, energy, chemicals, plant etc.

- Maintenance Costs *Previous Score 75 - Current Score 75*

The method by which the organisation can assess their maintenance costs (planned and unplanned) including a break-up of these costs into labour, materials, plant and equipment etc. It also looks at the records of indirect business costs.

- Renewal Liabilities and Risks *Previous Score 60 - Current Score 60*

The processes used to identify future CAPEX renewal liabilities including backlog maintenance. This also considers the way the business reports on its risk exposure.

- Historical Cost Data *Previous Score 70 - Current Score 70*

The ability of the organisation to identify past historical cost data for individual assets in all areas.

11.4 Strategic Planning Life Cycle

This quality element assesses the processes used by the organisation to complete their long term strategic planning and this includes the following sub-elements:

- Failure Mode Prediction

The processes used to predict the way in which individual assets or their components will fail to meet the key quality elements of service delivery namely:

- Capacity failures; *Previous Score 70 - Current Score 70*
- Reliability or levels of service type failures; *Previous Score 65 - Current Score 65*
- Mortality or physical asset failure; *Previous Score 55 - Current Score 55*
- Cost of service ie. Where the cost of service is likely to exceed the economic return necessary to justify retention of the asset (or the customer's willingness to pay). *Previous Score 55 - Current Score 55*

- Risk Assessment *Previous Score 60 - Current Score 60*

The processes used by the organisation to assess their current risk exposure in regards to asset failure and the way in which this is assessed as part of their business risk looking at both direct and indirect costs to the business.

- Optimised Decision Making *Previous Score 55 - Current Score 55*

The decision-making processes used to derive optimised renewal programs. The process reviews asset and non-asset solutions and (from an asset perspective) operations, maintenance and capital expenditure alternatives.

- Life Cycle Costing *Previous Score 55 - Current Score 55*

The processes used by the organisation to assess the long-term life cycle costs in relation to new investments. It also looks at individual asset strategies and the way in which these are aggregated to develop whole of portfolio type strategies based on least cost to the business in line with customer demands.

- Improvement Programs *Previous Score 65 - Current Score 65*

The processes used by the organisation to identify cost reduction opportunities or improvements in levels of service and the way in which these are used via a continuous improvement process throughout the organisation in both operational and capital expenditure areas.

- Capital Expenditure Valuation *Previous Score 55 - Current Score 55*

The processes used by the organisation to develop business cases for capital investment and assess the quality of that evaluation process with respect to different sized investments.

- Total Asset Management Plan Production *Previous Score 75 - Current Score 75*

The ultimate output of a strategic planning process is an asset management plan and this assesses the processes by which the organisation put such a plan into production. The quality of the actual plan capable of being produced is assessed as the final element of our asset management assessment process (see Item 6).

- Customer Review / Revision *Previous Score 45 - Current Score 45*

The method by which the organisation presents their long term strategic planning information to their customer and stakeholder groups and the process used to simulate the feedback from customers into their long term strategic planning.

- Business Goal Linkages *Previous Score 65 - Current Score 65*

The way in which the business is able to link their overall business goals with actual asset action plans in

terms of maintenance or capex investment eg. the meeting of environmental objectives and goals with respect to the way we plan to operate, maintain and renew our asset systems.

- Budget Rationalisation Process *Previous Score 60 - Current Score 60*

The process by which an organisation can rationalise their ideal total asset management plan to suit the available resources, business drivers or budget constraints. It looks at the way in which this process ensures that the organisation gets the best benefit for the dollar that it is expending.

11.5 Asset Creation / Disposal

Once an organisation has identified capital expenditure activities this quality element assesses the way in which the organisation creates the necessary assets (or disposes of them should they no longer be required). In this process the following sub-elements are assessed:

- Project Identification *Previous Score 65 - Current Score 65*

The way in which projects are taken through the budget rationalisation process to actual decisions to create or dispose.

- Project Management *Previous Score 65 - Current Score 65*

The processes used by the organisation to project manage the various different types of projects that would be involved in the asset creation refurbishment or disposal activity.

- Design / Value Engineering *Previous Score 55 - Current Score 55*

The processes used by the organisation to optimise the design activity, especially with respect to the way in which value engineering is used to optimise the design taking into account the strategic objectives of the asset.

- Contract Administration *Previous Score 60 - Current Score 60*

The processes used from a contract administration perspective.

- Contract Supervision *Previous Score 50 - Current Score 50*

- Asset Hand Over *Previous Score 50 - Current Score* 50

The way in which the organisation commissions and hands over new or renewed assets and in particular the way in which the necessary knowledge and data is transferred into the operational portfolio and asset management information systems.

- Asset Rationalisation *Previous Score 55 - Current Score 55*

The way in which the organisation approaches the issue of rationalising its portfolio and the way in which assets are identified for disposal.

- Asset Disposal *Previous Score 55 - Current Score 55*

The way in which the organisation proceeds through the disposal process whether this be actual sale, transfer of asset ownership or decommissioning of the asset involved.

11.6 Asset Operations

This quality element looks at the way in which the organisations operate their assets and the key quality sub-elements assessed include:

- Operating Procedures *Previous Score 75 - Current Score 75*

The quality of the operating procedures used with the individual assets including automated processes and the type of support systems provided.

- SCADA Systems *Previous Score 70 - Current Score 70*

The appropriateness of the practices used in system control and data acquisition or automated processes and the appropriateness of the policies set for these investments.

- Operations Manuals *Previous Score 75 - Current Score 75*

The policies and procedures in relation to operations manuals and the way in which these are available across the asset portfolio and staff including the appropriate quality levels from a business risk perspective.

- Emergency Response Plans *Previous Score 55 - Current Score 55*

The process used to determine the need for an emergency response plan and the policy and guidelines available for the development of these plans. (The plans themselves are dealt with under the data and knowledge section).

- Monitoring and Control *Previous Score 65 - Current Score 65*

The processes used to monitor and control the systems operations from a performance and cost perspective

11.7 Asset Maintenance

This quality element looks at the processes and practices used to maintain the individual assets and system portfolios in line with the business objectives and the overall asset management plan. The sub-elements assessed in this activity include:

- Policy / Strategy *Previous Score 55 - Current Score 55*

The overall policy or strategic objectives that the organisation uses for their maintenance functions and the way in which this is linked to their overall asset management plans and business risks.

- Planning *Previous Score 65 - Current Score 65*

The way in which maintenance plans are developed and the logic contained in that development following reliability centred maintenance (RCM) type approaches.

- Scheduling *Previous Score 55 - Current Score 55*

The methods used to schedule the planned and unplanned maintenance activities and the way in which these are prioritised. It also looks at the economic basis behind the processes developed.

- Job Execution and Control Feedback *Previous Score 55 - Current Score 55*

The processes involved in monitoring and controlling the maintenance works program and the quality of the data feedback required in both planned and unplanned maintenance activities.

- Maintenance Costing *Previous Score 45 - Current Score 45*

The method by which maintenance costs, their accuracy and the way in which the indirect costs of unplanned activity or system shutdowns are recorded. It also looks at the elements of maintenance costs including the recording of non-productive activities such as travel time etc.

- Maintenance Manuals *Previous Score 50 - Current Score 50*

The quality of the processes used to develop maintenance manuals and their availability to maintenance staff throughout the organisation.

- Review / Analysis *Previous Score 40 - Current Score 40*

The review and maintenance analysis process that is used to further refine the maintenance programs including:

- RCM analysis;
- Cost benefit analysis;
- Identification of cost reduction opportunities including the assessment of core and non-core activities with respect to commercial tactics.

11.8 Job / Work Resource Management

This assesses the quality of the processes and practices used to manage the work arising out of these miscellaneous operational and maintenance activities. The sub-elements assessed under this category include:

- Resource Planning *Previous Score 55 - Current Score 55*

The way in which the organisation is able to predict and plan their future workload and take appropriate action to level out abnormalities so as to ensure effective workload planning for all personnel.

- Inventory Control *Previous Score 55 - Current Score 55*

The way in which the organisation is able to link work activities and assets back to inventory systems so that spare parts, materials etc. can be booked and organised ahead of time to suit the work plan. It also assesses the quality of the inventory control system in terms of optimising spare parts and materials.

11.9 Review Audit (Continuous improvement)

This quality element looks at the way in which the organisation has set up its quality systems and processes and the way in which it regularly audits itself and derives specific improvement targets for coming years. The sub-elements included in this assessment are:

- Improvement Programs Implementation *Previous Score 45 - Current Score 45*

The process used to monitor and report on the progress being made in all asset management improvement projects including cost reduction opportunities etc.

- Internal QA Practices *Previous Score 40 - Current Score 40*

The way in which the organisation completes an internal quality assurance review of its activities and the work that it is completing in the asset management area.

- Cost Reduction Opportunities *Previous Score 65 - Current Score 65*

The way in which the organisation identifies cost reduction opportunities through the audit process and takes the necessary action to achieve these outputs.

- Independent Asset Management Audit *Previous Score 75 - Current Score 75*

The degree to which the organisation exposes itself to independent external audit, the way in which these audit projects are developed and the action taken on the auditors reports etc.

- Asset Management Process Diagrams *Previous Score 55 - Current Score 55*

The available process diagrams and flowcharts that are available to assist staff in this life cycle asset management process.

- Asset Management Quality Manual *Previous Score 30 - Current Score 30*

The quality of the asset management manuals, policy documents etc. that are available to assist staff in the life cycle asset management area.

11.10 Data and Knowledge (Data Availability / Quality)

This major quality element looks at the data and knowledge available on the assets and their performance, the forms of that data and its availability or usefulness to the organisation.

The assessment process looks at the following sub-elements:

- Asset Categories *Previous Score 75 – Current Score* 75

The way in which the asset data has been accumulated and the usefulness of that data from an asset management perspective.

- Hierarchical Level *Previous Score 85 - Current Score 85*

The level to which data is available and accurate against the various asset components and compares this with an appropriate level from a maintenance managed item (MMI) perspective.

- Location *Previous Score 80 - Current Score 80*

The ability of the organisation to locate and identify an asset appropriately. Where GIS systems are involved then the location is assessed from a spatial electronic perspective.

- Physical Asset Attributes (Basic Data) *Previous Score 80 - Current Score 80*

The quality of the data available in the basic physical parameters or Priority 1 type asset data (Primary data).

- Physical Asset Attributes (Secondary Data) *Previous Score 80 - Current Score 80*
- Condition Data *Previous Score 60 - Current Score 60*

The relative condition assessment information that is available at various hierarchical levels of assets and the way in which this data is graded to provide appropriate intervention and risk reduction strategies.

- Maintenance Data *Previous Score 65 - Current Score 65*

The actual data available and its quality in terms of maintenance from a history and current cost perspective including additional data such as:

- Cause of failure;
- Activities undertaken to overcome failure;
- Impacts or the consequences of failure.

• Job Resource Management *Previous Score 55 - Current Score 55*

The data available in terms of job management activities including prioritisation and workforce details etc.

• Risk Assessment *Previous Score 65 - Current Score 65*

The data available from a risk perspective to identify the consequence of failure of the various assets including:

- Safety;
- Environmental damage;
- Impact on customers and other associated issues.

It also considers the probability of failure and the ultimate application of risk cost to renewal decision making. Each of these consequences need to be related to the business risks involved.

• Cost Histories *Previous Score 55 - Current Score 55*

The cost histories that are available against assets in terms of maintenance, operations, renewal and the original creation cost.

• Intervention Options and Costs *Previous Score 50 - Current Score 50*

The records that are held in terms of costs for standard procedures, activities and rehabilitation techniques that allow the analysts to determine the most appropriate long term life cycle cost approach for the assets concerned.

• Optimised Renewal Decision Making (ORDM) *Previous Score 60 - Current Score 60*

The data available in terms of current strategies for individual asset renewals. With changing technology this data will need to be updated at regular intervals and revised or new strategies developed for individual assets. This assessment looks at the ability the organisation has to continually refine and update this data.

11.11 Asset Information (Support) Systems

This primary quality element assesses the asset information systems that are available to the organisation to assist or support the asset management processes.

This assessment looks at the functionality of the various applications required for asset management and assesses this against best practice.

The systems include the following sub-elements namely:

11.12 Primary Applications

• Finance System *Previous Score 60 - Current Score 60*

The way in which financial costs can be assessed, aggregated and disaggregated in terms of asset manage-

ment.

- Asset Register *Previous Score 40 - Current Score 40*

The functionality of the asset register and the ability of the register to meet asset management needs in terms of asset hierarchy, aggregation and disaggregation as well as its flexibility in being able to expand and contract to suit the specific needs of the assets and their management.

- Plans and Records *Previous Score 55 - Current Score 55*

The system that the organisation has to link plans and records (documents) to individual assets and the library system that is used to relate hard copy plans and/or electronic type diagrams and drawings to individual assets, facilities or systems.

- Geographic Information Systems (GIS) *Previous Score 85 - Current Score 85*

The functionality of any GIS system that the organisation may have in place or propose to put in place. This is related to the benefits that would be derived from the management of the asset types as owned by the organisation.

- Maintenance Management System *Previous Score 90 - Current Score 90*

The functionality and application available through the maintenance management system to enable the proper development of a planned maintenance program, the recording of all unplanned maintenance and the associated linkages to inventory and job management.

- Operations Manuals and Emergency Response Plans *Previous Score 60 - Current Score 60*

The quality of the existing operations manuals and emergency response plans and looks at the ways in which these systems are linked to assets. It assesses their availability and their accessibility to staff. It also reviews the overall quality of the key elements necessary for the appropriate operations plans and emergency response plans.

- Job Resource Management System *Previous Score 50 - Current Score 50*

The ability of the organisation to plan, level and appropriately resource the workloads required through both their CAPEX and normal operations and maintenance activities.

- Inventory Spares and Purchasing System *Previous Score 55 - Current Score 55*

The relative quality and functionality of any inventory system and the way in which it interfaces to the asset management system from point of view of ordering materials and spare parts. It also looks at the way in which the system is linked to a purchasing process that will enable the optimisation and purchase of appropriate materials together with specialist services or contracted activities.

11.13 Secondary Applications

- Condition Assessment and Record System *Previous Score 85 - Current Score 85*

The condition assessment information system elements and the way in which this data is recorded over time and enables condition predictions to be made.

- Predictive Models Decay and Cost *Previous Score 40 - Current Score 40*

The ability of the information systems to predict the future condition, probability of failure and likely future costs i.e. maintenance that may be incurred by the organisation.

- Capacity Utilisation Models *Previous Score 45 - Current Score 45*

The ability of the organisation to properly assess the overall capacity of the asset or its integrated system and to be able to predict future demand capacity failures and their associated risks.

11.14 Life Cycle Applications

Risk Assessment *Previous Score 50 - Current Score 50*

The information systems available to assist personnel to assess the risks associated with their assets and their asset activities. The application is assessed on its ability to complete different levels of risk assessment namely; initial, secondary and tertiary and looks at its ability to:

- Develop an economic business risk exposure;
- Enable predictive and hindsight calculations;
- Develop risks or potential benefits in terms of business goals.

- Treatment or Risk Reduction Cost Options *Previous Score 55 - Current Score 55*

This application is assessed on its ability to enable staff to extract base estimating data that can be used in risk reduction opportunities, opportunity assessments (forward cashflows and CAPEX) including:

- Non asset solutions;
- Maintenance or operations
- Rehabilitation;
- Replacement;
- Disposal.

- Optimised Renewal Decision Making *Previous Score 55 - Current Score 55*

This application is assessed on its ability to assist staff to complete the necessary economic evaluation of the various treatment options that may be applicable to the asset renewal, replacement. It also looks at life cycle costs for the creation of new assets. The application is assessed on its ability to:

- Evaluate a series of alternative options;
- Enable the input of data for the various parameters effecting the decision;
- Cover the full life cycle of all options;
- Enable the easy alteration and completion of various scenarios;
- Display the resulting information in a satisfactory manner.

- Project Management Applications *Previous Score 65 - Current Score 65*

The organisation's applications in regard to project management software and systems and in particular their ability to handle simple or complex projects management tasks.

- Maintenance Analysis Software (AWMS) *Previous Score 40 - Current Score 40*

The organisation's applications that assist in maintenance management planning and analysis using good industry practice maintenance techniques.

11.15 General Overall System Issues

This assesses the integration and user friendliness or effectiveness of the existing applications from a whole of life asset management perspective including:

- User Friendliness *Previous Score 405- Current Score 45*

This sub-element looks at the user friendliness of the various informations system applications from a perspective of encouraging users to make use of the full functionality thereby deriving a greater effectiveness of our asset management activities.

- Integration of Systems *Previous Score 45 - Current Score 45*

This sub-element assesses the level of integration achieved by the various applications especially in the primary system area and the way in which secondary and tertiary applications are interfaced or integrated with the primary systems. This assessment concentrates on the effectiveness or efficiency elements of the software and the way in which its integration avoids duplication and the need for multiple entries or data quality-checking etc.

11.16 Commercial Tactics (Contestability/Contracted Services)

This quality element looks at the commercial tactics employed in the completion of the works identified by the life cycle processes and practices. It looks at the way in which the organisation ensures the lowest unit costs for the key activities involved in asset acquisition, creation, operations and maintenance or renewal. The assessment looks at the way in which the organisation ensures that all elements of business activity are placed under contestable pressure or are benchmarked to ensure effectiveness and efficiency in those areas. The assessment looks at items including:

- Core / Non-Core Activities Identified *Previous Score 60 - Current Score 60*

The way in which the organisation assesses their core/non core (purchaser/ provider) activities and how this split is related to the readiness of the organisation or agency in terms of its information and contracts and the availability or readiness of contractors to complete the various activities.

- Packaging of Contracts *Previous Score 65 - Current Score 65*

The way in which the organisation has packaged up its provider contracts including the overall general economic evaluation as well as the ability of the contracts to maintain true competitive pressure over the long term.

- Specification Quality *Previous Score 75 - Current Score 75*

The quality of the contracts or service agreements that will exist for both core and non core activities (management functions).

- Information and Data Available *Previous Score 60 - Current Score 60*

The quality of the information and knowledge available to the contractors in terms of their asset management roles and also the quality of the information feedback process required by the contracts.

- Contract Supervision (Performance Monitoring) *Previous Score 60 - Current Score 60*

The effectiveness and efficiency with which the organisation supervises or administers the contracts involved. The assessment looks at the quality assurance processes used and the cost effectiveness of the evaluation system. eg. Detailed random sampling. It also looks at the way in which benchmarking is used to supplement this process especially in the core purchaser roles.

- Contract Evaluation *Previous Score 65 - Current Score 65*

The way in which the organisation has gone about assessing its contractor evaluation (in terms of the initial contract letting) and the way in which their performance is monitored throughout the contract period.

- Support Systems *Previous Score 55 - Current Score 55*

The way in which the organisation's information systems support the management of these contracts. It looks at the way in which the work is identified and issued, the completion of the work and the necessary supervision or approval roles as well as the ultimate invoicing and payment system.

11.17 Organisational/People Issues

Under this major element Worley-GHD assesses the way in which the organisational structure, roles and responsibilities support or assist the life cycle asset management functions. The assessment is judged against the key success factors that GHD have witnessed in our work with clients in this area. The key sub-elements investigated include:

- Corporate Sponsorship and Commitment *Previous Score 50 - Current Score 50*

The organisation's commitment to asset management through their policy and corporate intent type statements as well as the direct sponsorship of the program and protection of asset value through the appointment of a single executive manager with that responsibility.

- Asset Management Roles and Responsibilities *Previous Score 60 - Current Score 60*

The way in which the organisation has allocated responsibility for the various life cycle functions and the way in which the whole of this process is coordinated across the entire organisation through some form of asset management team and steering committee.

- Overall Commitment *Previous Score 75 - Current Score 75*

The actual overall commitment of the organisation to appropriate best practice in Asset Management. It looks at the way in which the overall organisation is working towards its goals in this area.

- Skills and Age Profiles *Previous Score 60 - Current Score 60*

The organisation's knowledge of its individual staff skills and the general age profile of staff within the Asset Management area. It assesses how the organisation matches its resource needs to its asset management planning capabilities and the way in which succession planning is addressed as a key risk to the business.

- Training Programs *Previous Score 60 - Current Score 60*

The training structure available to staff in regard to life cycle asset management and the way in which these training programs are integrated into the professional development programs for individual staff members. It also assesses the way in which the organisation blends both in-house and external training opportunities with regard to individual staff.

11.18 Asset Management Plans

This element draws together all of the above quality elements to assess the quality of the organisations Asset Management Plans (AMP's).

The assessment process looks at the key elements of an asset management plan and assesses the organisation's current ability in terms of the following components:

- Knowledge of Assets *Previous Score 75 - Current Score 75*

The organisation's knowledge of its assets and their capabilities to meet the current and projected levels or standards of service via the AMP is assessed. Key components of asset knowledge include:

- Primary info (location, size, scope)

- Physical condition
- Levels of service
- Performance/reliability
- Utilisation and capacity

• Demand Projections and Forecasts *Previous Score 70 - Current Score 70*

The organisation's ability to project the forward needs or demands for assets and the levels of service that will be required by them.

• Levels of Service *Previous Score 50 - Current Score 50*

This assesses the organisation's standards and levels of service against the demands by both customers and stakeholders. It looks at the appropriateness of these standards and their relationship to industry practice and business goals. The ability of the AMP to outline methods used to determine the levels of service (i.e. stakeholder consultation) is also assessed. The way in which the organisation has then presented this information to the key stakeholders in the process is also assessed.

• Predicted Failure Modes Prediction and Consequences *Previous Score 60 - Current Score 60*

The organisation's ability to identify the various failure modes of assets and the accuracy of the timing with which these failures are predicted. The organisation's ability to clearly identify the economic consequences of the predicted failure modes and the business risk exposure they represent in both present and future is assessed.

• Operations and Maintenance *Previous Score 60 - Current Score 60*

This assesses how the AMP outlines long term operations and maintenance requirements including optimisation of the blend between proactive and reactive maintenance.

• Optimised Renewal Decision Making *Previous Score 60 - Current Score 60*

This assesses the way in which the organisation identifies the optimal renewal strategy for individual assets, facilities and systems. It includes an assessment in relation to both asset and non asset solutions as well as capital, maintenance and operating alternative options.

• New Works Identification *Previous Score 65 - Current Score 65*

The predicted need for new assets or augmentations of the existing systems and assesses the economic evaluation process used to identify both the type of asset required, the time at which it will be required.

• Works Prioritisation *Previous Score 60 - Current Score 60*

It assesses the way in which the organisation rationalises budgets to suit their current economic viability and business goals. The use of risk cost analysis and cost benefit analysis to rank works is assessed.

• Financial Forecasts (Accuracy and Assumptions) *Previous Score 70 - Current Score 70*

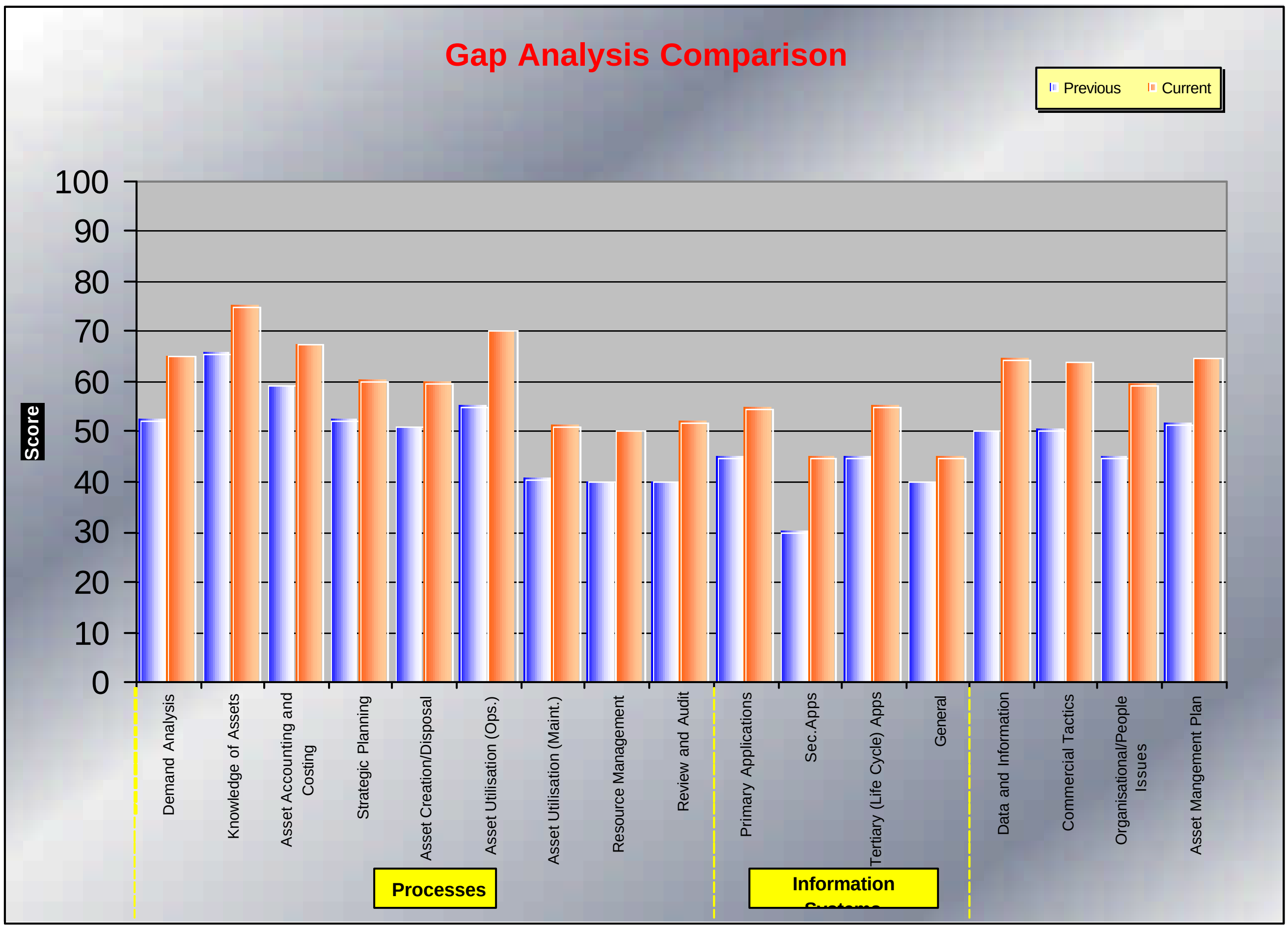
This assesses the accuracy of, and assumptions, which support the long-term cash-flow forecasts, produced in the AMP. The following components of the cash-flow forecasts are assessed:

- Operations;
- Maintenance;
- Renewal expenditure
- Capital expenditure

- Improvement Planning *Previous Score 65 - Current Score 65*

This assesses how the AMP outlines a programme for improving the practices which support AM planning and therefore improving the level of confidence in the AM plan.

The chart below depicts the overall improvment within each of the aforementioned catagories. Systems are to be established to regularly monitor these gap related trends, with focus on improvement in each of the areas.



Processes

Demand Analysis

Attribute	History Records	Element Breakup	Customer Survey	Trend Prediction	Overall Rating
Appropriate Practice Score	75	80	75	80	**80**
Current Score	65	55	60	65	**65**
Gap	10	25	15	15	**15**
Criticality	5	5	5	5	**5**
Weighted Gap (Criticality x Gap)	50	125	75	75	**82**
Priority Ranking					**1**

Knowledge of Assets

Attribute	Hierarchical Level	Basic (Primary) Physical Data	Secondary Physical Data	Tertiary Physical data	Condition	Performance	Utilisation	Overall Rating
Appropriate Practice Score	85	80	80	85	85	90	85	**85**
Current Score	70	75	75	70	75	70	80	**75**
Gap	15	5	5	15	10	20	5	**9**
Criticality	5	5	5	5	5	5	5	**5**
Weighted Gap (Criticality x Gap)	75	25	25	75	50	100	25	**56**
Priority Ranking								**1**

Asset Accounting & Costing

Attribute	Valuations	Depreciation and Effective Lives	Operational Costs	Maintenance Costs	Renewal Liabilities and Risks	Historical Cost Data	Overall Rating
Appropriate Practice Score	85	85	80	80	70	80	**80**
Current Score	70	70	65	75	60	70	**67**
Gap	15	15	15	5	10	10	**13**
Criticality	4	4	4	4	4	4	**4**
Weighted Gap (Criticality x Gap)	60	60	60	20	40	40	**45**
Priority Ranking							**7**

Strategic Planning

Attribute	Failure Mode Prediction (Capacity)	Failure Mode Prediction (Reliability/LOS)	Failure Mode Prediction (Mortality)	Failure Mode Prediction (Cost)	Risk Assessment	Optimised Renewal Decision Making	Life Cycle Costing	Improvement Programmes	CAPEX Evaluation	AMP Production	Customer Review/Revision	Business Goal Linkages	Budget Rationalisation Process	Overall Rating
Appropriate Practice Score	85	90	80	80	85	80	85	85	80	90	65	80	85	**80**
Current Score	70	65	55	55	60	55	55	65	55	75	45	65	60	**60**
Gap	15	25	25	25	25	25	30	20	25	15	20	15	25	**20**
Criticality	4	4	4	4	4	4	4	4	4	4	4	4	4	**4**
Weighted Gap (Criticality x Gap)	60	100	100	100	100	100	120	80	100	60	80	60	100	**91**
Priority Ranking														**8**

Score scale: Excellence (100, 95, 90, 85, 80, 75, 70); Competence (65, 60, 55, 50, 45, 40, 35, 30); Systematic Approach (25, 20); Awareness (15, 10); Innocence (5, 0)

Attribute score scale: Excellence (70–100), Competence (30–65), Systematic Approach (20–25), Awareness (10–15), Innocence (0–5). Score: 100, 95, 90, 85, 80, 75, 70, 65, 60, 55, 50, 45, 40, 35, 30, 25, 20, 15, 10, 5, 0

Processes (Cont'd)	Attribute	Appropriate Practice Score	Current Score	Gap	Criticality	Weighted Gap (Criticality x Gap)	Priority Ranking
Asset Creation/Disposal	Project Identification	75	65	10	3	30	
	Project Management	80	65	3	3	9	
	Value Engineering	80	60	20	3	60	
	Contract Administration	85	60	25	3	75	
	Contract Supervision	80	50	30	3	90	
	Asset Handover	85	50	35	3	105	
	Asset Rationalisation	85	55	30	3	90	
	Asset Disposal	80	55	25	3	75	
	Overall Rating	**80**	**60**	**21**	**3**	**67.8**	**10**
Asset Utilisation (Ops.)	Operating Procedures	85	75	10	4	40	
	SCADA Systems	85	70	15	4	60	
	Operations Manuals	80	75	5	4	20	
	Emergency Response Plans	85	55	30	4	120	
	Monitoring and Control	85	65	20	4	80	
	Overall Rating	**85**	**70**	**15**	**4**	**65**	**3**
Asset Utilisation (Maint.)	Policy Strategy	75	55	20	4	80	
	Planning	80	65	15	4	60	
	Scheduling	80	55	25	4	100	
	Job Execution and Control (Feedback)	80	55	25	4	100	
	Maintenance Costing	80	45	35	4	140	
	Maintenance Manuals	75	50	25	4	100	
	Review/Analysis	70	40	30	4	120	
	Overall Rating	**75**	**51**	**24**	**4**	**102**	**5**
Res. Mgt.	Resource Planning	75	50	25	2	50	
	Inventory Controls	75	50	25	2	50	
	Overall Rating	**75**	**50**	**25**	**2**	**50**	**12**
Review and Audit	Implemented Improvement Programme	75	45	30	3	90	
	Cost Reduction Opportunities Identified	80	65	15	3	45	
	Independent AM Review/Audit	80	75	5	3	15	
	Internal QA Processes	60	40	20	3	60	
	AM Process Diagrams	70	55	15	3	45	
	AM Quality Manuals	65	30	35	3	105	
	Overall Rating	**70**	**52**	**18**	**3**	**60**	**11**

Westpower Limited: Gap Analysis

Information Systems

Score bands (Attribute / Score): Excellence 100–70; Competence 65–30; Systematic Approach 25–20; Awareness 15–10; Innocence 5–0

Group	Attribute	Appropriate Practice Score	Current Score	Gap	Criticality	Weighted Gap (Criticality x Gap)	Priority Ranking
Information Systems – Primary Applications	Finance	80	60	20	4	80	
	Asset Register	80	40	40	4	160	
	Plans and Records	75	55	20	4	80	
	Geographic Information Systems (GIS)	60	60	0	4	0	
	Maintenance Management Systems	80	65	15	4	60	
	Ops. Manuals and Emergency Response Plans	75	60	15	4	60	
	Job/Resource Management	70	50	20	4	80	
	Inventory/Spares/Purchasing	80	55	25	4	100	
	Overall Rating	**75**	**55**	**20**	**4**	**79.5**	**6**
Information Systems – Sec. Apps	Condition Assessment and Record System	70	50	20	3	60	
	Predictive Models (Decay and Cost)	75	40	35	3	105	
	Capacity Utilisation Models	70	45	25	3	75	
	Overall Rating	**70**	**45**	**25**	**3**	**80**	**9**
Information Systems – Tertiary (Life Cycle) Apps	Risk Assessment	70	50	20	3	60	
	Treatment Option Costs and Benefits	75	55	20	3	60	
	Optimised Renewal Decision Making	80	55	25	3	75	
	Project Management	75	65	10	3	30	
	Maintenance Analysis (RCM/FMECA)	75	40	35	3	105	
	Overall Rating	**75**	**55**	**20**	**3**	**65**	**11**
Information Systems – General	User Friendliness	75	45	30	3	90	
	System Integration	85	45	40	3	120	
	Overall Rating	**80**	**45**	**35**	**3**	**105**	**7**
Data and Information	Asset Categorisation/Identification	90	75	15	4	60	
	Hierarchical Level	95	80	15	4	60	
	Location	85	80	5	4	20	
	Physical Attributes (Basic Data)	85	80	5	4	20	
	Physical Attributes (Secondary Data)	75	70	5	4	20	
	Condition Data	85	60	25	4	100	
	Maintenance Data	80	65	15	4	60	
	Job Resource Management	85	55	30	4	120	
	Risk Assessment	85	65	20	4	80	
	Cost Histories	80	55	25	4	100	
	Intervention Options and Costs	80	50	30	4	120	
	Optimised Renewal Decision Making (ORDM)	85	60	25	4	100	
	Overall Rating	85	60	20	4	72	4

Westpower Limited: Gap Analysis

Comm. Tactics **Org Isuues** **AMP**

Group	Attribute	Appropriate Practice Score	Current Score	Gap	Criticality	Weighted Gap (Criticality x Gap)	Priority Ranking
Commercial Tactics	Core/Non Core Activities Identified	80	60	20	4	80	
Commercial Tactics	Packaging of Contracts	85	65	20	4	80	
Commercial Tactics	Specification Quality	90	75	15	4	60	
Commercial Tactics	Information & Data Available	85	60	25	4	100	
Commercial Tactics	Contract Supervision/Performance Monitoring	80	60	20	4	80	
Commercial Tactics	Contract Evaluation	85	65	20	4	80	
Commercial Tactics	Support Systems	85	55	30	4	120	
Commercial Tactics	**Overall Rating**	**85**	**64**	**20**	**4**	**87.7**	**5**
Organisational/People Issues	Corporate Sponsorship and Commitment	75	50	25	4	100	
Organisational/People Issues	AM Roles and Responsibilities	80	60	20	4	80	
Organisational/People Issues	Asset Management Steering Committee	80	55	25	4	100	
Organisational/People Issues	Business Asset Management Teams	70	55	15	4	60	
Organisational/People Issues	Overall Commitment	85	75	10	4	40	
Organisational/People Issues	Skill and Age Profiles	80	60	20	4	80	
Organisational/People Issues	Training Programmes	75	60	15	4	60	
Organisational/People Issues	**Overall Rating**	**80**	**59**	**21**	**4**	**73.3**	**8**
Asset Management Plan	Knowledge of Assets	90	75	15	5	75	
Asset Management Plan	Levels of Service	80	50	30	5	150	
Asset Management Plan	Demand Projections and Forecasts	85	70	15	5	75	
Asset Management Plan	Failure Mode Prediction and Consequences	80	60	20	5	100	
Asset Management Plan	Operations and Maintenance	80	60	20	5	100	
Asset Management Plan	Optimised Renewal Decision Making	85	60	25	5	125	
Asset Management Plan	New Works Identification	80	65	15	5	75	
Asset Management Plan	Works Prioritisation	85	60	25	5	125	
Asset Management Plan	Financial Forecasts (Accuracy and Assumptions	85	70	15	5	75	
Asset Management Plan	Improvement Planning	85	65	20	5	100	
Asset Management Plan	**Overall Rating**	**85**	**65**	**20**	**5**	**102**	**2**

12.0 Proposed Asset and Works Management System

12.1 Background

Westpower has identified the need to review its current asset and works management solutions and associated processes to ensure it can continue to deliver compliant and cost effective services.

The company plans to consolidate its future business in the asset and potentially generation areas, and will require scalable business solution that can address these future needs

The core business application modules include Billing, Customer Information, Asset Information (GIS and asset data), SCADA, Financials, Job Costing and CAD. The business processes are functionally split between Asset Management/ Operations and Service Delivery. The current systems are not completely aligned with this business structure in areas such as work management, material management and asset information.

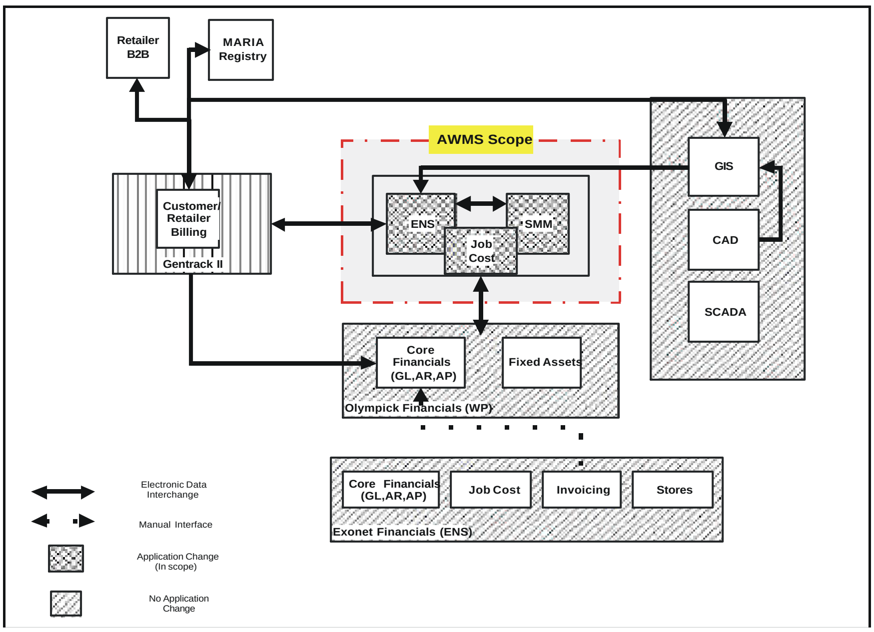
The proposed AWMS (Asset and Works Management System)is to include components with the appropriate levels of separation to support the assets/ contracting business model and the application interfaces that will enable effective business processes in areas such as:

- Asset and Maintenance Planning
- Work Packaging and Scheduling
- Fixed Asset Valuation
- Network Operations
- Work Management
- Asset Performance Monitoring

At this stage it is recognised that the Billing, GIS and Financial solutions will not be affected apart from integration with the new solution.

12.2 Current Business Solutions Model

The current Westpower solutions model is outlined in the diagram below with the AWMS proposal highlighted.



The primary roles of the Westpower /ElectroNet Services (ENS) business units impacting on asset and works management are:

Asset Management – The asset management team is responsible for the strategic management, operation and performance of the network assets. This includes the design of network upgrades and extensions, maintenance requirements, operating procedures and construction standards.

Work is packaged and prioritised by the asset management group with input from contracting (operations) and compiled into an annual plan and budget. Once the plan and associated budget is approved the work is released to operations for delivery.

Operations/Contracting Services – The internal Contracting team is primarily responsible for delivering the maintenance and construction works required to meet the objectives of the asset management plan. Where required, they are responsible for establishing contracts with external service providers and monitoring their performance and stage.

Finance – Finance provides corporate support for both the assets and the operations units that includes financial management, budgets, asset valuation, regulatory reporting support and in the case of operations also includes job costing. Currently the financial management of Assets is carried out within Olympick and Operations uses Exonet. This may change over time to centralise on the Exonet solution however the accounts for each business will remain segregated.

12.3 Future Solutions Model

The future solutions model features a comprehensive Asset and Works Management Solution integrated with the existing GIS and financial systems. The primary focus of the AWMS will be to provide improved visibility and accessibility of information critical to both assets and operations including:

- Incident and outage management
- Work programme (maintenance and projects) for defined period
- Work locations (area and asset types)
- Resource requirements (labour, material, tools and plant)
- Work order status updates
- Work order completion data
- Total cost of work by asset and work type
- Asset hierarchy model (site and equipment connectivity)
- Asset specifications and attributes
- Asset performance
- Asset utilisation

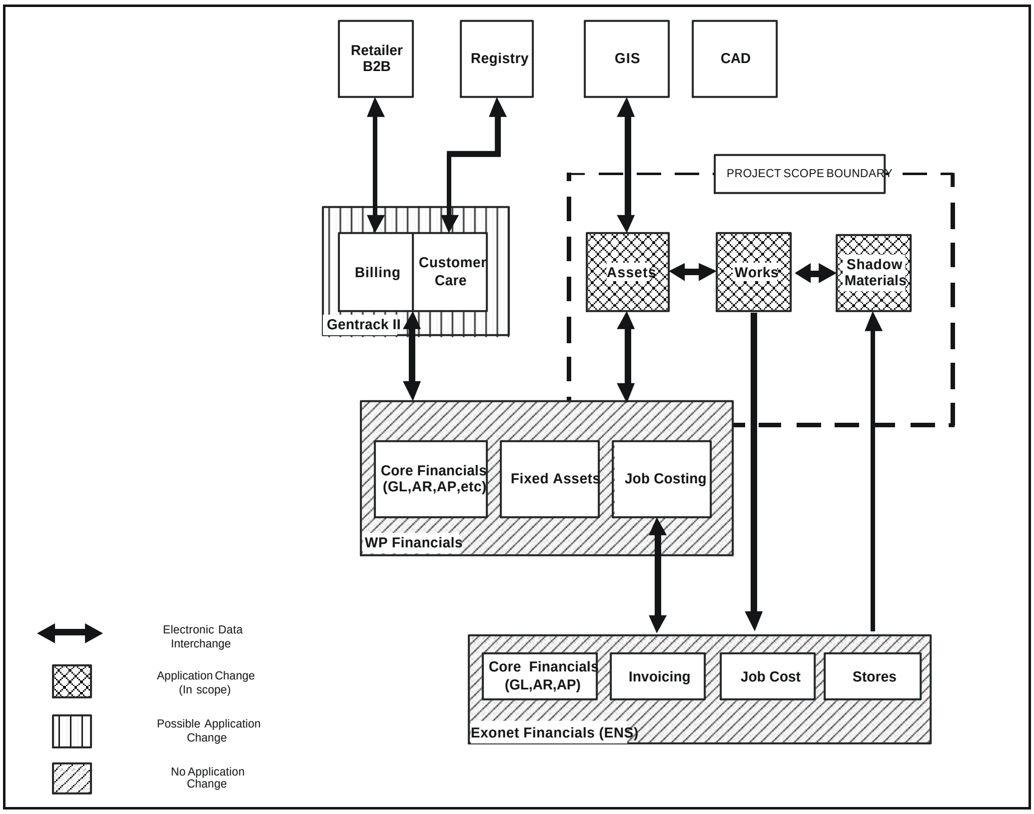
The target environment for Westpower business solutions is outlined in the diagram on the following page. The solution will be capable of supporting core asset management processes and be sufficiently linked into operational processes to ensure that changes to network equipment and asset condition are reflected in the AWMS solution.

Although Westpower will be the primary system users, there will be specific outputs from the AWMS solutions that will be available to ENS including:

- Rolling work plans
- Material requirements
- Asset location data, specifications and attributes

The solution shall support role based user profiles to ensure that the different informational and functionality needs of users are catered for. Examples of this would include:

- Online service request form for investigations, network release and miscellaneous work
- Planned work programme view for ENS resource planners
- Material requirement view for stores planning



12.3.1 Proposed Business Solutions Model

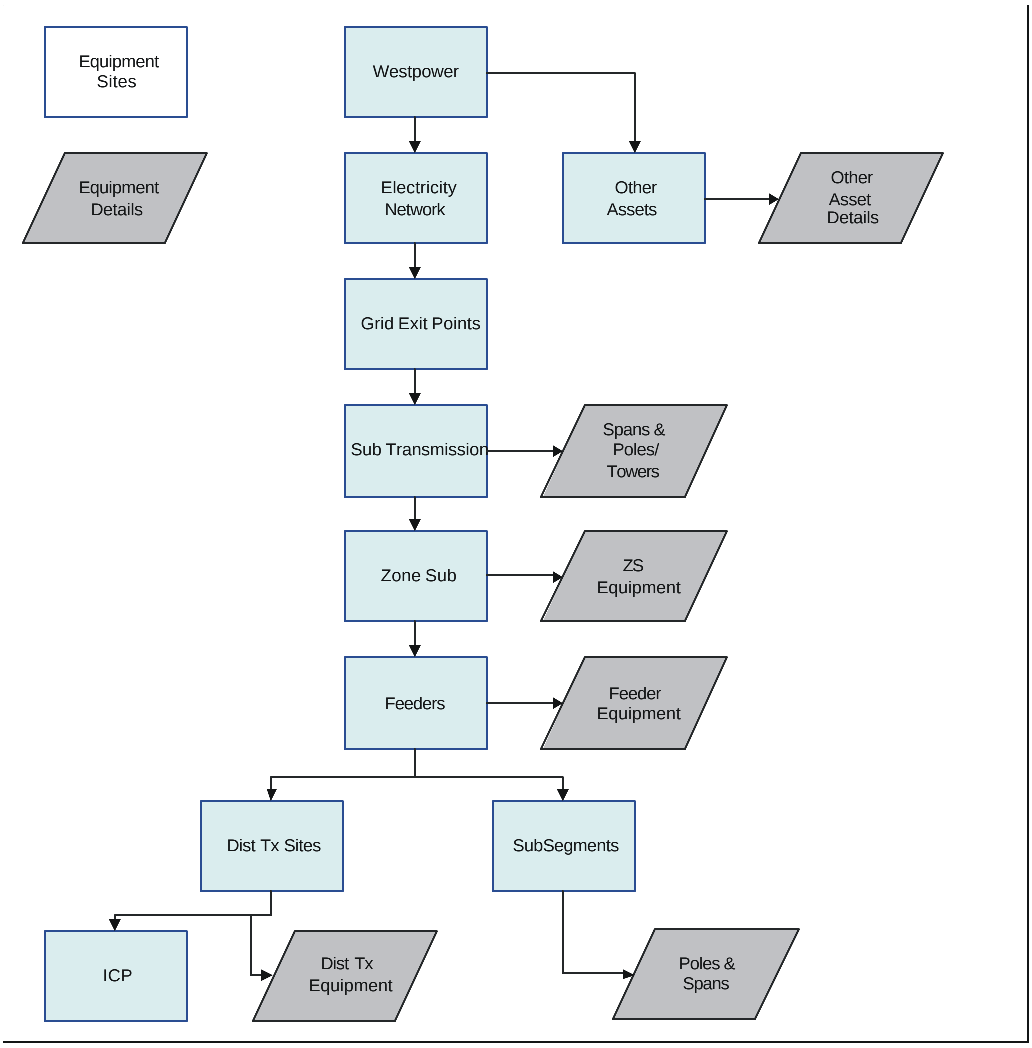
A critical success factor for this project is the ability to deliver seamless support for WP and ENS business processes with the AWMS. Process automation initiatives will include:

- Collaboration Westpower/ENS input to building the annual and rolling workplans and budgets
- AWMS driven approval of work for release
- Effective release of approved work to ENS
- Synchronisation of network connectivity and equipment details between GIS and AWMS
- Work order closure and completion processes
- Job cost management and updates
- Maintenance programming and condition assessment plans

12.4 Asset Register

The asset register will become the primary repository for information relating to asset life cycle management and technical performance. The asset register will provide the Westpower asset management group with the ability to track equipment, associated costs, histories and failures of all assets.

The current asset model is shown below in a simplified form. It is envisaged this model shall be retained.



APPENDIX A

Maintenance Activity Definitions

Inspection, Service and Testing

Routine

This is expenditure on patrols, inspections, servicing and testing of assets on a routine basis. Typically, these activities are conducted at periodic intervals defined for each asset or type of asset. This work does not involve any repairs other than some minor component replacements in the course of servicing.

Special Inspection, Service and Testing

Expenditure on patrols, inspections, servicing and testing which are based on a specific need, as opposed to being time-based as with periodic inspections and servicing.

Faults

Repairs undertaken during fault conditions to restore supply. This does not include the eventual repair of a faulted asset, where it is taken out of service in the course of repairing the fault; only the expenditure required to restore supply is included.

Planned repairs and refurbishment

Repairs to, and refurbishment of an asset, which may involve component replacement but not the complete replacement of the asset. This includes corrective repairs of defects identified within a year, "special" repairs (e.g. based on an identified type failure or type weakness) and planned refurbishment's which may involve a significant proportion of component replacement. However to identify refurbishment's as distinct from general repairs would require identification of all specific refurbishment projects over the planning period, and this has not proved feasible for this plan.

Planned replacement

Replacement of an existing asset with a modern equivalent asset providing similar capacity or other aspect of service provided. Note that the asset need not be identical in capacity etc, but should be materially similar.

Maintenance contingency

An explicit planning contingency, where it is not feasible to identify all minor work, or where it is expected that work will arise but its classification cannot be easily predicted. All contingencies are specifically identified and no implicit contingencies are included in the detailed expenditure projections for other activity classifications.

This contingency is converted into one of the above activity classifications once committed. Therefore "Maintenance Contingency" is not a real activity for reporting purposes.

Enhancement and Development Activity Definitions

Enhancement

This is the replacement of an existing asset with a modern equivalent asset, which is materially improved on the original asset, or modifications to an existing asset, which have this effect. Specifically, this will include improvements to the existing asset configuration, which are undertaken with the purpose of:

Further improving the inherent safety of the system (e.g. installing smoke/heat detectors and entry alarms in substations)

Improving the level of customer service (e.g. increasing capacity by replacing a transformer with a larger unit, or adding an extra circuit to it to increase security)

Improving economic efficiency or investing to improve the asset by reducing operating or maintenance costs (e.g. fitting vibration dampers to specific lines to reduce the rate of component deterioration)

Improving environmental risk management (e.g. fitting oil containment facilities at substations)

Improvement to corporate profile (e.g. landscaping station grounds, although this is also fully justifiable on the basis of reduced grounds maintenance)

Note that each aspect of improvement is related to a specific Asset Management performance driver.

Development

This is work, which involves installation of new assets in sites or configurations where none previously existed. This may also include substantial upgrade work (e.g. re-building a substation at a higher voltage) in which the original configuration is significantly altered or extended.

Development contingency

An explicit planning contingency, where it is not feasible to identify all minor work, or where it is expected that work will arise but its classification can not be easily predicted. No implicit contingencies are included in the detailed enhancement and development expenditure projections. For the same reasons as those discussed under "Maintenance Contingency", this activity is not included in financial reports.

Other Activity Definitions

Operating

Any disconnection of customer's services for any reason except non-payment of electricity accounts. This includes activities such as house painting, transportation of high loads and low voltage switching. It also includes operation of high voltage network where this is not directly associated with maintenance or enhancement work.

Trees

This activity covers all tree cutting and trimming to maintain safe working clearances from power lines and any costs incurred during negotiations with customers regarding tree trimming.

Asset Type Definitions

High Voltage Lines

Includes all power distribution and sub-transmission lines with a rated voltage of 11kV or higher, together with associated easements. Within the plan, line work is further desegregated into major line components, being:

- poles
- conductors and accessories
- insulators and hardware

Low Voltage Lines

Includes all low voltage lines with a rated voltage of 400V or lower, together with associated easements, up to the customer's service fuse. As for high voltage lines, line work is further desegregated into major line components, being:

- poles
- conductors and accessories
- insulators and hardware

Service Lines

Includes all service lines on road reserve from the customer's service fuse to the point at which it crosses the customer's boundary. This includes:

- fuse arms
- service fuses
- service lines on road reserve

Zone Substations

This includes substation sites and the power transformers within them with a secondary voltage of 11kV or higher. Individual items of equipment such as disconnectors, circuit breakers and bus-work are covered in other asset type definitions, which are generic for the whole network. That is, no distinction is made between a disconnector in a substation and one on a distribution line.

- power transformers
- other station equipment
- regulator sites

Distribution Substations

All distribution substation equipment including

- distribution transformers
- DDO fuses
- lightning arrestors
- earthing systems

Switchgear

All high voltage switchgear and other items of equipment, both on lines and within substations, including

- circuit breakers
- structures and bus-work
- instrument transformers
- capacitors
- protection systems
- metering
- buildings, grounds, fences and other services

SCADA, Communications and Protection

Includes SCADA Master Station and Remote Terminal Units at individual sites. Communication equipment comprises specific communications sites and associated equipment and facilities and radio communications equipment installed in vehicles and at substations and other bases. Protection assets included in this definition covers protection relays and equipment, which is generally installed at substation site.

Buildings and Structures

Includes all building assets as well as some of the older "bunker" type distribution substations.

Ripple Control

Ripple Injection Plants installed in Zone Substations. This definition also includes the load control software included in the SCADA Master Station.